REPORT ON THE MERCURY TMDL IMPLEMENTATION PLAN STAKEHOLDER PROCESS

Prepared for the Minnesota Pollution Control Agency
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Executive Summary

Between June 2007 and May 2008, stakeholders from around the state were convened to develop recommendations to assist the Minnesota Pollution Control Agency (MPCA) in meeting the requirements of the Statewide Mercury Total Maximum Daily Load (TMDL). The stakeholders developed strategies to limit mercury emissions and discharges from sources within Minnesota that would assist the MPCA in preparing a Mercury TMDL Implementation Plan.

The stakeholder process was successful in meeting its goals. It resulted in the development of a Strategy Framework, or body of recommendations, that includes strategies to meet the TMDL air emissions goal of 789 pounds (lb) per year, a procedure for distributing the unallocated point source waste load, a plan for addressing new and expanding sources of mercury emissions, and a set of other actions that will support the state's efforts to control mercury releases into the environment.

The work of this process expands previous efforts to reduce mercury emissions in the state. The MPCA estimates that between 1990 and 2005 emissions of mercury in Minnesota decreased from 11,272 lb to 3,314 lb, a reduction of over 70%. These reductions were the result of a combination of federal and state initiatives, local programs and voluntary actions related mainly to the use and disposal of mercury in products. Just prior to the convening of the stakeholder process, several initiatives were put in place that would further reduce emissions, most notably the Mercury Emissions Reduction Act of 2006. This law requires the three largest power plants in the state to reduce mercury emissions by 90%, or by about 1,200 lb, by the end of 2014. In addition, voluntary reductions pledged by Minnesota Power and Xcel Energy at four of their plants are scheduled to reduce emission by about 240 lb by 2010. This process was able to identify strategies that would further reduce air emissions to below 789 lb per year by 2025.

While these accomplishments are critical, this process also identified actions that will be necessary to achieve the overall water quality goals of the state, and highlighted some of the work that will be necessary to fully implement the strategies and achieve the TMDL goals. Not only must the state continue to work with and strengthen relationships with other regional, national and global mercury-reduction efforts, the MPCA will need to undertake several new responsibilities to fully implement the recommendations of the Strategy Framework. In particular, the strategy for New and Expanding Sources of Air Emissions establishes a set of issues that will need to be addressed, either through rulemaking or the adoption of guidance, for the plan to be achieved. The MPCA also will need to develop a plan to address those waters that were excluded from the statewide TMDL. The Strategy Framework, however, is a critical first step, and can serve as a model for states and others to follow.

Introduction

In the spring of 2007, the Minnesota Pollution Control Agency (MPCA) contracted with the Minnesota Environmental Initiative (MEI) to convene, manage and facilitate a year-long stakeholder process to identify strategies to limit mercury emissions and discharges from sources within Minnesota. The strategies will assist the MPCA in developing a plan to meet the goals of the statewide Total Maximum Daily Load (TMDL) for mercury, which received approval from the U.S. Environmental Protection Agency in March 2007. In June 2008, a Strategy Framework, or body of recommendations produced through the Mercury TMDL Stakeholder Process, was submitted to the MPCA for incorporation into the state's implementation plan for mercury.

This report contains a description of the stakeholder process, the development of specific air emission and water discharge strategies, and the resulting Strategy Framework. The Strategy Framework can be used as a stand-alone document. It contains key elements and recommendations for meeting the goals of the TMDL that are intended to be incorporated into the state's Mercury TMDL Implementation Plan, including strategies to meet the TMDL air emissions goal of 789 lb per year, a procedure for distributing the unallocated point source waste load, a plan for addressing new and expanding sources of mercury emissions, and a set of other actions that will support the state's efforts to control mercury releases into the environment. The report also provides conclusions and observations about the stakeholder process, its design and its outcomes.

Methods

The goal of the project was to develop, with input from stakeholders, elements of the state's Mercury TMDL Implementation Plan. The process required the management and facilitation of several stakeholder groups, who were responsible for developing strategies for point source discharges and air emissions of mercury, including provisions for new and expanding sources.

Minnesota Environmental Initiative

The Minnesota Environmental Initiative (MEI), a contractor to the MPCA, was responsible for the convening, management and facilitation of the stakeholder process. MEI managed the stakeholder process to be open and transparent, with a goal of engaging all interested parties and allowing each party an opportunity to be informed and to provide input into the development of the process outcomes. MEI staff scheduled and convened meetings of the stakeholder groups, kept meeting minutes, compiled stakeholder input, coordinated technical input from the MPCA and other groups, and managed the development of the Strategy Framework document.

In addition to the management of the meetings and documentation of the process decisions, MEI staff worked outside of the meetings to engage and respond to a variety of inquiries and input from stakeholders and other interested parties. MEI staff met with individuals and organizations independently to gain a better understanding of the relevant issues, and incorporated this input into the design of meeting agendas and discussions. MEI also worked with various industry sectors not directly represented in the stakeholder groups to communicate the goals of the process, and to work with these groups on the development of strategies that would directly affect their operations. Occasionally, MEI was called on to resolve issues or differences in perspective brought forward by individual stakeholder groups involved in the process.

Ron Nargang, a subcontractor to MEI, chaired the process and facilitated each of the stakeholder group meetings. His background and role on the project were unique, and led to an effective facilitation style. As a former Minnesota Department of Natural Resources (DNR) commissioner, and director of the Nature Conservancy in Minnesota, he brought to the process an ability to understand implementation issues and an established history of working among diverse parties on natural resources topics. His standing as an independent facilitator allowed him to effectively balance the interests of the stakeholders while keeping the goals of the project in mind. Consensus was derived more through a conversational style than through a strict voting process, which created an open and inclusive atmosphere among the stakeholder groups. Discussions remained focused on relevant issues and the adoption of strategies that would ultimately achieve the goals of the process.

Stakeholder Process Groups

Over the course of the process, MEI engaged three groups of interested stakeholders to identify mercury-reduction strategies and develop recommendations for the state's Mercury TMDL Implementation Plan. The groups included the Strategy Work Group, the Partners Group and a group of other interested parties. In addition, MEI used a Steering Team, a Core Team, and a Technical Advisory Group to help support the three stakeholder groups and guide the process.

The Strategy Work Group (SWG) was the primary group tasked to identify the mercury-reduction strategies and to produce the set of recommendations to the MPCA. The SWG consisted of 17 major stakeholders, selected to represent the diverse interests in mercury from around the state, including representatives from the MPCA and other state agencies, mining and power industries, wastewater treatment, environmental groups, tribes, and others. MEI and the MPCA identified numerous stakeholders in the initial phase of the process. MEI contacted potential candidates and conducted a standard interview with each to determine their background with the TMDL, experience with the technical aspects of the issues, commitment to the timeframe, and ability to work within the definition of the goals of the project before making final participant selections. The SWG met 16 times between June 2007 and June 2008 at half- to full-day meetings held in the Twin Cities area. All of the SWG meetings were open to the public. Often, additional stakeholder and industry representatives attended the meetings, presented to the SWG, and provided insight and input during the meetings. A complete list of SWG members and their alternates is included in Appendix D. A set of ground rules for SWG participation that were adopted in the early stages of the process is included in Appendix J. The MPCA's formal charge to the group is included in Appendix B.

The Partners Group was an extended group of 50 to 60 individuals and organizations that represented broader interests and was assembled to provide additional feedback to the SWG. The Partners Group met twice during the year with the SWG to review progress, and provide input on specific elements of the strategies and recommendations. These were full-day meetings held in the central Twin Cities area. Partners Group members were further involved throughout the process with regular e-mail updates, and an open invitation to attend and participate in the SWG meetings. Partners Group members were encouraged and often called upon to provide supplemental information and input for strategy background and development, and to submit comments to the SWG on proposed strategies. A complete list of Partners Group members is included in Appendix E.

The original project design included a Stakeholder Input Group meeting, a formal meeting with a third, larger group of approximately 100–200 other stakeholders. However, during conversations with a range of stakeholders and potential Partners Group members, it became apparent that there were not a significant number of additional interested stakeholders beyond the Partners Group to necessitate another formal group meeting. Instead, approximately 20 stakeholders were added to the Partners Group list halfway through the process and were invited to participate in the second Partners Group meeting. These individuals and organizations were given the opportunity to review the draft Strategy Framework and to submit written comments to the SWG. Comments received from this solicitation were reviewed during the final SWG meeting prior to finalizing their recommendations to the MPCA.

MEI used three additional groups to help support the Mercury TMDL Stakeholder Process. The Steering Team consisted of four SWG members: Rebecca Flood, Patrick Flowers, Mike Robertson and David Thornton, and was facilitated by Ron Nargang. Staff from MEI and the MPCA also participated in the meetings. The Steering Team meetings were held as conference call meetings in between each SWG meeting and provided an opportunity for direct feedback on the process, the structure of SWG meetings, and insight into specific strategies.

Although not designed into the initial scope of the project, MEI and MPCA staff opted to convene regular meetings of a management team for the project. This group, the Core Team, consisted of David Thornton, Ned Brooks, Mike Sandusky, Marvin Hora and Todd Biewen from MPCA and Ron Nargang, Kabby Jones, Jack Hogin and Mike Harley from MEI. The Core Team met between each of the SWG meetings and provided an opportunity for MPCA and MEI to discuss project management, and progress toward developing the Strategy Framework. The Core Team meetings were valuable to both MEI and MPCA staff and helped shape the overall direction and progress of the project.

The Technical Advisory Group (TAG) was created to provide input on issues of monitoring, prevention, control options and other issues identified by the SWG. The TAG was designed to be a resource to the SWG to research issues of science and technology. The TAG was only used when the SWG requested them to respond to technical questions or issue statements. The group consisted of a core group of four professionals: Keith Hanson, Barr Engineering; Anne Jackson, MPCA; Ed Swain, MCPA; and John Sorensen, University of Minnesota - Duluth; and a list of auxiliary members that were called upon if needed to provide assistance on specific technical topics. The TAG met separately from the SWG and communicated its findings back to the SWG via the core group of four members, and the MPCA. A formal description of the TAG's role was developed to define this set of work, and is included in Appendix I.

MEI developed and maintained a Web site to communicate information about the stakeholder process with the public and each of the stakeholder groups. Background information about the TMDL, the emissions inventory, and information related to specific meetings, including schedules, locations, agendas and meeting materials were posted to the site and updated throughout the process.

Strategy Development

The Mercury TMDL Stakeholder Process used each of the stakeholder groups to develop the final recommendations for the MPCA. The SWG was the primary group charged with identifying mercury-reduction strategies for sources in Minnesota and with developing recommendations for the TMDL Implementation Plan. The Partners Group and other interested parties provided further suggestions and feedback to the SWG throughout the stakeholder process.

In the early stages of the process, MEI invited representatives from various industries, organizations and research groups to give presentations to the SWG on the TMDL, mercury methylation science, emission sources in Minnesota, mercury-emitting industry processes and existing and developing mercury-control technologies. Presenters included representatives from the SWG, Partners Group, MPCA, and the Energy and Environmental Resource Center and the University of North Dakota. These presentations allowed all SWG members to achieve a similar basis of knowledge and understanding. They also allowed all SWG members to participate in informed discussions regarding Minnesota mercury emission sources and industry-specific mercury-reduction strategies.

Early in the strategy development process, the SWG considered a variety of suggestions and recommendations to address each of the sector-based emissions. These were continually

reviewed and refined in an iterative process. Many of the sector-specific emission-reduction strategies were initially proposed to the stakeholders by SWG members or other stakeholders representing specific industries. Others were developed by the MPCA or as a result of a SWG member recommendation. Similarly, the first version of the strategy for allocation of the point source loading capacity was developed by three of the SWG members who represented the wastewater treatment sector. In all cases, the SWG reviewed the proposed draft strategies and provided feedback and suggestions on the strategy for refinement. A document to track strategy development was used to compare strategies and assist the stakeholders with strategy evaluation. The stakeholders considered various criteria, including timeframe for implementation, feasibility, implementation issues and barriers, and cost. The MPCA and sector representatives collaborated on technical review of individual strategies, providing information on cost, implementation issues and emission-reduction potential. MEI coordinated the strategy development process with individual SWG members and subgroups, the MPCA, Partners Group members, industry representatives, and others. The ultimate selection of strategies was based mainly on reduction potential and overall feasibility. A complete list of strategies that were considered is included in Appendix G. This process proved to be very successful in developing sector-specific emission-reduction strategies and a process for distribution of the unallocated portion of the water point-source waste load.

When developing the air and water strategies, the SWG identified several topics and issues that were important to the success of the process, but that did not fit into the collection of sector-based emissions strategies, or the waste load allocation strategy. As a result, the Other Recommended Actions and the Strategy Framework Implementation were developed. In many cases, the SWG requested that the MPCA staff craft initial strategies as a starting point for discussions. Similar to the mercury-reduction strategies, these recommendations were cycled through an iterative process of feedback and refinement with the MPCA and included consideration of comments from the other stakeholder groups. Ultimately, the SWG decided on the final version for each of these recommendations.

The development of the strategy for new and expanding sources was one of the more challenging assignments for the stakeholders. Because the strategies to reduce air emissions to meet the overall TMDL goal of 789 lb had to be completed in order to consider additional emissions, this portion of the Strategy Framework was not developed until later in the process. Although this topic was the primary reason for an extended project schedule, its resolution was a critical element in the recommendations. The SWG first considered a proposal developed by the MPCA, and raised many questions regarding offsets for new or expanding sources, the administration of the policy, and tracking of the TMDL goals. Considerable time was spent on this strategy, including an additional meeting devoted to this topic. Stakeholders provided input, both formally and informally, towards the development of the recommendations. Ultimately, the SWG approved a framework for new and expanding sources recognizing that additional work by the MPCA will be needed before it can fully implement the strategy.

At the conclusion of the process, MEI provided draft and final versions of the Strategy Framework document to the SWG and the Partners Group for comment. The SWG responded to feedback from the Partners Group and produced a final Strategy Framework, included with this report.

Summary of Process Outcomes

Over the course of the project, the stakeholder groups developed recommendations for key elements of the state's mercury TMDL implementation plan. Together, these five elements constitute the strategy framework. They include:

- Strategies and timelines for reducing air emissions that will meet the air emissions goal of 789 lb per year by 2025
- Guidelines for water point sources discharges to ensure that total statewide mercury discharges remain below 24.2 lb per year
- A process for addressing new and expanding sources of air emissions
- A set of other recommended actions supported by the stakeholder groups
- Detailed recommendations for implementation of the strategy framework

A detailed description of each of these elements is included in the Strategy Framework in the next section of this document.

Air Emissions

The stakeholder groups developed a set of strategies that establishes sector-based emissions targets and timelines that are projected to reduce emissions to 734 lb per year by 2025. Thirteen strategies were developed to address individual sector or source categories listed in the state emissions inventory, included in Appendix C. Each strategy provides a plan for reducing emissions from individual sectors or source categories, and includes at a minimum an interim emissions goal for 2018 and a final goal for 2025. The sector-based reductions are summarized in the table on page 8.

A detailed listing of all inventoried sources and projected emissions through 2025 is included in Appendix F.

A list of all of the strategies that were considered is included in Appendix G.

Summary of Projected Sector-based Air Emission Following Adoption of Strategies			
	Mercury Emission (lb)		
Sector	**2005**	**2018**	**2025**
Coal-fired Electric Power Generation	1,716	294	235
Industrial, Institutional, Commercial Boilers	71	33	33
Petroleum Refining	13	7	7
Petroleum Product Utilization	27	15	15
Wood Combustion	31	14	14
Sale, Use & Disposal of Mercury-containing Products	235	88	88
Smelters & Shredders That Recycle Cars & Appliances	139	20	10
Recycling Mercury from Products in Minnesota	65	8	8
Dental Preparations	62	10	5
Cremation	80	63	32
Sewage Sludge Incineration	9	6(1)	6
Mercury Product Manufacturing in Minnesota	42	13	0.3
Taconite Processing	735	841(2)	210
Subtotal	**3,225**	**1,412**	**663**
Emissions from Other Sources(3)	89	68	71
Total	**3,225**	**1,464**	**734**

Notes:

(1) Achieved by 2020.

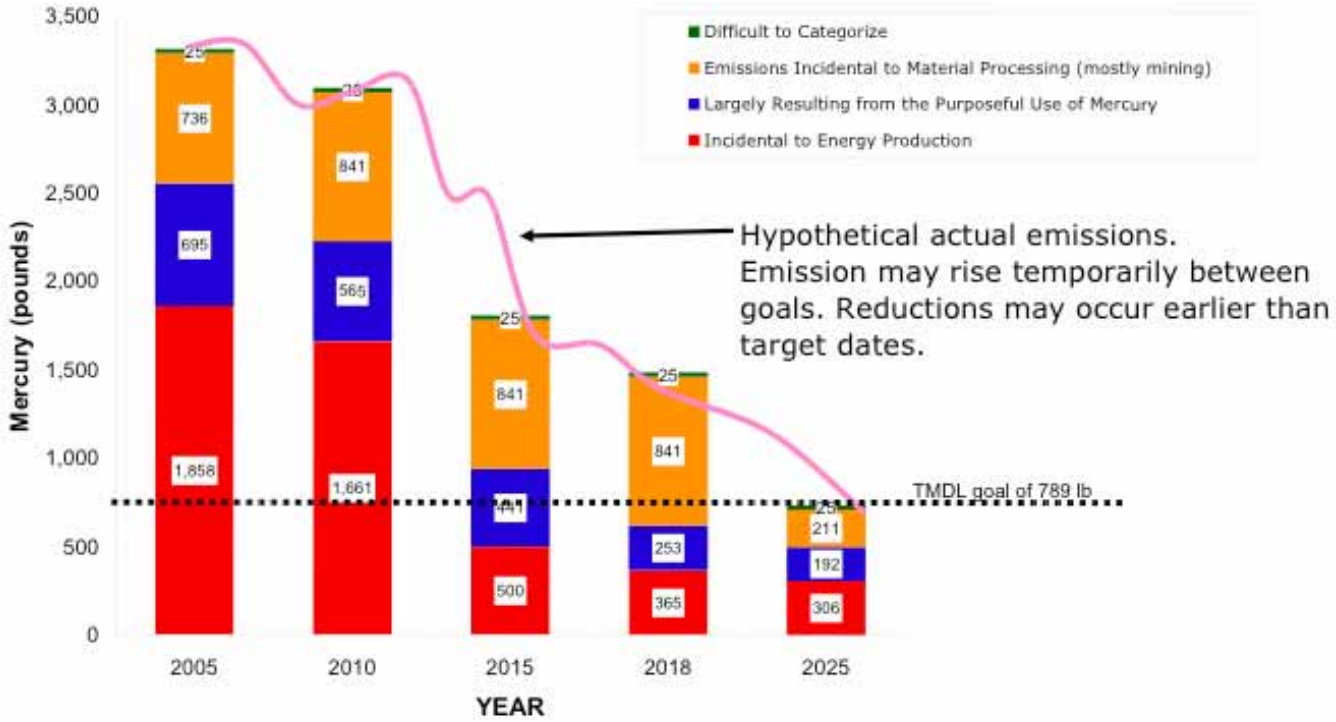
(2) Some growth expected before reductions achieved. Assigned non-numeric goals for 2018.

(3) These sources/sectors were not addressed with reduction strategies. See detailed inventory in Appendix C for specific emissions information.

Projected emissions for 2005 through 2025 are shown in the following chart. Emissions are expected to maintain a downward trend, with some variation to accommodate relatively modest additions from new and expanding sources.

Chart of Projected Mercury Emissions 2005-2025

Based on Reduction Targets Established
by the Strategy Work Group



Water Point-source Discharges

The Statewide Mercury TMDL allows for point-source discharges up to 24.2 lb per year. (Current discharges amount to approximately 16.2 lb per year.) The strategy framework includes a process for distribution of the unallocated portion of the mercury loading capacity. It recommends that the unallocated point-source waste load be distributed on a first-come, first-served basis, provided that specific criteria are met. These criteria include the requirement that any facility proposing a new or expanded discharge have a mercury minimization plan, that those facilities discharging more than 0.2 million gallons per day (MGD) conduct effluent monitoring, and that the discharges meet interim and final water-quality-based standards, if applicable. It is believed that there is more than adequate reserve capacity available for new and expanding point sources in the state.

New and Expanding Sources of Air Emissions

The stakeholder groups were charged with developing recommendations for accommodating new sources of mercury emissions as well as expansions of existing sources. The result is a framework that allows for new and expanding sources, provided that the ultimate TMDL goals are not violated.

The framework assumes that, through implementation of the air emissions strategies, the current TMDL goal of 789 lb per year will be met by 2025. In the interim, new and expanding sources will be allowed, provided that the emissions from these sources are permanently offset with in-state reductions after 2025. (Temporary, out-of-state offsets will be allowed between now and 2025.) Further, new and expanding sources must achieve best control, complete environmental review as applicable to each specific project, and must submit a plan to the MPCA that outlines a detailed plan how controls and offsets will be achieved. The MPCA will issue permits with enforceable conditions for new and expanding sources based on an agreed-to plan.

The stakeholder group identified several issues that the MPCA needs to address through rulemaking or adoption of guidance before fully implementing the New and Expanding Sources strategy. These include definition of best control for regulated and unregulated sources, a plan for addressing proposals for new or expanding sources near water bodies not covered by the statewide TMDL, a process for determining local and cumulative impacts of new and expanding sources, and a de minimis emissions level for new and expanding sources, among others.

Other Recommended Actions

Over the course of the project, the stakeholders identified several strategies to address factors that will have an impact on mercury contamination in the state, apart from sector-specific air emissions or point-source discharges. These strategies have been grouped as Other Recommended Actions and have been incorporated into the Strategy Framework. These actions include:

- The permanent retirement of mercury recovered from products in Minnesota.
- The consideration and potential study of the potential effects of surface water level manipulation and land uses on mercury concentrations in water bodies.
- Support for other regional, national and international efforts to reduce mercury contamination originating from sources outside of the state.

Recommendations for Implementation

Although not specifically required in the initial outline of tasks from the MPCA, the stakeholders developed a set of guidelines and practices that will complement the implementation of the recommended air emissions reductions strategies, and the recommended process for distribution of the unallocated point source waste load. These guidelines include:

- A statement that the Strategy Framework should be incorporated into the state's Mercury TMDL Implementation Plan.
- An outline of implementation tools that the MPCA could use to achieve the goals outlined in specific strategies.
- Definition of the intended schedule for implementation.
- Expectations for monitoring and reporting of air emissions.
- Recommendations for accommodating future adjustments to the emissions inventory.
- A plan for establishing a group to oversee the implementation of the mercury TMDL.

Other Outcomes

The strategy development process required a detailed inventory of mercury emissions. Over the course of the project, the MPCA worked to assemble a comprehensive list of sources and emissions estimates, relying on both existing and new sources of data. As a result, the state inventory for mercury emissions has been refined and improved. Various sectors have agreed, through the strategy development process, to provide and update this information on a regular basis. The most current inventory of sources and emissions estimates is included in Appendix C.

Conclusions and Observations

The mercury TMDL stakeholder process was successful in meeting its goals. The Strategy Framework developed by the stakeholder groups met the criteria developed by the MPCA for the process. Specifically, the stakeholders were able to identify strategies and timelines for reducing air emissions that will meet the air emissions goal of 789 lb per year, develop guidelines for water point-source discharges to ensure that total statewide mercury discharges remain below 24.2 lb per year, and recommend a process for addressing new and expanding sources of air emissions.

Overall the process design was successful. However, two important adjustments were made to the original workplan to accommodate the specific needs of this process. First, the project schedule was extended by three months to accommodate additional stakeholder meetings. It can be difficult to prescribe the needs and schedules for stakeholder processes, because they are dependent on the need for group learning and team building, the level of commitment of the stakeholders, schedules of all of the participants, and the degree to which consensus can be reached. It became apparent in the later stages of the process that the stakeholders desired more time to fully address strategies for all sectors with the same level of attention, and to give the issue of new and expanding sources adequate attention. Second, the Stakeholder Input Group meeting, which was included in the original scope of work, was dropped from the project. Conversations with a range of stakeholders and potential Partners Group members revealed that there were not a significant number of additional interested stakeholders beyond the Partners Group to necessitate another formal group meeting. Instead, approximately 20 stakeholders were added to the Partners Group list halfway through the process, and were invited to participate in the second Partners Group meeting.

This process relied on input from a primary and a secondary group of stakeholders. Although meaningful engagement of stakeholders beyond the core group can be difficult to achieve in a stakeholder process, the secondary Partners Group served several important functions in this process. Their engagement and review of the progress achieved by the SWG at two key points in the process served to build confidence in the overall direction and actions of the SWG. The breakout group work included as part of the Partners Group meetings was valuable. These small working group sessions allowed sector and industry representatives to provide direct input to SWG members who facilitated the group sessions. Using a combination of mixed-sector breakout sessions and sector-focused sessions was also effective. The sector-focused small group sessions allowed focused work by industry sector representatives and resulted in the development of solidly supported strategies. The mixed-sector sessions provided a forum for stakeholders to compare and appreciate the requirements that were proposed for other sectors. Overall the engagement of stakeholders beyond the process provided transparency in the strategy development process. The use of a project Web site facilitated communication with the broader stakeholder audiences.

The success of this process relied heavily on participation and input from the MPCA. The MPCA provided a staff member to serve on the SWG and the Steering Team, and also provided technical background information on the TMDL, including a detailed inventory of emissions sources. In addition, staff members were asked in many instances to provide input on draft strategies and to collaborate on the evaluation of the technical aspects of proposed strategies. The stakeholders' desire to involve the MPCA staff in the detailed development and evaluation of strategies demonstrates trust in the agency's technical work and sets a foundation for

implementation of the strategies. The core management team at MPCA was asked to meet with MEI on a regular basis to provide reaction to the progress of the stakeholder groups, and to provide input into the management and direction of the process. These meetings were not anticipated at the outset of the project, but proved to be very valuable to both MPCA and MEI staff.

It is apparent to the MPCA staff that the work to fully implement the strategies and achieve the TMDL goals will be a long and demanding process, especially the successful implementation of the recommendations for a policy and program to accommodate new and expanding sources of air emissions in the state. The Strategy Framework describes numerous tasks for the agency to accomplish, and establishes a set of issues that will need to be addressed, either through rulemaking or the adoption of guidance, for the plan to be achieved. The set of Other Recommended Actions included in the Strategy Framework also requires that the MPCA evaluate the retirement of mercury from recycled products in Minnesota, continue the analysis of watershed-management issues as they relate to methylation, and continue to work with and strengthen relationships with other regional, national and global mercury-reduction efforts.

In addition, the MPCA will be dependent on the work of others to make the strategy framework as effective as it is intended. First, the MPCA will need to maintain a high level of coordination with the Minnesota Department of Natural Resources (DNR) to assure progress on controls for taconite-processing operations. The work outlined in the Strategy Framework demands a high commitment of time and resources, both staff attention and research funding, to meet the timeline for technology research and implementation. Both the MPCA and the DNR should recognize the strength of working together to achieve these goals. Second, the implementation plan requires the agency to participate in the taconite oversight group, and to convene the TMDL Implementation Oversight Group to monitor progress on achieving the TMDL goals. The SWG identified both of these groups as key to the success of the implementation plan, and the MPCA should begin organizing both of these groups as soon as possible.

This process underscored the importance of both state and global efforts to reduce mercury in the environment. The SWG members and MPCA staff acknowledged throughout the process that not only does the MPCA need to address the water bodies excluded from the statewide TMDL, but that it will take national and global efforts to achieve the overall mercury goals for the state. This plan, however, is a critical first step, and can serve as a model for states and others to follow.

Executive Summary

Mercury is a neurotoxin, meaning it damages the central nervous system. The developing nervous system is at the greatest risk for damage. Mercury is also a global pollutant; it is transmitted around the world and accumulates to levels in fish that are potentially toxic to humans and wildlife. This report sets a target for fish tissue concentration of mercury that is generally safe for human consumption, and translates the target to reduction goals for mercury sources.

Environmental contaminants are usually treated as media-specific—an air, water, or soil contaminant. Mercury is a multimedia pollutant: transported by air, stored in soil, and chemically transformed and bioaccumulated in water. Mercury reductions needed to achieve the target for safe fish consumption are translated to mercury emissions reductions, because 99 percent of mercury load to Minnesota's lakes and streams is from atmospheric deposition.

Because this report includes jargon from the Clean Water Act and the Clean Air Act, the following point of clarification is needed: this report will refer to water releases of mercury as "discharges" and air releases as "emissions." While stacks from air emission sources may be referred to as point sources in the air-permitting arena, the Total Maximum Daily Load (TMDL) concept arises from the Clean Water Act, where "point sources" refer to identifiable pipe conveyances and include wastewater and stormwater, which have National Pollutant Discharge Elimination System (NPDES) permits. Therefore, air sources (i.e., stacks) will be referred to as "point source emissions" and water sources (i.e., pipes) will be referred to as "point source discharges."

Impaired Waters List Section 303(d) of the Federal Clean Water Act requires every state to prepare a list of impaired waters. Minnesota's 2004 303(d) List ("Impaired Waters List") includes water quality impairments in 1892 lakes and river reaches. Two-thirds of those waters are impaired because of mercury (Figure ES- 1). The 1239 impairments by mercury consist of 820 lake impairments and 419 river impairments. Twelve lakes and 20 river reaches are impaired for mercury in fish tissue and in the water column; 808 lakes and 399 river reaches are impaired for fish tissue only.

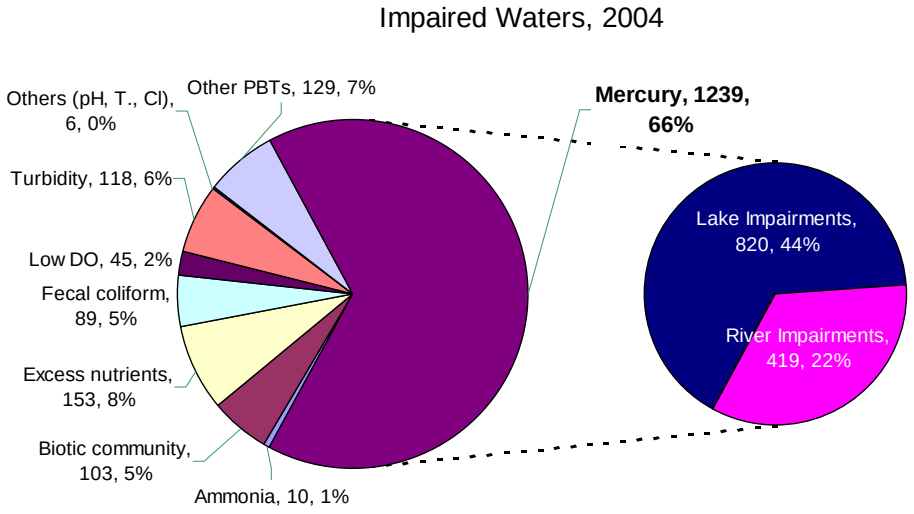


Figure ES- 1 Minnesota's 2004 Impaired Waters by Pollutant

Each impaired water is required to have a total maximum daily load study (TMDL). The TMDL is an evaluation of (1) pollutant sources, (2) pollutant load reduction needed to meet water quality

standards and (3) allocation of the acceptable load to all sources. Because the source of essentially all mercury in Minnesota waters is atmospheric and, therefore, shared by all mercury-impaired waters of the state, the pollutant allocation to atmospheric sources will be the same for these waters. Seventy percent of atmospheric mercury deposition is from anthropogenic sources (i.e., from human activities) and the remaining thirty percent is from natural sources, such as volcanoes. Although state waters share common mercury sources, their capacity to assimilate the pollutant load varies because of differences in geography, water chemistry, and food webs. These differences are apparent in the geographic variation of mercury concentrations in fish, which is addressed through a regional approach.

Regional Approach The state is divided into two regional mercury TMDLs: a northeast (NE) region and a southwest (SW) region. The boundary between the two regions is based on ecoregion boundaries (Figure ES- 2); NE comprises 41% of the state and SW covers 59%. Land-water mercury transport processes and concentrations in fish differ between the two regions. Land cover controls transport processes and, consequently, water quality. NE region is dominated by forest and wetlands, and SW region is dominated by cultivated lands. Because there are similarities and differences between the two regions, the regional mercury TMDLs were developed (and described) in parallel.

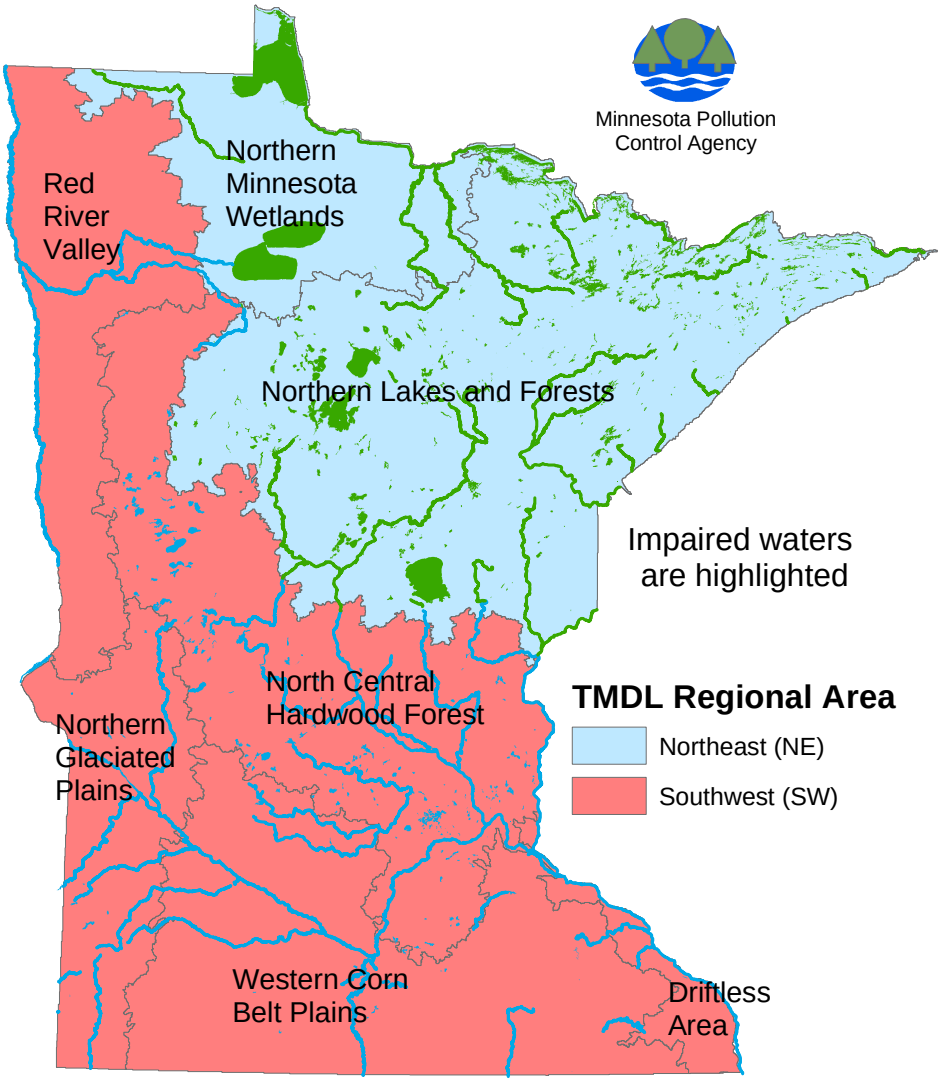


Figure ES- 2 TMDL Regional Areas and Mercury-Impaired Waters

TMDL Development The TMDL development follows a series of logical scientifically-based steps, beginning with establishment of the regional target level or endpoint goal (Table ES- 1). Both regions have the same fish tissue target level; however, because fish mercury concentrations differ by region, the

Table ES- 1 Summary of Minnesota's Regional Mercury TMDLs

This table summarizes the six steps to develop Minnesota's Mercury TMDL.	See referenced report sections for more information about each step.	Units	Region NE	Region SW
(1) The State is divided into two regions—Northeast (NE) and Southwest (SW)—based on differences in mercury's movement through the environment. [Section **Error! Reference source not found.**]	Regional Area in Minnesota	km^2	90,151	129,674
	Percent of total state area		41%	59%
(2) The TMDL target is the water quality criterion for mercury in fish. The 90th percentile fish tissue mercury concentration for a standard length walleye (40 cm) is compared to the fish tissue mercury criterion. The Reduction Factor is the percent reduction needed for fish to meet the water quality criterion. [Section 4.4]	**Target Level and Reduction Factor**			
	Target fish mercury concentration	mg/kg	0.2	0.2
	Mercury concentration for standard length walleye ($WE40_{90}$)	mg/kg	0.572	0.405
	Reduction Factor [$RF=(WE40_{90} - 0.2)/WE40_{90}$]		**65%**	**51%**
(3) Loads from mercury sources are summed by region for the 1990 mercury load that was either discharged from wastewater or deposited from air emissions. About 99% of the statewide mercury load was from nonpoint (air) sources in 1990. Nonpoint source load is the product of atmospheric deposition (12.5 grams per square kilometer per year) and regional area. Water sources contribute about one percent of the total load [Section **Error! Reference source not found.**][1]	**Mercury Load for Baseline Year – 1990**			
	Point Source Load (PSL; wastewater discharge)	kg/yr	26	7
	PSL percent of Total Source Load		2.2%	0.4%
	Nonpoint Source Load (NPSL; atmospheric deposition)	kg/yr	1127	1621
	Total Source Load (TSL)	kg/yr	**1153**	**1628**
(4) The Mercury TMDL is a loading goal equal to 1990 Total Source Load multiplied by (1- Reduction Factor), and is equal to wasteload allocation (WLA) plus load allocation (LA). The WLA consists of water point source discharges; it is set at one percent of the TMDL or equal to the estimated point source load, whichever is lower. The remainder of the TMDL is LA, which the atmospheric deposition sources. [Section 9][2]	**Final TMDL**			
	Mercury TMDL Loading Goal [TSL• (1– RF)]	kg/yr	**404**	**798**
	Wasteload Allocation (WLA)	kg/yr	**4**	**7**
	Load Allocation (LA)	kg/yr	**400**	**791**
(5) To achieve the Mercury TMDL Goal, all load reductions must come from anthropogenic sources, which are 70% of the total atmospheric mercury deposition and are divided into in-state and out-of-state emission sources. In-state emission sources contribute 10% of the total mercury deposition, or 14.3% of the anthropogenic sources. The load is allocated to in-state and out-of-state contributions for both regions. The TMDL goal is converted to a mercury deposition flux (g km^{-2} yr^{-1}) when divided by the regional area. [Section 6.4]	**Mercury Load Allocation for In-state and Out-of-state Deposition Sources** [3]			
	In-State contribution to LA [0.143•LA]	kg/yr	57	113
	Out-of-State contribution to LA [(1-0.143)•LA]	kg/yr	343	678
	Mercury TMDL Atmospheric Deposition Goal	g km^{-2} yr^{-1}	4.4	6.1
	Necessary reduction from anthropogenic emission sources (RF ÷ 0.7)		**93%**	73%
(6) Because atmospheric mercury deposition is uniform across the entire state and in-state emissions disperse across both regions, the greater reduction goal, established for the northeast, becomes the statewide mercury load reduction goal, which is a 93% reduction in anthropogenic emissions. Subtracting the emissions reduction goal from the 1990 state emissions gives the state's TMDL mercury emissions goal. Since this TMDL uses 1990 as the starting point, it is informative to determine progress the state has made from 1990 to 2000. Between 1990 and 2000, 73% of the emissions reduction goal was achieved, leaving 27% still to be met. [Section 6.4]	**Minnesota's Mercury TMDL Emissions Reduction Goal**		**Statewide**	
	State's mercury emissions for 1990	lb/yr	11,272	
	Emissions Reduction Goal (0.93 •1990 Emissions)	lb/yr	10,483	
	Minnesota's TMDL Mercury Emissions Goal (1990 Emissions – Reduction Goal)	**lb/yr**	**789**	
	Emissions reductions as of 2000 (68% of 1990 emissions)	lb/yr	7,634	
	Emissions reduction remaining as of 2000 to achieve goal	lb/yr	2,760	
	Percent of 1990 Emissions Reduction Goal remaining as of 2000		27%	

[1] For discussion of Reserve Capacity see Section 6.5

[2] For discussion of Margin of Safety see Section 7

[3] Minnesota's mercury deposition sources are 30% natural and 70% anthropogenic. The anthropogenic share is comprised of 30% global and 40% regional sources; one-fourth of the forty percent is from sources within Minnesota; therefore, the state's anthropogenic sources are 10% of total deposition (0.25 * 0.4). There are no significant natural sources (e.g., volcanoes and natural mercury mineral ores) in Minnesota. Mercury in Minnesota's soils is from atmospheric deposition.

necessary load reductions to achieve the goal differ by region. Minnesota's target level for mercury in fish is 0.2 mg/kg (parts per million, ppm), based on the EPA's development of a methylmercury criterion for fish tissue to protect human health. Minnesota's fish tissue mercury criterion is lower than EPA's 0.3 ppm criterion because of the higher fish consumption rate in the state. The 0.2 ppm corresponds to the Minnesota fish consumption advisory threshold for one meal per week—above that mercury concentration the consumption advice is one meal per month for women who are pregnant or intending to become pregnant and children under 15 years of age.

Load reductions must be calculated relative to an appropriate baseline annual load. The most recent research that establishes total mercury deposition in Minnesota took place from 1988 to 1990. In addition, a baseline year of 1990 for this TMDL corresponds to the baseline year for Great Lakes mercury reduction goals and Minnesota's mercury emissions reduction goals. Prior to 1990 mercury use was relatively high and dropped precipitously beginning around 1990 as mercury was removed from many common products. Mercury deposition and mercury in fish tissue were probably in a relative steady state through 1990; therefore, comparing mercury deposition and fish tissue concentration in 1990 is most likely valid because of the steady state conditions leading up to 1990, but we have since entered a non-steady state period as mercury deposition declines.

For these regional TMDLs, target levels of mercury concentrations were determined in standard size top predator fish: northern pike (*Esox lucius*) and walleye (*Sanders vitreus*). Because mercury bioaccumulates and biomagnifies, concentration is highest at the top of the food web; therefore, achieving the mercury target concentration in the top predator fish will result in the whole food web, including the water column, achieving the target level. For the 1990 baseline year, fish tissue data were combined for each region for a five-year period—1988 to 1992—to account for annual weather fluctuations.

The target level of 0.2 ppm was applied to the 90^{th} percentile mercury concentration. By protecting for the 90^{th} percentile we expect to achieve the target level for other biota and for water concentrations of mercury. The difference between the regional 90^{th} percentile concentration for the standard size fish and 0.2 ppm is the reduction factor (RF) needed to meet water quality standards. The RF is greater for the NE than the SW for both walleye and northern pike. Mercury concentrations in walleye, however, were slightly higher than northern pike levels in both regions and, therefore, the RF for walleye was selected for load reduction calculations to provide a margin of safety. The resulting RFs are 65% for the NE and 51% for the SW.

The total source load (TSL) is the sum of the point source loads (PSL) and the non-point source loads (NPSL). Point source loads include the NPDES permitted facilities in the state, excluding cooling water discharges. PSL for the region is the product of facility design flow and the average measured effluent mercury for wastewater treatment plants in the state (5 ng Hg/L). Non-point source load is the product of atmospheric deposition flux in 1990 (12.5 g km^{-2} yr^{-1}) and regional surface area. The subsequent 1990 TSLs for NE and SW regions were 1153 kg/y and 1628 kg/y, respectively. About one percent of the TSL is attributable to PSL.

Mercury TMDL Goal for Minnesota Total mercury deposition in 1990 was 12.5 g km^{-2} yr^{-1} throughout the state. To achieve the target levels in fish tissue, the mercury deposition goals are 4.4 g km^{-2} yr^{-1} for the NE and 6.1 g km^{-2} yr^{-1} for the SW.

Mercury load reduction goals for each regional TMDL were calculated by applying the RF to the baseline mercury load. Reductions can only come from anthropogenic sources; therefore, load reduction goals require anthropogenic source reductions of 93% (65% reduction goal divided by 70% of total that is anthropogenic) in the NE region and 73% (51% of reduction goal divided by 70% anthropogenic) in the SW region.

Ten percent of the mercury deposition is estimated to originate from anthropogenic sources within the state. Since natural sources cannot be controlled and are not expected to change, all mercury reductions must come from anthropogenic sources. The state's percentage of the anthropogenic sources is 14.3% (10% of total divided by 70% of total). The state's contributions to the load allocations (LA) are 57 kg/yr for the NE and 113 kg/yr for the SW. The out-of-state contributions to the LA are 343 kg/yr for the NE and 678 kg/yr for the SW.

Mercury Emission Reduction Goals Mercury load reduction goals are applied to emission reductions for the state. Atmospheric deposition of mercury is considered uniform across the state, and in-state emissions disperse across both regions; therefore, the emissions goal is applied statewide rather than by region. The northeast's greater regional reduction goal (i.e., 93% of anthropogenic sources) determines the TMDL's emission reduction goal. In 1990, the total mercury emissions from in-state sources were 11,272 lbs (5513 kg); the TMDL emissions goal is eight percent of the 1990 emissions: 789 lbs (358 kg). Minnesota's 1990 mercury emissions were reduced 68% by 2000, which is equivalent to 73% statewide emissions reduction goal, leaving 27% of the emissions reductions goal remaining. Going from 3,638 lbs mercury emissions in 2000 to the emissions goal of 789 lbs constitutes a 78% reduction in mercury emissions.

TMDL Implementation To achieve the mercury reductions goals, Minnesota will develop a detailed implementation plan. An implementation plan is not required in a TMDL; it is developed after the TMDL plan is approved by the USEPA. A section on proposed implementation is included in this report to inform the public and to aid in the discussion on reasonable assurance. The implementation and reasonable assurance sections summarize initiatives that the MPCA believes have already reduced fish contamination in Minnesota and will maintain a path of reduced fish contamination in the future. Although wastewater point sources are very minor contributors to the total mercury load, the MPCA will continue to pursue mercury reductions from these sources through mercury minimization plans and other permit conditions. For mercury emission sources, sector-specific reduction milestones are presented, along with an outline of regulatory and non-regulatory mercury reduction strategies to be considered in the detailed implementation planning. The Great Lakes Initiative (GLI) requires wastewater dischargers in the Lake Superior basin to meet a mercury water quality standard of 1.3 ng/L and implementation of this mercury TMDL does not in any way supercede or conflict with the GLI requirements.

Purpose/Mission: Recommend to the Minnesota Pollution Control Agency key elements of the Mercury TMDL Implementation Plan for Minnesota that have the support of a vast majority of stakeholders in the State. This includes strategies for reducing mercury releases to air and water from Minnesota sources, including timetables and sector targets as well as decisions on how to accommodate possible new sources of releases to the state's environment.

Membership: Sixteen to 18 individuals that represent a range of the diverse mercury stakeholders in the state, selected by the Minnesota Environmental Initiative. Membership:

Len Anderson, St. Louis River TMDL
Rebecca Flood, Metropolitan Council Environmental Services
Patrick Flowers, Xcel Energy
Collie Graddick, Environmental Justice Advocates of Minnesota
Joe Hensel, Rochester Public Utilities
Mark Knoff, City of Mankato
Nancy Lange, The Izaak Walton League of America
Bob Meier, Minnesota Department of Natural Resources
Dennis Niemi, Minnesota Power
Chuck Prokop, Minnesota Trout Association
Mike Robertson, Minnesota Chamber of Commerce
Nancy Schuldt, Fond du Lac Reservation
Kris Sigford, Minnesota Center for Environmental Advocacy
Dave Skolasinski, Cleveland-Cliffs
David Thornton, Minnesota Pollution Control Agency
Tim Tuominen, Western Lake Superior Sanitary District
Scott Vagle, US Steel - Minnesota Ore Operations

Leadership: Chaired by Ron Nargang and managed by the Minnesota Environmental Initiative. Directed by a steering team comprised of four Strategy Work Group members, including the MPCA and supported by Kabby Jones of MEI and Ned Brooks of MPCA

Other Input: Additional stakeholders will be invited to provide input to the Strategy Work Group. A Partners Group of about 30-40 additional stakeholders may meet up to 2 times with a larger gathering of all interested individuals invited to react to draft strategies.

MPCA Role: Through a contract, the MPCA is providing funding to the Minnesota Environmental Initiative to manage the process and intends to incorporate the group's recommendations into the final Mercury TMDL Implementation Plan. The MPCA will also provide a member to serve on the Strategy Work Group and Steering Team as well as staff to support the process.

Timing: Over a 10 month period, beginning in June 2007. Recommendations will be delivered to the MPCA by April 2008.

Anticipated Outcomes/Results: Specific elements of the Mercury TMDL Implementation Plan to be developed by the Strategy Work Group include:

1. Recommended strategies and guidelines for water point source discharges to ensure that total statewide mercury discharges remain below 24.2 lb (11 kg), per year including:

- How to address existing sources as well as new and expanding sources. (this is most likely a permitting strategy/guidelines)

- How to allocate future reserve capacity of 8.8 lb (4 kg) among municipal and industrial sectors.

- How to account for chemicals or conditions that impact methylation including sulfate discharges to mercury-impaired waters.

- Mercury minimization plan guidance for municipal wastewater treatment plants (considers adoption of EPA Region V guidance, other state's guidance or propose alternative).

2. Recommend strategies and timeframes for meeting the TMDL air emission goal of 789 lb annual emissions from Minnesota sources, including:

- Establish air emission sector reduction targets for emissions from energy, taconite and product-related sectors.

- Develop sector-specific strategies to meet the overall and sector goals.

- Develop interim and final timeframes for the sector and overall goals.

- Determine how to accommodate potential new sources of air emissions. (inform development of guidelines/rules that will closely follow this process)

3. The stakeholder-developed TMDL Implementation elements should meet the following criteria:

- Must demonstrate that point source discharge cap of 24.2 lb (11 kg) per year will be met and air emission goal of 789 lb per year will be achieved in a reasonable timeframe.

- Demonstrated commitment of a stakeholders to support and implement recommendations.

- Meet Clean Water Act and related federal and state regulations and guidance.

Estimated Mercury Emissions in Minnesota for 2005 to 2018,

Not Including Reductions Expected from the 2007-2008 Mercury TMDL Stakeholder Process

Minnesota Pollution Control Agency
April 22 2008

Introduction

This document contains estimates of mercury emissions to the atmosphere from human activity within Minnesota provide baseline information for the deliberations of the group of stakeholders that are working toward the implementation of the goals of Minnesota's mercury TMDL[a]. A primary goal of the TMDL is to ultimately reduce Minnesota's anthropogenic mercury emissions to a total of 789 pounds (lb.) per year, an ambitious goal considering this document estimates 2005 emissions to have been about 3,300 lb. The TMDL requires that the state design an implementation plan that will result in the 75% reduction in emissions, from 3300 to 789 lb. Specifically, the Mercury TMDL Stakeholder Process[b] has the mission to identify mercury reduction strategies and to develop recommendations for the state's implementation plan.

The purpose of this document is to provide estimates of what mercury emissions would be if none of the new mercury reduction strategies that result from the TMDL stakeholder process are implemented. There are existing initiatives[c] and social trends that will result in reduced total emissions, but projected reductions are not nearly sufficient to reach the TMDL emission goal. For instance, initiatives in the electric utility sector are projected to reduce those emissions by 76%, but no such initiatives yet exist for most other activities that emit mercury, some of which, without intervention, may increase emissions in proportion to economic activity or because of social trends. New and expanded point-source air emissions are only included in the estimates if they have received a permit from the Minnesota Pollution Control Agency (MPCA), but as a result of normal economic activity there will be additional proposed air emissions.

This document estimates that, in the absence of new mercury reduction strategies, mercury emissions will decline by about 40% by 2018, to about 2,000 lb., with negligible reason to decline further after 2018. The MPCA is asking stakeholders to identify reduction strategies that can decrease projected emissions by a at least a further 60% — from the 2018 projection of about 2,000 lb. to the goal of 789, or lower. To facilitate economic change and growth, the stakeholders are also asked to recommend strategies that will accommodate new emissions without exceeding the statewide goal.

[a] Statewide Mercury Total Maximum Daily Load (TMDL) Pollutant Reduction Plan. http://proteus.pca.state.mn.us/water/tmdl/tmdl-mercuryplan.html
[b] Mercury Total Maximum Daily Load Stakeholder Process. http://www.mn-ei.org/projects/mercury.html
[c] Mercury. http://www.pca.state.mn.us/air/mercury.html

Table 1 Estimated mercury emissions (pounds) from human activity in Minnesota for the years 2005, 2010 and 2018

Mercury Emission Inventory for Minnesota (lb/year)

Updated by MPCA staff April 22, 2008

Categories	note	Confidence	estimated 2005 emissions	projected 2010 emissions	projected 2018 emissions	Likely change in same-facility emissions by 2018
Incidental to Energy Production						
Coal -- Electric Utility	1	high	1716.3	1041.0	410.3	specific reductions
Coal -- Commercial, Institutional, & Industrial	2	medium	71.3	77.0	86.0	up 15% plus 4 lb Heron Lake
Volatilization from coal ash	3	very low	0.0			may become significant
Petroleum Refining	4	medium	12.9	13.6	14.8	up 15%
Petroleum Product Utilization	5	very low	27.1	28.7	31.2	up 15%
Wood Combustion	6	medium	30.5	32.3	35.1	up 15%
Biomass other than wood	7	medium	0.0	2.1	2.1	
Natural Gas Combustion	8	medium	0.3	0.3	0.3	up 15%
Subtotal: Incidental with energy production			**1858.4**	**1195.0**	**579.9**	
% of total state emissions			**56%**	**46%**	**30%**	
Largely Resulting from the Purposeful Use of Mercury						
Proportional to Hg content of Solid Waste						
Volatilization: solid waste collection & processing	9	very low	169.0	152.8	126.8	down 25%
On-site household waste incineration	10	very low	40.0	36.2	30.0	down 25%
Volatilization from spills and land dumping	11	very low	24.0	21.7	18.0	down 25%
Landfill volatilization	12	very low	2.1	1.9	1.6	down 25%
Volatilization: land application of compost	13	low	0.2	0.2	0.2	down 25%
Proportional to Hg content of Liquid Waste						
Volatilization: land application of sludge	14	low	1.6	1.3	0.8	down 50%
Recycling Activities						
Shredders & smelters that recycle cars and appliances	15	low	138.7	24.1	11.4	80% removal of fewer switches
Recycling mercury from products within MN	16	very low	65.0	71.3	81.3	up 25%
Non-Ferrous metal recycling (Al, Pb,)	17	low	0.9	1.0	1.1	up 25%
Dental Mercury						
Dental Preparations	18	very low	62.4	56.4	20.1	down due to less use, traps
Cremation	19	low	80.0	105.0	126.7	increased deaths & % cremated
Incineration						
Municipal solid waste combustion	20	high	49.2	38.3	38.3	reductions at 2 facilities
Sewage Sludge Incineration	21	high	8.5	8.9	11.9	Up 13%; new Buffalo facility 2 lb
Medical waste incineration	22	high	0.4	0.6	0.8	up 100%
Hazardous waste incineration	23	high	0.3	0.3	0.3	none
Class IV incinerators	24	high	0.0	0.0	0.0	none
Mfg & Use of Non-dental Mercury-containing Products						
Mercury product manufacturing in Minnesota	25	low	42.0	38.0	31.5	down 25%
General Laboratory Use	26	very low	10.0	6.5	1.0	down 90%
Volatilization from dissipative use	27	low	0.8	0.6	0.4	down 50%
Subtotal: Associated with purposeful use of mercury			**695.1**	**564.9**	**502.0**	
% of total state emissions			**21%**	**22%**	**26%**	
Emissions Incidental to Material Processing						
Taconite Processing	28	high	734.8	840.6	840.6	several new facilities
(2005: includes 19.0 from dust + 6.6 lb from fuel)						(Keewatin controlled 28% in 2005)
Thermal treatment of soil	29	low	0.8	0.8	0.8	
Subtotal: Emissions incidental to material processing			**735.6**	**841.4**	**841.4**	
% of total state emissions			**22%**	**32%**	**43%**	
Difficult to Categorize (is the Hg from fuel or materials?)						
Asphalt Manufacturing	30	low	4.3	4.3	4.3	Unclear what trend is
Agriculture, Food, & Kindred Products	31	low	1.1	1.1	1.1	Unclear what trend is
Mineral Products	32	low	13.8	13.8	13.8	Unclear what trend is
Miscellaneous Industrial Processes	33	low	0.2	0.2	0.2	Unclear what trend is
Wood, Pulp & Paper, & Publishing Products	34	low	5.1	5.1	5.1	Unclear what trend is
Subtotal: Emissions difficult to categorize			**24.6**	**24.6**	**24.6**	
% of total state emissions			**1%**	**1%**	**1%**	
		GRAND TOTAL=	**3,314**	**2,626**	**1,948**	

Abbreviations: NA = Not Applicable; NQ = Not Quantified;

Confidence intervals: High +/- 10%; Medium +/- 25%; Low +/- 50%; Very Low +/- 100% or more.

Notes to Table 1, estimated mercury emissions in Minnesota, 2005-2018.

Emissions Incidental to Energy Production

1. Coal — Electric Utility

Based on data submitted by electric utilities; projections are based on reduction goals and the U.S. Environmental Protection Agency's (U.S. EPA) Integrated Planning Model (IPM) projections for unit utilization.

Table 2 Mercury emissions from coal-burning electric utilities

Owner	Plant name	Unit ID	Capacity (MW)	Total Hg emissions 2005 (lb)	Total Hg emissions 2010 (lb)	Total Hg emissions 2018 (lb)
Laurentian Energy Authority	All Virginia & Hibbing units	All units		12.8	8.0	8.0
Municipal	Austin Northeast	NEPP	29	8.3	10.9	11.8
Municipal	Springfield	4	4	0.0	0.0	0.0
Municipal	Willmar	1	3	0.0	1.0	1.0
Municipal	Willmar	3	19	3.7	6.5	6.5
Cleveland Cliffs	Silver Bay Power	BLR1	36	1.3	0.7	0.7
Cleveland Cliffs	Silver Bay Power	BLR2	69	1.7	1.3	1.3
Minnesota Power	Clay Boswell	1	69	3.0	3.1	3.3
Minnesota Power	Clay Boswell	2	69	3.0	3.4	3.6
Minnesota Power	Clay Boswell	3	350	90.0	9.9	9.9
Minnesota Power	Clay Boswell	4	426	184.0	13.5	14.3
Minnesota Power	Syl Laskin	1	55	21.0	12.5	12.5
Minnesota Power	Syl Laskin	2	55	0.0	12.6	12.6
Minnesota Power	Hibbard	3		3.0	3.0	3.0
Minnesota Power	Hibbard	4		3.0	3.0	3.0
Minnesota Power	Taconite Harbor Energy Center	1	65	22.0	2.4	2.4
Minnesota Power	Taconite Harbor Energy Center	2	67	17.9	2.0	2.0
Minnesota Power	Taconite Harbor Energy Center	3	68	17.0	2.0	2.0
Ottertail	Hoot Lake	1	8	0.0	0.0	0.0
Ottertail	Hoot Lake	2	62	39.4	17.3	18.3
Ottertail	Hoot Lake	3	84	0.0	23.8	25.2
Rochester	Silver Lake	1, 2, 3, 4	110	3.9	6.0	6.0
Xcel	Allen S King	1	571	60.6	8.8	8.8
Xcel	Black Dog	3	120	32.2	57.8	57.8
Xcel	Black Dog	4	186	65.1	80.8	80.8
Xcel	High Bridge	5		23.1	0.0	0.0
Xcel	High Bridge	6		36.6	0.0	0.0
Xcel	Minnesota Valley	4	50	0.0	0.0	0.0
Xcel	Riverside	8		60.2	0.0	0.0
Xcel	Riverside	6/7		45.5	0.0	0.0
Xcel	Sherburne County	1	762	333.7	352.5	35.2
Xcel	Sherburne County	2	752	314.0	356.0	35.6
Xcel/SMMPA	Sherburne County	3	936	310.3	42.0	44.5
		Total		**1716.3**	**1041.0**	**410.3**

Table 3 This electrical generating project has the potential to emit mercury, has been proposed, but has not yet received a permit (and is not included in the emission calculations):

Project	Type	Start-up date	Lb/yr	Status
Mesaba Energy	EGU	2010	54	Environmental Impact Statement

2. Coal — Commercial, Institutional & Industrial

Future emissions from non-electric utility coal combustion are projected to grow by 15% by 2018, as a result of normal economic growth in Minnesota.

Table 4 Mercury emissions from coal combustors that are not electric utilities

Facility	Unit	2005 mercury emissions (lb/yr)
Southern Minnesota Beet Sugar Coop	Boiler No. 1	8.70
University of MN - SE Plant	Boiler No. 5	8.50
American Crystal Sugar - E Grand Forks	Boiler No. 1	7.92
American Crystal Sugar - E Grand Forks	Boiler No. 2	7.82
ADM - Mankato	Boiler No. 5	6.08
Verso Paper Co - Sartell Mill	Bros Boiler	5.93
Verso Paper Co - Sartell Mill	B & W Boiler	3.59
American Crystal Sugar - Crookston	Boiler #1	2.84
American Crystal Sugar - Crookston	Boiler #2	2.84
American Crystal Sugar - Moorhead	Boiler #1, North	2.69
American Crystal Sugar - Moorhead	Boiler #2, Center	2.36
American Crystal Sugar - Moorhead	Boiler #3, South	2.31
ADM Corn Processing - Marshall	Coal Boiler #1	2.16
ADM Corn Processing - Marshall	Coal Boiler #2	2.16
American Crystal Sugar - Crookston	Boiler #3	1.59
District Energy St Paul Inc-Hans O'Nyman	Boiler 2	1.03
District Energy St Paul Inc-Hans O'Nyman	Boiler 3	0.78
Order of St Benedict/St John's Abbey	Boiler #4	0.72
Order of St Benedict/St John's Abbey	Boiler #1	0.30
University of Minnesota - Crookston	Boiler 4	0.25
Order of St Benedict/St John's Abbey	Boiler #2	0.24
University of MN - Twin Cities	SG201	0.16
Duluth Steam Cooperative Association	Boiler 1	0.09
Wausau Paper Printing & Writing LLC	Boiler 4	0.08
Wausau Paper Printing & Writing LLC	Boiler 3	0.08
Duluth Steam Cooperative Association	Boiler 2	0.06
Duluth Steam Cooperative Association	Boiler 4	0.06
Wausau Paper Printing & Writing LLC	Boiler 2	0.02
	Total	**71.35**

The following new facility is expected to contribute mercury emissions by 2010, but is not yet up and running (and is included in emission calculations):

Table 5

Facility	Unit	Potential mercury emissions (lb)
Heron Lake (ethanol plant)	Boiler	4

The following electrical generating project that has the potential to emit mercury has been proposed but has not yet received a permit (and is not included in the emission calculations):

Table 6

Project	Type	Start-up date	Lb/yr	Status
Agassiz Energy	Industrial Boiler - Ethanol	2010	4	EIS

3. Volatilization from coal ash

Although emissions from coal ash are thought to be virtually zero in 2005, this category is included because changes in pollution control equipment and the utilization of coal ash may make this a significant category. In 2005 coal combustion constitutes the majority of mercury emissions in Minnesota, at least partly because very little of the mercury contained in coal is retained by pollution control equipment. Major consumers of coal in Minnesota have committed to controlling mercury emissions, an effort that has the potential to greatly increase the mercury content of coal ash. There also has been a great deal of interest in the beneficial utilization of coal ash in a variety of ways, including soil stabilization for building construction, paved and unpaved roads, as flowable fill, as a raw material for livestock pads, and as an agricultural amendment. It is unclear whether mercury-enriched coal ash will be used in a way that allows for the volatilization of the mercury from the utilized ash, and, if so, what the rate of release would be. The MPCA has worked with Dr. Mae Gustin of the University of Nevada to predict mercury volatilization rates from coal ash. Most current coal ash contains very little mercury, so additional work will be needed to assess volatilization potential if there are proposals to utilize coal ash that is enriched in mercury.

4. Petroleum Refining

The mercury content of crude oil is poorly known, so estimates of emissions have low confidence. Minnesota has two refineries: Flint Hills Resources (formerly Koch Petroleum Group) Pine Bend Refinery and Marathon Petroleum's St. Paul Park Refinery. Flint Hills Resources has conducted two mass balance studies of the mercury flow through its facility, and its most recent study (2004) concluded that inputs of crude oil were 42.5 lb., emissions at the facility 9.6 lb., and products contained 15.9 lb., of which 10 lb. is associated with sulfur, which is sold as a commodity. Because virtually all of the sulfur is exported from Minnesota, none of the mercury in the sulfur is assumed to be emitted in Minnesota. An additional 15.7 lb. could not be accounted for in Flint Hills Resources' mass balance, which, until clarifying information is obtained, are assumed in this analysis to have been emitted at the facility. For the 2005 TRI report, Flint Hills reported mercury emissions of 9.6 lb. from its Pine Bend facility. For the 2005 TRI report, Marathon Petroleum reported 3.3 lb. mercury emissions at its facility. If one scales the inputs to Marathon to Flint Hills, one would predict inputs of 11.0 lb. to Marathon, and that 5.5 lb. mercury might be in the products from Marathon.

The Flint Hills Refinery refines a much greater quantity of crude oil than the Marathon facility. In 2007, Flint Hills Resources' Pine Bend refinery in Minnesota completed a project that increased its crude oil processing capacity by about 19%, from 270,000 to 320,000 barrels per day. The refinery primarily refines Canadian crude oil, which it processes into petroleum products such as gasoline, diesel, propane and butane[d]. Marathon's facility has a capacity of 70,000 barrels per day. Crude oil from Canada and the United States is processed at the refinery into gasoline, diesel, fuel oil, jet fuel, kerosene, propane and asphalt.[e]

Future emissions from this sector are projected to be proportional to change in capacity, which in 2007 increased 15% from 340,000 to 390,000 barrels per day.

5. Petroleum Product Utilization

From the calculations presented in note 4 (above), non-sulfur products, including mercury missing from the mass balance, produced by Flint Hills Resources may contain as much as 21.6 lb. mercury, and products produced by Marathon Petroleum may contain 5.5 lb., a total of 27.1 lb. mercury. These estimates are quite uncertain, and it is not clear where these products are consumed and if all the mercury contained in products is emitted to the atmosphere. For the purposes of this state-wide mercury emission inventory, it is assumed that all the mercury that may be in products is emitted in the state. A more detailed estimate of mercury emissions from petroleum products would require data on all imports and exports of petroleum products from the state, the mercury content of those products, and the fate of that mercury upon use of the product, including fuels and sulfur. Such data are not available, so the simple analysis presented here will be use. Future emissions from this sector are projected to grow by 15% by 2018 from 2005, in parallel to Minnesota's increase in refining capacity.

[d] http://www.fhr.com/refining/minnesota.aspx

[e] http://www.marathon.com/Global_Operations/Refining_Marketing_and_Transportation/Refining/St_Paul_Park_Minnesota/

6. Wood combustion

Table 7

Facility	Unit	Unit size mmBtu/hr	Lb Hg
Sappi Cloquet LLC	Power Boiler #9	430	5.0
District Energy St. Paul Inc. - Hans O'Nyman	Boiler 7	563	9.6
Sappi Cloquet LLC	Power Boiler #7	300	7.0
Boise White Paper LLC - Intl Falls	Boiler #2		2.9
Norbord Minnesota	Wellons Burner		1.1
Blandin Paper/Rapids Energy Center	Boiler #6	270	0.7
Blandin Paper/Rapids Energy Center	Boiler #5	270	0.7
Georgia-Pacific - Duluth Hardboard	Boiler 4	52	0.4
ISD 146 - Barnesville High School	Wood/Bark Waste		0.3
Norbord Minnesota	Konus Burner 2		0.2
Norbord Minnesota	Konus Burner 1		0.2
Foldcraft Co	Primary Boiler		0.2
Georgia-Pacific - Duluth Hardboard	Boiler 5	17	0.2
Boise White Paper LLC - Intl Falls	Boiler #2		0.2
Potlatch Forest Products Corp Lumbermill	Steam Boiler		0.1
St Gabriel's Hospital	Wood/Bark Waste		0.1
Alltrista Consumer Products Co.	Boiler 1		0.1
Alltrista Consumer Products Co.	Boiler 2		0.1
Alltrista Consumer Products Co.	Boiler 3		0.1
Alltrista Consumer Products Co.	Boiler 4		0.1
23 other smaller facilities			1.1
		Total	**30.5**

7. Biomass other than wood

New facilities that combust biomass other than wood are beginning to be constructed in Minnesota. Fibrominn, which combusts turkey litter waste is operational. Koda Energy received an air emission permit from the MPCA in August 2007 and is under construction. Koda Energy will build a 308.18 MMBtu/hr combined heat and power biomass boiler to produce on average, 120,000 lb./hour of steam for process heat at Rahr Malting and 17.8 MW of electricity. Koda Energy will burn oat hulls and other biomass byproducts from the RAHR facility.

Table 8

Project	Type	Startup date	Estimated lb Hg/yr	Status	Hg emission range in TSD for Air Permit
Fibrominn	EGU	2007	0.1	Operational	
Koda Energy	EGU & steam	2010	2	Under construction	1.8 to 8.1
		Total	**2.1**		

8. Natural gas combustion
This estimate is based on an emission factor of 0.0008 lb. mercury/trillion Btu (Electric Power Research Institute. Mercury in the Environment - A Research Update. TR-107695. Palo Alto, December 1996). Future emissions from natural gas consumption are projected to grow by 15% by 2018, but due to the extremely low emission factor, total projected emissions will remain at 0.3 lb./year.

Emissions Largely Resulting from the Purposeful Use of Mercury

Proportional to Hg content of Solid Waste.

9. Volatilization: solid waste collection & processing
This estimate is based on the assumption that 5% of the mercury in solid waste is volatilized during collection, transportation and mechanical processing. This estimate includes municipal solid waste (MSW) that is landfilled, incinerated and composted, but does not include Problem Materials Not Recycled (PMNR; washing machines, oil filters, tires, etc.), waste that is recycled (newspaper, glass, cans), demolition, medical waste incineration, MSW compost or backyard burn barrels. Emissions from steel-recycling facilities is calculated separately (see note 15). Future emissions from solid waste volatilization are projected to decrease by 25% by 2018 because of decreased availability and disposal of mercury-containing products.

Table 9

Fate of Municipal Solid Waste	1990	1995	2000	2005
Recycling	1,381,690	1,766,528	2,267,952	2,490,000
MSW Compost	30,000	67,997	21,092	20,000
Resource Recovery (combustion)		1,379,329	1,228,830	1,240,000
Landfill	800,000	1,145,067	1,909,152	2,120,000
Problem Materials Not Recycled		110,868	110,841	120,000
On-site Disposal	110,000	95,226	96,064	80,000
TOTAL (tons)		4,565,015	5,633,932	6,250,000
Mercury Content (ppm) (calculated from incinerators)	3.66	0.97	0.62	0.5
Total landfilled, combusted, composted (tons)	2,200,000	2,592,393	3,159,074	3,380,000
Mercury content (lb) of Solid Waste (excluding recycling, PMNR)	16,104	5,029	3,917	3,380
Volatilization during handling and transport (lb) (5% of landfill, combustion, composting)	805	251	196	169
Emissions from on-site combustion, also known as "Burn Barrel emissions" assuming 50% is emitted.	403	92	60	40
Volatilized during landfilling, assuming 0.1% is emitted	5.9	2.2	2.4	2.1
Volatilized during and composting, assuming 1% is emitted	2.2	1.3	0.3	0.2

From MPCA SCORE reports:
www.pca.state.mn.us/publications/reports/lrp-p2s-3sy07.pdf
Report on 2005 SCORE Programs
A summary of waste management in Minnesota (December 2006)

10. On-site household waste incineration

It is thought that a significant quantity of solid waste produced by households in Minnesota is not introduced into any organized collection system, but rather is burned on site. This practice could be a significant source of mercury emissions, given that there is no pollution-control equipment and that we know from testing at large municipal solid waste incinerators that household waste contains mercury. Much of household waste is paper, cardboard, and plastic, materials that have a mercury concentration that is much lower than the calculated average for waste. Therefore, the average mercury concentration must be maintained by the occasional introduction of high-mercury items, such as older batteries, broken thermometers, fluorescent lamps, thermostats, etc. In rural areas, on-site disposal often takes the form of an outdoor "burn barrel." In urban and suburban areas, older houses and apartments were often designed with a basement incinerator, although the use of these incinerators has undoubtedly decreased since regulation in the early 1970s. The MPCA estimates the quantity of waste not collected in Minnesota, which is thought to be burned on site, commonly in burn barrels. The following table outlines available data on the production and fate of MSW in Minnesota, and estimates mercury emissions. These figures imply that about 2% of MSW is burned on site. This may be an underestimate, given that at least two studies have shown much higher rates of on-site incineration. Zenith Research Group (1997) found that 11% of residents in the Duluth area affirmed that they use a burn barrel. A 2000 Zenith study of Minnesota residents in the Duluth area found that 18% of residents surveyed admitted to the practice (Zenith Research Group. 2000. Increased Awareness. Prepared for Western Lake Superior Sanitary District.). Future emissions from burn barrels are projected to decrease by 25% by 2018 because of educational initiatives, a decrease that could be accelerated if additional incentives are provided.

Table 10

	1990	1995	2000	2005
Emissions from on-site combustion, "Burn Barrel emissions" assuming 50% is emitted.	403	92	60	40

(See Table in Note 8 for calculations)

11. Volatilization from spills and land dumping

The MPCA estimates that large quantities of mercury are in use in Minnesota, and that a portion that is removed from service each year (8%) is spilled, and that 5% of the mercury that is spilled volatilizes:

Table 11

Year	Hg in use (lb)	Hg removed from use (lb)	Spilled (%)	Hg volatilized (lb)
1990	190,000	13,667	8.0	54.7
1995	160,000	12,000	8.0	48.0
2000	130,000	12,000	8.0	48.0
2005	70,000	6,000	8.0	24.0

It may appear unlikely that such large amounts of mercury are being removed from use, yet these estimates are supported by mercury content of the solid waste stream, as quantified by stack tests at solid waste incinerators. Based on stack tests, the solid waste stream contained at least 16,000 lb. of mercury in 1990, 5,000 lb. in 1995, and 4,000 lb. in 2000. Although it is likely that more mercury was properly disposed of after 1990, it also seems likely that as long as mercury is in use, it will be accidentally spilled and volatilized.

12. Landfill volatilization
0.1% of mercury in landfilled municipal solid waste (MSW) is assumed to volatilize to the air per year based on studies of MSW emissions in Florida by S. E. Lindberg and J. L. Price. (Lindberg, S. E.; Price, J. L. Airborne emissions of mercury from municipal landfill operations: a short-term measurement study in Florida. *J. Air & Waste Manage. Assoc.* 1999, 49, 520–532.) See table in Note 9 for calculations.

13. Volatilization: land application of compost
See table in Note 9 for calculations.

Proportional to Hg content of Liquid Waste

14. Volatilization: land application of sludge
After correcting for the water content, about 50,000 dry tons of sewage sludge are land applied in Minnesota each year. This estimate assumes that 1% of the mercury applied to the surface of the land volatilizes within a year, but does not attempt to calculate any carryover from previous years. The mercury content of the sludge has been declining over time. Sludge averaged 3.6 ppm of mercury in 1990, 1.8 ppm in 1995, 1.4 ppm in 2000, and 0.7 ppm in 2005. Future emissions from land-applied sludge are projected to decrease by 50% by 2018 because of continued efforts to reduce mercury discharge to sanitary sewers, especially by dentists.

Recycling Activities

15. Shredders and smelters that recycle cars and appliances
Mercury is released by the recycling of cars and major appliances because of the presence of mercury switches in some of these products. There are several shredding facilities in Minnesota that process vehicle and appliance scrap, including Gerdau Ameristeel, Schwartzman Co. and Bay Side Recycling Corp. Emissions from shredders have only been characterized at one Minnesota facility (Gerdau Ameristeel, 10 lb./year) and further study is needed to identify all facilities and characterize their practices. In 2007 Gerdau processed the equivalent of 64% of the vehicles retired in Minnesota.

There is one electric arc furnace (EAF) mini-mill in Minnesota that melts steel from recycled cars and appliances, Gerdau Ameristeel, formerly North Star Steel. In the national TRI, Gerdau Ameristeel reported emissions of 255.3 lb. for 2005, which the MPCA believes overestimates true emissions because (a) it was based on a 1999 stack test when vehicles contained 15% more mercury switches and (b) the stack test was extrapolated to the total number of hours the bag houses were running rather than the hours that melts of scrap metal occurred — the bag house fans were left on when mercury was not being volatilized. Adjusting for just the hours that the melting was occurring, total facility emissions for 2005 are now estimated to have been 138.7 lb., including 10 lb. from the shredder. While 138.7 may be a 15% overestimate (21 lb.) for Gerdau facility alone because it is based on the 1999 stack test, 138.7 may be a fair 2005 estimate for Minnesota as a whole when including emissions from other shredders, and so that number is used as a statewide estimate.

Data from the National Vehicle Mercury Switch Recovery Program (NVMSRP) project a 59% decline in the quantity of mercury switches in the autos that are retired in Minnesota from 2005 to 2018, and 89% decline from 2005 to 2025 (Figure 1).

A 59% decline in mercury switches alone would imply that state-wide emissions would be 56.9 lb. in 2018 and 15.3 lb. in 2025. However, the recent Electric Arc Furnace NESHAP Area Source Rule for mercury, which includes the National Vehicle Mercury Switch Recovery Program (NVMSRP) goal of 80% removal of switches from vehicles *prior to shredding*, means that statewide emissions are projected to be 24.1 lb. in 2010, 11.4 lb. in 2018 and 3.1 lb. in 2025 (Table 13).

Future emissions are projected to decline from a combination of (1) reduced mercury in auto scrap due to the NVMSRP and, and (2) a parallel reduction in the number of switches in other scrap because the use of switches in appliances, such as washing machines, gas ovens, freezers and residential boilers, was halted. The NVMSRP effort is scheduled to end on a national basis after 2017, when 90% of the switches originally installed in vehicles are projected to have retired. Figure 1 shows the estimated amount of mercury in vehicles available for recovery in Minnesota, the estimated amount contained in Gerdau Ameristeel's annual input, and the effect of 80% recovery under the NVSMRP.

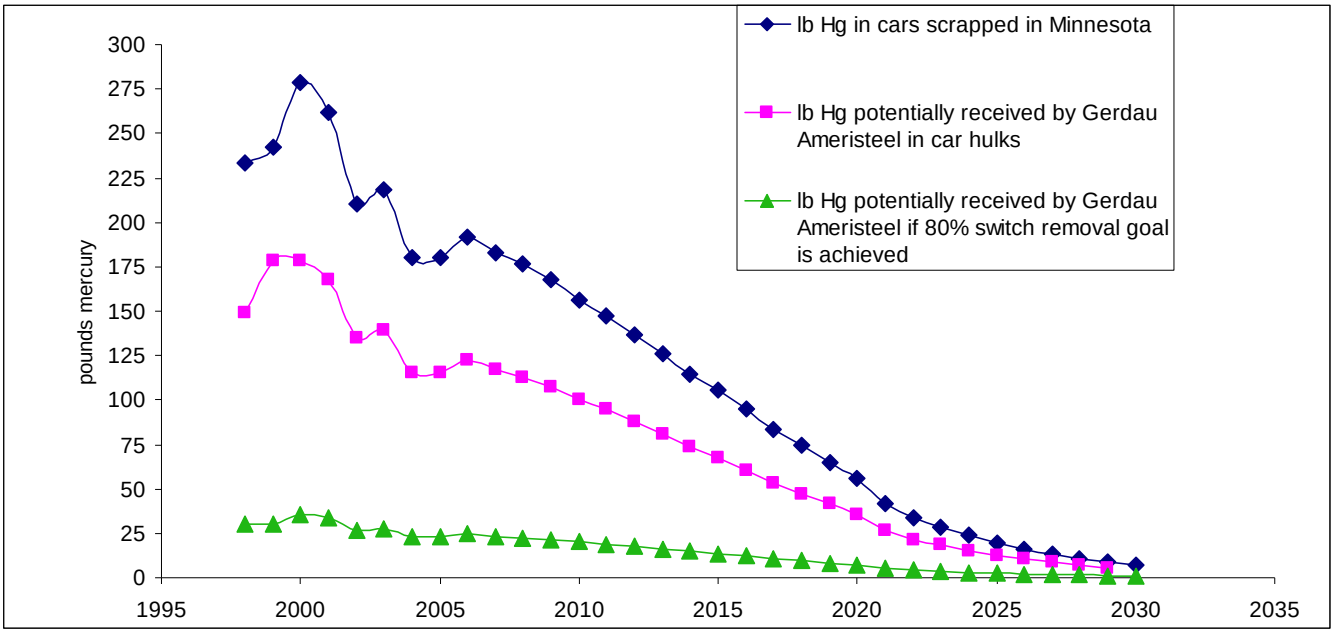


Figure 1 Modeled calculations of the mass of mercury available for recovery from vehicles retired each year in Minnesota and contained in vehicle scrap inputs to Gerdau Ameristeel. The source of the data is NVMSRP Measurement Subcommittee, assuming that Gerdau Ameristeel receives 64% of vehicles retired in Minnesota. Data, supporting information and references are available at www.elvsolutions.org/model.html. Switch retirement forecasts are based on several sources, including Polk vehicle registration data, vehicle population and retirement studies and models from the Federal Reserve Bank, the Department of Energy, the Society of Automotive Engineers, and the Michigan Mercury Switch Study.

Table 12

Year	Lb Hg in cars scrapped in Minnesota	Lb Hg potentially received by Gerdau Ameristeel in car hulks	Lb Hg potentially received by Gerdau Ameristeel if 80% switch removal goal is achieved	Statewide Hg emissions (lb) reflecting switch decline and 80% removal after 2008
2000	278.3	178.1		
2005	180.1	115.2		138.7
2010	156.6	100.2	20.0	24.1
2018	74.2	47.5	9.5	11.4
2025	19.8	12.7	2.5	3.1

16. Recycling mercury from products within Minnesota

It is difficult to estimate the emissions associated with recycling mercury in Minnesota because it is unclear what the emission factor is for recycling mercury. This estimate was made in the late 1990s by Brian Golob, who at the time was employed by one of the three mercury recycling companies in Minnesota. Future emissions from mercury recycling are projected to increase by 25% by 2018 because of increasingly aggressive efforts to remove mercury from use and recycle it.

17. Non-ferrous metal recycling (Al, Pb)

These emissions are calculated by the MPCA air emission inventory staff:

0.55	Industrial Processes	Secondary Metal Production	Aluminum	Burning/Drying
0.36	Industrial Processes	Secondary Metal Production	Lead	Blast Furnace (Cupola)
0.91	**Total**			

Dental Mercury

18. Dental Preparations

Dentists have used mercury amalgam for over 150 years in the United States. Mercury amalgams typically contain between 42 and 50% mercury. The mercury employed in the amalgam has a variety of pathways to the atmosphere, including direct volatilization during preparation in the dental office, from the patient's mouth, after removal in the dental office, during transit in wastewater pipes, from sewage sludge, from crematoriums, and a variety of more subtle pathways. In this estimate, the MPCA includes direct volatilization from the dental office, from the consumer, and during transit in wastewater pipes, but excludes all other pathways, which are included in other emission categories. The MPCA based the estimates on information in the report *Substance Flow Analysis of Mercury in Products* (August 2001, www.pca.state.mn.us/air/mercury-mn.html#publications). However, the MPCA reduced volatilization during transit from 10 to 5%, although no data on the subject are presently available. 2005 projections are based on data from Cain et al. 2007, using the MPCA assumptions that transit loss is 5% and that otherwise Minnesota can be estimated as 2% of national figures.

Table 13

	1990	1995	2000	2005	2018
Dental office (lb)	46.2	46.2	46.2	31.8	15.9
Customer breathing (lb)	11	12.1	13.2	6.4	3.2
Transit loss (lb)	46.2	40.7	35.2	24.2	1.0
Total Emissions (lb)	**103.4**	**99**	**94.6**	**62.4**	**20.1**

19. Crematories

Cremation can release significant quantities of mercury because of the mercury amalgam that is present as dental fillings, and cremation probably releases all of this mercury to the atmosphere. The MPCA estimates for this source are based on calculations presented in Substance Flow Analysis of Mercury in Products (August 2001, www.pca.state.mn.us/air/mercury-mn.html#publications), which calculates that an average of 2.63 grams of mercury are emitted per cremation. Cremations are expected to significantly increase in the future and the number of mercury fillings in people's teeth will decline after about 2025 due to better dental care (Fig. 2). Therefore emissions to the atmosphere are projected to increase until about 2025 before declining (Fig. 3).

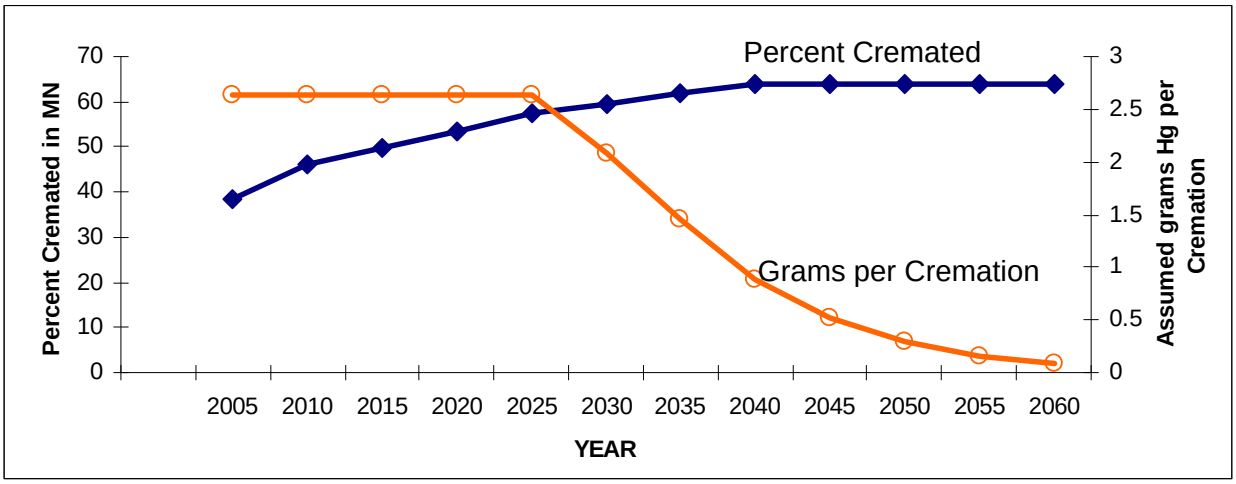


Figure 2

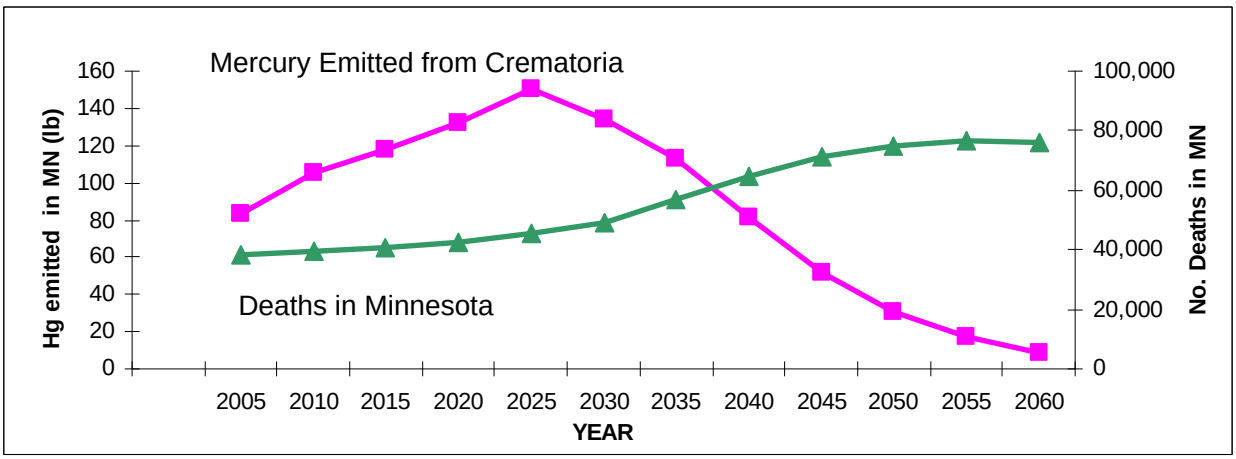


Figure 3

Table 14

Year	MN Hg cremation emissions (lb)	% Cremated in MN	Deaths in MN	Assumed g Hg per cremation	Change in Hg from 2005 (Brown et al. 2002)
2005	83	38	38,200	2.63	
2010	105	46	39,400	2.63	
2015	118	50	40,800	2.63	
2020	133	54	42,800	2.63	
2025	151	57	45,400	2.63	
2030	134	60	49,200	2.08	-21%
2035	113	62	57,000	1.45	-30%
2040	81	64	64,800	0.89	-39%
2045	52	64	71,000	0.52	-42%
2050	31	64	75,000	0.29	-44%
2055	17	64	76,400	0.16	-46%
2060	9	64	76,000	0.08	-48%

Notes:

Brown, L.J., Wall, T.P., and Lazar, V. 2002. Trends in caries among adults 18 to 45 years old. *J. American Dental Assoc*. 133:827-834

BOLD numbers are from literature, others are interpolated.

CANA (Crematoria Association of North America) predicts that the national cremation rate will reach 64% in 2040, which may be an underestimate for Minnesota, which in the past has exceeded national rates by about 7%.

Incineration

20. Municipal solid waste combustion

The mercury emissions in the following table are based on stack tests submitted to the MPCA

Table 15

Facility	Unit	Lb emitted
Mayo Waste Management Facility	Pathological Waste Incinerator	0.033
Xcel Energy - Key City/Wilmarth	Boiler #1 (with CE 001 scrubber and CE 002 baghous	1.814
Xcel Energy - Key City/Wilmarth	Boiler #2 (with CE 003 scrubber and CE 004 baghous	1.826
Pope/Douglas Solid Waste Management	MSW Incinerator Unit 1	0.216
Pope/Douglas Solid Waste Management	MSW Incinerator Unit 2	0.132
Xcel Energy - Red Wing Generating Plant	Boiler 1	5.310
Xcel Energy - Red Wing Generating Plant	Boiler 2	5.060
Red Wing Solid Waste Boiler Facility	Left and Right Incinerator and Common Auxiliary Bu	1.336
Covanta Hennepin Energy Resource Co LP	MSW Incinerator	5.360
Covanta Hennepin Energy Resource Co LP	MSW Incinerator	4.471
Enviro-Chem Inc - Plant 1	Recovering Metals	0.010
Enviro-Chem Inc - Plant 1	Recovering Metals	0.010
Enviro-Chem Inc - Plant 1	Recovering Metals	0.010
Enviro-Chem Inc - Plant 1	Recovering Metals	0.010
Olmsted Waste-to-Energy Facility	Municipal Waste Combustor Unit #1	1.785
Olmsted Waste-to-Energy Facility	Municipal Waste Combustor Unit #1	0.000
Olmsted Waste-to-Energy Facility	Municipal Waste Combustor Unit #2	0.524
Olmsted Waste-to-Energy Facility	Municipal Waste Combustor Unit #2	0.000
Perham Resource Recovery Facility	South MSW Incinerator	10.590
Fergus Falls Resource Recovery Facility	MSW Incinerator 1	2.522
Fergus Falls Resource Recovery Facility	MSW Incinerator 2	0.853
Polk Cnty Solid Waste Resource Recovery	Incinerator 1	2.262
Polk Cnty Solid Waste Resource Recovery	Incinerator 2	1.184
Polk Cnty Solid Waste Resource Recovery	Dump Stack for Incinerator 1	0.004
Polk Cnty Solid Waste Resource Recovery	Dump Stack for Incinerator 2	0.004
Great River Energy - Elk River	Unit 1 Boiler	0.460
Great River Energy - Elk River	Unit 2 Boiler	0.460
Great River Energy - Elk River	Unit 3 Boiler	0.723
Verso Paper Co - Sartell Mill	B & W Boiler	2.302
	Total	**49.239**

Perham experienced a malfunction of pollution control equipment in 2005, which allowed an unusual amount of mercury to be emitted. Projections after 2005 assume that Perham emits 2.0 lb./year.

The Olmsted facility has a permit to expand, and construction is underway in 2008. The Olmsted expansion is expected to increase mercury emissions at the facility by approximately 1.0 lb./year.

21. Sewage Sludge Incineration

Sewage sludge contains mercury from a variety of wastewater sources. There are two sludge

incinerators in Minnesota, the Metropolitan Plant, and the Seneca Plant. Based on data provided by the Metropolitan Council, the MPCA estimates that 247 lb. of mercury were emitted in 1990, 160 lb. in 1995, 112 lb. in 2000, and only 8.5 lb. in 2005. In late 2004 a new incinerator with about 97% mercury-control efficiency began operation at the Metropolitan plant (as calculated by Balogh and Nollet, 2007, Sci Total Environ. Mercury mass balance at a wastewater treatment plant employing sludge incineration with offgas mercury control.) In September 2007 the Buffalo Wastewater Treatment Plant (Buffalo, Minn.) received an amended permit to construct a sewage sludge incinerator that will control mercury emissions with activated carbon. It is unknown what actual emissions of mercury will be from this new facility. The Air Quality Permit limits mercury emissions to 4 lb./year, but emissions are likely to be much lower. For the purpose of projecting emissions, 2 lb./year are assumed at startup in 2008. To account for increased loading and emissions due to population growth, increases of 1% per year are projected.

Table 16.

Facility	1990	1995	2000	2005	2010	2018
Metropolitan Plant	212	136	95	2.4	2.5	2.7
Seneca Plant	35	24	17	6.1	6.4	6.9
Buffalo Plant					2.0	2.2
Total emitted (lb)	**247**	**160**	**112**	**8.5**	**11.0**	**11.8**

21. Medical waste incineration

Emission data are based on stack tests submitted to the MPCA, as summarized in the following table.

Table 17.

Facility	1990	1995		2000		2005	
	Lb Hg emitted	Lb Hg emitted	Lb Hg/ton	Tons burned	Lb Hg emitted	Tons burned	Lb Hg emitted
Mayo Foundation, Rochester	115	1	7.71E-05	5,292	0.40	5,300	0.4
Medical Safety Systems, Cannon Falls	33	25	3.10E-03	1,851	5.70	0	0.0
Small Class IV incinerators at hospitals (about 80 in 1990, 20 in 1995, 6 for part of 2000)	368	10	2.10E-04	200	0.04	0	0.0
Total mercury emitted	**516**	**36**			**6.14**		**0.4**

Notes:

After 1990, the Mayo Foundation Incinerator was replaced with a new facility that controls mercury emissions with activated carbon injection.

The Medical Safety Systems facility in Cannon Falls closed permanently in August 2000.

Most hospital (Class IV) incinerators were required to close by February 2000 due to federal regulations; those still operating in 2000 are listed below:

Table 18

Date operation ceased	Hospital
January 2000	Fairmont Community Hospital
February 2000	Worthington Regional Hospital
February 2000	St. Cloud Hospital
June 2000	Lakewood Health Center, Baudette
October 2000	NW Medical Center, Thief River Falls
November 2000	Northcountry Regional Hospital, Bemidji

23. Hazardous waste incineration
Minnesota has only one hazardous waste incinerator, 3M Chemolite. Based on data submissions from that facility, MPCA estimates annual mercury emissions of 5 lb. per year. 3M did not submit any data recently, and 5 lb. may be an overestimate.

23. Class IV incinerators
Small incinerators were once commonly used at grocery stores and other small businesses to incinerate waste, largely cardboard. All of these small incinerators, of which there were about 1,000 in 1990, closed by January 1996 because of new state regulations to reduce particulate emissions. It is assumed that they mostly burned cardboard with mercury at 0.2 ppm. The MPCA estimates that Class IV incinerators burned about 138,000 tons in 1990 and 70,000 tons in 1995.

Manufacturing & Use of Non-dental Mercury-containing Products

25. Mercury product manufacturing in Minnesota
Mercury is released from product manufacturing processes. According to the IMERC database of mercury product manufacturers, there are three mercury product manufacturing facilities located in Minnesota. These include Anchor Scientific, Long Lake; Electro-Sensors, Inc., Minnetonka; and SJE Rhombus, Detroit Lakes. SJE Rhombus is the only facility that has filed a TRI report for mercury. This mercury-switch manufacturing facility calculates that in 2005 it emitted 42 lb. mercury (TRI report). Because of progressive bans on the sale of mercury switches in states, now totaling about 15 states including Minnesota, SJE Rhombus projects a decline in the manufacture of mercury switches. MPCA conservatively projects a decline in emissions of 25% by 2018. The other two facilities have not filed TRI reports for mercury releases. Further information is needed.

In addition to these three companies, there is a neon lamp industry in the state, a product line that utilizes mercury. FMS Corporation (FMSneon.com, Minneapolis) manufactures a wide variety of neon sign components for national and international distribution, and in addition there are a number of small businesses engaged in neon lamp manufacturing for artistic and commercial applications. Use and emissions of mercury in this sector have not been studied and warrant further investigation.

26. General laboratory use
Chemical laboratories have traditionally used mercury for a variety of uses, including physical measurements and chemical analyses. The EPA Mercury Report to Congress (1997) estimated that in 1995, 2,200 lb. of mercury were volatilized from laboratories nationally. Given that Minnesota represents 2% of all economic activity nationally, the MPCA estimates that 44 lb. of mercury were emitted in 1990 and 1995, that this source declined to 22 lb. by 2000, 10 lb. by 2005, and 5 lb. by 2018. The decline is projected to occur as a result of continued education.

27. Volatilization from dissipative use
“Dissipative use” is the consumption of mercury in products that are meant to be used and absorbed into the environment, such as fungicides and preservatives. The largest use of mercury in this category was mercuric compounds used as a preservative in latex paints, a practice that was discontinued in 1992. Mercury was legally used in some cosmetics as a preservative (up to 65 ppm) until a Minnesota law banned the sale in January 2008.

Emissions Incidental to Material Processing

27. Taconite processing

In Minnesota, the iron in taconite ore is concentrated and marble-size pellets are baked, or indurated, for ease of handling before they are shipped for smelting outside of the state. Induration volatilizes virtually all of the mercury that is present in the concentrate. For this volatilization estimate, emission factors (lb. per million long ton) are calculated from Jiang et al., 2000 ("Mercury Emissions from Induration of Taconite Concentrate Pellets – Stack Testing Results from Facilities in Minnesota." A presentation at the U.S. Environmental Protection Agency conference, Assessing and Managing Mercury from Historic and Current Mining Activities, San Francisco, Calif., November 28-30, 2000.).

Table 19

Facility	2005	2010	2018
Northshore Mining Co - Silver Bay	7.3	7.3	7.3
US Steel Corp - Minntac	185.3	185.3	185.3
United Taconite LLC - Thunderbird Mine	1.1	1.1	1.1
Northshore Mining Co - Babbitt	0.1	0.1	0.1
Hibbing Taconite Co	227.1	227.1	227.1
Ispat Inland Steel Mining - Minorca	33.4	33.4	33.4
US Steel - Keewatin Taconite	146.9	105.8	105.8
United Taconite LLC - Fairlane Plant	133.6	133.6	133.6
Minnesota Steel Industries (MSI)	0.0	77.0	77.0
Mesabi Nugget	0.0	70.0	70.0
Total	**734.8**	**840.6**	**840.6**

Note: Keewatin Taconite had pollution-control equipment installed in Oct 2005, which reduces Hg emissions by 28% after 2005

The following mining projects that have the potential to emit mercury have been proposed but have not yet received a permit (and are not included in the emission calculations):

Table 20

Project	Type	Start-up date	Potential Hg emissions (lb)	Status
Polymet	Mining	2012	8	Env. Review
Keetac expansion	Mining	2013 est.	49 est.	Announced
Mesabi Nugget II	Mining	?	?	Announced

29. Thermal treatment of soil

An average of 5,000 tons of surface soil are heated annually in Minnesota to remove organic contaminants as a method of soil remediation. A concentration of 0.08 ppm of mercury is assumed in the soil, and it is assumed that all of the mercury in the soil is emitted to the atmosphere, releasing about 0.8 lb.

Difficult to Categorize (Is the mercury from fuel or materials?)

These four subcategories, totaling about 25 lb., are new to the mercury emission inventory, appearing as output from the MPCA's air toxics emission inventory. MPCA staff will investigate these categories to determine if emissions are mostly associated with energy consumption or material processing. With that knowledge, it may be appropriate to reassign the emissions to one of the three major categories above, resulting from Energy, Purposeful Use, or Material Processing. In addition, it may be possible to project time trends.

30. Asphalt manufacturing
This category was responsible for the emission of 4.3 lb. of mercury in 2005, based on U.S. Environmental Protection Agency (U.S. EPA) emission factors from plants that prepare hot asphalt. In the plants tested by the U.S. EPA, it is not clear whether the mercury originated in the raw materials or the fuel that was used to heat the materials. With further investigation, it should be possible to assign these emissions to either of two major categories in this mercury emission inventory, Incidental to Energy Production or Emissions Incidental to Material Processing.

31. Agriculture, food and kindred products
This category was responsible for the emission of 1.1 lb. of mercury in 2005, based on U.S. EPA fugitive emission factors for activities classified under SCC code 30288801, which is usually applied to facilities that handle grain. With further investigation, it should be possible to assign these emissions to either of two major categories in this mercury emission inventory, Incidental to Energy Production or Emissions Incidental to Material Processing.

32. Mineral products
This category was responsible for the emission of 13.8 lb. of mercury in 2005, based on U.S. EPA emission factors for activities classified under SCC codes 30588801 (fugitive dust emissions, 10.0 lb.), 30501049 (wind erosion, 2.41 lb.), and 30500311 (firing of bricks, 1.42 lb.). With further investigation, it should be possible to assign these emissions to either of two major categories in this mercury emission inventory, Incidental to Energy Production or Emissions Incidental to Material Processing.

33. Miscellaneous industrial processes
This category was responsible for the emission of 0.2 lb. of mercury in 2005, based on U.S. EPA emission factors for activities classified under SCC code 39999999, for miscellaneous industrial processes.

34. Wood, pulp and paper, and publishing products
This category was responsible for the emission of 5.1 lb. of mercury in 2005, based on U.S. EPA emission factors for activities classified under SCC code 30700104 (emissions from Boise Cascade recovery furnace, 3.6 lb.), SCC code 30701010 (Oriented strandboard rotary dryer, 1.1 lb.), and SCC code 30700106 (Lime Kiln, 0.4 lb.). With further investigation, it should be possible to assign these emissions to either of two major categories in this mercury emission inventory, Incidental to Energy Production or Emissions Incidental to Material Processing.

Appendix D: Strategy Work Group Roster *(Alternates Listed in Italics)*

Len Anderson, St. Louis River TMDL
Gary Glass, St. Louis River TMDL

Rebecca Flood, Metropolitan Council Environmental Services
Tim Tuominen, Western Lake Superior Sanitary District

Patrick Flowers, Xcel Energy
Jim Bodensteiner, Xcel Energy

Collie Graddick, Environmental Justice Advocates of Minnesota
Boise Jones, Environmental Justice Advocates of Minnesota

Joe Hensel, Rochester Public Utilities
Craig Diekvoss, Rochester Public Utilities

Mark Knoff, City of Mankato
Mary Fralish, City of Mankato

Nancy Lange, The Izaak Walton League of America
Bill Grant, The Izaak Walton League of America

Bob Meier, Minnesota Department of Natural Resources
Marty Vadis, Minnesota Department of Natural Resources

Dennis Niemi, Minnesota Power
Tim Hagley, Minnesota Power

Chuck Prokop, Minnesota Trout Association
Jeff Broberg, Minnesota Trout Association

Mike Robertson, Minnesota Chamber of Commerce
Tony Kwilas, Minnesota Chamber of Commerce

Nancy Schuldt, Fond du Lac Reservation
Kari Hedin, Fond du Lac Reservation

Kris Sigford, Minnesota Center for Environmental Advocacy
Paul Aasen, Minnesota Center for Environmental Advocacy

Dave Skolasinski, Cleveland-Cliffs
Jeff McCulloch, Cleveland-Cliffs

David Thornton, Minnesota Pollution Control Agency
Paul Eger, Minnesota Pollution Control Agency

Tim Tuominen, Western Lake Superior Sanitary District
Joe Mayasich, Western Lake Superior Sanitary District

Scott Vagle, US Steel - Minnesota Ore Operations
Tom Moe, US Steel – Minnesota Ore Operations

Appendix E: Partners Group Roster – List of Participating Organizations

Association of Minnesota Counties
Automotive Recyclers of Minnesota
Barr Engineering
Blue Water Science/Minnesota Waters
Carver County
Chisago County
City of Mankato
Clean Water Action Alliance
Cleveland-Cliffs Inc
Cremation Society of Minnesota
Environmental Justice Advocates of Minnesota
Excelsior Energy Inc.
Flaherty & Hood
Flint Hills Resources
Fond du Lac Reservation
Friends of the Boundary Waters Wilderness
Friends of the Mississippi River
Gerdau Ameristeel
Great River Energy
Green Lights Recycling Inc.
Hennepin County
Heron Lake BioEnergy, LLC
Indigenous Environmental Network
Institute for Agriculture & Trade Policy
Iron Mining Association of Minnesota
Lakewood Cemetery
League of Minnesota Cities
Leech Lake Division of Resource Management
Lower Sioux Indian Community
Marathon Ashland Petroleum
Mercury Technologies of Minnesota
Mercury Waste Solutions
Metropolitan Council
Minnesota Center for Environmental Advocacy
Minnesota Chamber of Commerce
Minnesota Dental Association
Minnesota Department of Commerce
Minnesota Department of Employment and Economic Development
Minnesota Department of Health
Minnesota Department of Natural Resources
Minnesota Department of Natural Resources
Minnesota Environmental Partnership
Minnesota Funeral Directors Association
Minnesota Municipal Utilities Association
Minnesota Pollution Control Agency
Minnesota Power
Minnesota Public Utilities Commission
Minnesota Public Utilities Commission
Minnesota Rural Water Association
Minnesota Steel Industries, LLC
Minnesota Technical Assistance Program
Minnesota Trout Association
Minnesota Wastewater Operators Association
North American Water Office
Otter Tail Power Company
Polymet Mining Corporation
Ramsey County Public Health
Richardson, Richter & Associates
Rochester Public Utilities
Sappi Cloquet Paper Mill
Save Lake Superior Association
SJE Rhombus Controls
Solid Waste Management Coordinating Board
Southern Minnesota Municipal Power Agency
St. Louis River TMDL
Superior National Forest
The Izaak Walton League of America
The Osgood Group/Minnesota Waters
University of Minnesota Facilities - Energy Management
University of Minnesota Mortuary Science Program
Upper Sioux Community Environmental Services
US Steel
Voyageurs National Park
W.J. McCabe - Duluth Chapter of Izaak Walton League
Western Lake Superior Sanitary District
Westside Community Health Services
White Earth Band of Ojibwe
Xcel Energy

Appendix F: Projected Mercury Emissions After Adoption of Reduction Strategies

Projected Mercury Emissions After Adoption of Sector-Based Reduction Strategies			
Sector/Category	**Estimated 2005 Emissions (lb)**	**Projected 2018 Emissions (lb)**	**Projected 2025 Emissions (lb)**
Incidental to Energy Production			
Electric Utility-coal	1,716.0	294.0	235.0
Industrial -coal	71.3	33.0	33.0
Volatilization from coal ash	0.0	0.0	0.0
Petroleum Refining	12.9	7.4	7.0
Petroleum Product Utilization	27.1	15.0	15.0
Wood Combustion	30.5	14.0	14.0
Biomass Other Than Wood	0.0	2.1	2.1
Natural Gas Combustion	0.3	0.3	0.3
Subtotal	**1,858.1**	**365.4**	**306.4**
Largely Resulting from the Purposeful Use of Mercury			
Proportional to Hg content of Solid Waste			
Volatilization: solid waste collection & processing	169.0	69.3	69.3
On-site household waste incineration	40.0	5.0	5.0
Volatilization from spills and land dumping	24.0	12.0	12.0
Landfill volatilization	2.1	1.6	1.6
Volatilization: land application of compost	0.2	0.1	0.1
Proportional to Hg content of Liquid Waste			
Volatilization: land application of sludge	1.6	1.0	0.8
Recycling Activities			
Smelters and shredders that recycle cars and appliances	138.7	20.0	10.0
Recycling mercury from products within MN	65.0	8.0	8.0
Non-Ferrous metal recycling (Al, Pb)	0.9	1.1	1.1
Dental Mercury			
Dental Preparations	62.4	10.0	5.0
Cremation	80.0	63.0	32.0
Incineration			
Municipal solid waste combustion	49.2	38.3	38.3
Sewage Sludge Incineration	8.5	6.0	6.0
Medical waste incineration	0.4	0.7	0.8
Hazardous waste incineration	0.3	0.3	0.3
Class IV incinerators	0.0	0.0	0.0
Mfg & Use of Non-dental Mercury-containing Products			
Mercury product manufacturing in Minnesota	42.0	13.0	0.3
General Laboratory Use	10.0	3.6	1.0
Volatilization from dissipative use	0.8	0.5	0.4
Subtotal	**695.1**	**253.5**	**192.0**
Emissions Incidental to Material Processing			
Taconite Processing	734.8	840.6	210.0
Thermal treatment of soil	0.8	0.8	0.8
Subtotal	**735.6**	**841.4**	**210.8**
Difficult to Categorize			
Asphalt Manufacturing	4.3	4.3	4.3
Agriculture, Food, & Kindred Products	1.1	1.1	1.1
Mineral Products	13.8	13.8	13.8
Miscellaneous Industrial Processes	0.2	0.2	0.2
Wood, Pulp & Paper, & Publishing Products	5.1	5.1	5.1
Subtotal	**24.6**	**24.5**	**24.6**
GRAND TOTAL	**3,313.4**	**1,484.8**	**733.8**

Appendix G: List of Strategies Considered

Air Emission Reduction Strategies			
Source/Sector: 1.0 Energy Sector			
1.1 Coal-Fired Electric Power Generation			
Strategy: 1.1a			
90% Reduction at units not subject to prior reduction		Reduction Potential[6]	208 lbs
Description:	Through addition of activated carbon injection or other technologies, achieve a 90% reduction at all units not yet controlled for mercury. (Facilities not achieving reductions as a result of MERP, AREA or Hg2006.)		
Timeframe:	Medium		
Cost:	$143 million capital, $22.4 million annual (including capital and operation costs) or $107,692lb/yr. (mercury control costs only) Source Preliminary MPCA estimates.		
Feasibility:	Technology currently available		
Measurement:	Stack tests		
Implementation Issues and Barriers:	Assume 90% reduction of 2018 emission at units not already required to achieve 90% control		
Comments:	Small units have limited engineering and financing abilities.		
Strategy: 1.1c			
90% reduction at remaining plants greater than 100 MW and 70% at plants less than 100 MW		Reduction Potential	177 lbs
Description:	Achieve 90% reduction at remaining plants greater than 100 MW and 70% at plants less than 100 MW not covered by the Mercury Reduction Act of 2006, AREA or MERP.		
Timeframe:	Medium		
Cost:	$108 million capital, $16.3 million annual (including capital and operation) or $92,090/lb. Source Preliminary MPCA estimates.		
Feasibility:	Technology currently available		
Measurement:	Stack tests		
Implementation Issues and Barriers:	Black Dog 3 and 4 are controlled to 90%; remaining units controlled to 70%		
Comments:	Small units have limited engineering and financing abilities.		

Strategy: 1.1e			
70-90% reduction at units in top 95% of cumulative mercury emissions (2005)		Reduction Potential	175 lbs
Description:	Require plan for at least 90% reduction at Sherco 1,2,3; Clay Boswell 3,4; Allen S. King 1 by 2012. Require 70% control at Hoot Lake 2,3; High Bridge 5, 6; Taconite Harbor 1, 2, 3; Riverside 6, 7, 8 (projects are already underway). Require plan for at least 90% reduction at Black Dog 3,4 by 2015. Require plan for at least 70% reduction at Laskin 1,2; Austin Northeast 1 by 2020. EGU's emitting less than 5 lb/year excluded from requirements. Upgraded or modified EGU projects must be mercury neutral.		
Timeframe:	Medium		
Cost:	$113 million capital, $13.6 million annual or $75,000/lb/yr		
Feasibility:	Technology currently available		
Measurement:	Stack Tests		
Implementation Issues and Barriers:	Suggest that implementation at smaller units lag to conduct performance testing, planning and implementation. Small units have limited engineering and financing abilities.		
Comments:	Of the currently unaffected units, Black Dog is controlled to 90%. Hoot Lake is moved to the lower group as its two units have a mercury control project pending.		
Strategy: 1.1i			
Require new electric generation sources to offset mercury emissions		Reduction Potential	Up to 50 lbs
Description:	Require new electric generation sources to find reductions elsewhere equal to or greater than new emissions.		

[6] Reduction Potential is from 2018 estimated emissions for all strategies.

Timeframe:	
Cost:	Approximately $80,0000/lb/yr.
Feasibility:	
Measurement:	Stack tests
Implementation Issues and Barriers:	
Comments:	Proposals and permits for coal-fired boilers in Mn have been for about 10 lbs each; assumes 5 additional projects. Could apply to other sectors or all new sources.

Strategy: 1.1j		
Replace some coal with low- or no- mercury fuels	Reduction Potential	45 lbs

Description:	A portion of generation at existing coal plants is re-powered or retrofitted as needed to use natural gas or biomass or other fuel lower in mercury than existing coal.
Timeframe:	Medium
Cost:	Not estimated
Feasibility:	
Measurement:	Stack tests
Implementation Issues and Barriers:	
Comments:	Estimate assumes replacing 10% of coal generation in 2018. Relates to actions recommended by Minnesota Climate Change Advisory Group. Will coordinate with outcome of MCCAG.

Strategy: 1.1k		
Increase renewable energy generation beyond 25% by 2025	Reduction Potential	Undeter-mined

Description:	Increase renewable energy generation beyond 25% by 2025 such that current coal generation is displaced by non-mercury sources
Timeframe:	Long
Cost:	
Feasibility:	
Measurement:	Stack tests
Implementation Issues and Barriers:	
Comments:	In order to reduce mercury emissions, un-needed coal-fired generation in the state would need to be retired. Relates to actions recommended by Minnesota Climate Change Advisory Group. Will coordinate with outcome of MCCAG.

Strategy: 1.1l		
Reduce demand for electricity by increasing energy efficiency	Reduction Potential	Undeter-mined

Description:	Reduce demand for electricity from coal-fired power plants by further increases in energy efficiency in Minnesota.
Timeframe:	Long
Cost:	
Feasibility:	
Measurement:	Stack tests
Implementation Issues and Barriers:	
Comments:	In order to reduce mercury emissions, un-needed coal-fired generation in the state would need to be retired. Relates to actions recommended by Minnesota Climate Change Advisory Group. Will coordinate with outcome of MCCAG.

1.2 Industrial/Commercial/Institutional Boilers

Strategy: 1.2a		
70% reduction via improved controls	Reduction Potential	55 lbs

Description:	Improve overall particulate matter capture and/or apply activated carbon injection on all ESP- or FF- industrial/commercial/institutional coal-fired controlled units where existing mercury emissions are greater than 2 lbs/yr and emissions control is not at least 70%. (No electric generation units are included in this strategy.)
Timeframe:	Short to Medium
Cost:	Total statewide capital cost (1999$): $4.7 million capital, $600,300/yr annual operating cost, total annual cost (CR +operating)=$1.0 million, cost per lb: $20,774.
Feasibility:	Technically feasible
Measurement:	Emissions testing

Implementation Issues and Barriers:	None
Comments:	Assumes industrial coal-fired boilers can be controlled by an additional 70% over 2018 baseline. No control assumed for biomass. Costs were developed using EPA's methodology of determining costs for implementing mercury control standards at utility boilers. (RTI International, 2003. See CAMR docket).
Strategy: 1.2b	
Follow recommendations of anticipated federal industrial boiler standards.	Reduction Potential: 55 lbs
Description:	Follow federal industrial boiler MACT standards, anticipated in approximately 2012. If federal standards do not require at least 70% control, then improve overall particulate matter capture and/or apply activated carbon injection on all ESP- or FF-industrial/commercial/institutional coal-fired controlled units where existing mercury emissions are greater than 2 lbs/yr and emissions control is not at least 70%. (EGU's excluded)
Timeframe:	Medium
Cost:	Total statewide capital cost (1999$): $4.7 million capital, $600,300/yr annual operating cost, total annual cost (CR +operating)=$1.0 million, cost per lb: $20,774.
Feasibility:	Technically feasible
Measurement:	Emissions testing
Implementation Issues and Barriers:	
Comments:	Assumes industrial coal-fired boilers can be controlled by an additional 70% over 2018 baseline. No control assumed for biomass. Costs were developed using EPA's methodology of determining costs for implementing mercury control standards at utility boilers. (RTI International, 2003. See CAMR docket).
1.3 Petroleum Refining	
Strategy: 1.3a	
Improve understanding of emissions sources	Reduction Potential: Unknown
Description:	Develop research plan to determine emission sources from refining process, and more consistent sampling and testing of mercury content of crude oil.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	
Strategy: 1.3b	
Require x % reduction from sector	Reduction Potential: Undetermined
Description:	Following study of emissions and crude oil testing results, require either % reduction or establish emissions cap for sector.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	

1.4 Petroleum Product Combustion	
Strategy: 1.4a	
Improve understanding of mercury containing products and emissions sources	Reduction Potential: Undetermined
Description:	
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation	

Issues and Barriers:	
Comments:	
Strategy: 1.4b	
Require x % reduction from sector	Reduction Potential
Description:	Following study of petroleum products and mercury emission sources, require either % reduction or establish emissions cap for sector.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	
1.5 Wood Combustion	
Strategy: 1.5a	
70% reduction via improved controls	Reduction Potential 32 lbs
Description:	Improve overall particulate matter capture and/or apply activated carbon injection on all units where existing mercury emissions are greater than 2 lbs/yr and emissions control is not at least 70%. (No electric generation units are included in this strategy.)
Timeframe:	Short to Medium
Cost:	Undetermined
Feasibility:	
Measurement:	Emissions testing
Implementation Issues and Barriers:	
Comments:	Assumes units can be controlled by an additional 70% over 2018 baseline.
Strategy: 1.5b	
Follow recommendations of anticipated federal industrial boiler standards.	Reduction Potential 32 lbs
Description:	Follow federal industrial boiler MACT standards, anticipated in approximately 2012. If federal standards do not require at least 70% removal, then improve overall particulate matter capture and/or apply activated carbon injection on all units where existing mercury emissions are greater than 2 lbs/yr and emissions control is not at least 70%. (EGUs excluded)
Timeframe:	Medium
Cost:	Undetermined
Feasibility:	Technically feasible
Measurement:	Emissions testing
Implementation Issues and Barriers:	
Comments:	Federal MACT standards for industrial boilers will include wood boilers. Assumes units can be controlled by an additional 70% over 2018 baseline.
1.6 Natural Gas Combustion	
Strategy: No strategies under consideration due to minimal emissions.	

Source/Sector: 2.0 Products	
2.31 Smelting	
Strategy: 2.31a	
Achieve higher recovery rates prior to metal processing.	Reduction Potential 32 lbs
Description:	Achieve higher recovery rates prior to crushing and shredding through greater education/outreach with scrap chain (dismantlers, recyclers, crushers, shredders) and certification of scrap dealers. Includes both auto and appliance scrap materials.
Timeframe:	
Cost:	
Feasibility:	

Measurement:	
Implementation Issues and Barriers:	
Comments:	Up to 35% reduction beyond 2018 estimate
Strategy: 2.31c	
Mercury emission controls at smelting facility	Reduction Potential: 70 lbs
Description:	Reduce emissions from at single electric arc smelting furnace in the state by the addition of air pollution control equipment for mercury. Consider provision for pilot testing with interim date.
Timeframe:	Medium
Cost:	$ 490,588 capital, $1,028,458 annual (including capital and operating) or $5,142/lb/yr. Source: EPA MACT Standard (2007)
Feasibility:	Not yet demonstrated, unknown effectiveness. No EAF currently equipped with mercury-specific controls
Measurement:	Fly ash, stack testing
Implementation Issues and Barriers:	
Comments:	Assumes switch removal and installation of activated carbon on PM control devices. Assumes 78% reduction
Strategy: 2.31d	
Continue study of emissions	Reduction Potential: 32 lbs
Description:	Continue to study emissions from Mn Facilities (Gerdau) in order to refine emissions estimate and better understand potential sources of mercury in scrap metal supply.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	Current emissions information suggests unaccounted for sources of mercury in scrap supply. Consider reduction target achievable via improved practices or controls based on outcome of emissions study.
Strategy: 2.31e	
Achieve higher recovery rates prior to metal processing.	Reduction Potential: 32 lbs
Description:	Achieve higher recovery rates prior to crushing and shredding by increasing reimbursement rate for switches
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	Current rate for switches at $1/unit
2.41 Dental Preparations	
Strategy: 2.41a	
Promote prevention of tooth decay and increase demand for alternatives to mercury amalgams.	Reduction Potential: 5 lbs
Description:	Use education and outreach to promote prevention of tooth decay, and increase demand for alternatives to mercury amalgams.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	Up to 25% (assumes half of emissions associated with new restorations and 50% reduction in emissions)
Strategy: 2.41b	
Support other initiatives that promote prevention of tooth decay	Reduction Potential: Undeter-mined

Description:	Support Mn Department of Health's "Access to Care" initiative, which aims to provide equal access to health care, including dental care, to all Minnesotans regardless of immigration or insurance status.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	Initiative is supported by Mn Dental Association.
Strategy: 2.41d	
Increase use of alternatives to mercury amalgams	Reduction Potential / Undetermined
Description:	Increase use of alternatives to mercury amalgams by requiring the same insurance coverage for all restorations. Require insurance plans to cover preventive care, including sealants.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	Work with Department of Commerce to investigate regulation of insurance providers in Minnesota. Encourage unions and employers to negotiate policies to cover the cost difference. Start with public employers.
Strategy: 2.41f	
Increase use of alternatives to mercury amalgams	Reduction Potential / Undetermined
Description:	Improve efficacy of alternatives to mercury amalgams
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	
Strategy: 2.41g	
Increase use of non-mercury alternatives	Reduction Potential / Undetermined
Description:	Training and continuing education on alternatives for dentists
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	
Strategy: 2.41h	
Capture air emissions from clinics	Reduction Potential / Undetermined
Description:	
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Implementation Issues and Barriers:	
Comments:	Carbon filtration on vacuum line, effectiveness unknown
Strategy: 2.41i	
Support 100% Participation in Mn Dental Association BMPs.	Reduction Potential / Undetermined
Description:	Support 100% Participation in Mn Dental Association BMPs. If 100% compliance is

	not met by 2009, pursue mandatory compliance options.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	Voluntary compliance with BMPs is required by 2009 in Memorandum of Understanding between the State and the Mn Dental Association. Includes all dentists, not just MDA members.
Strategy: 2.41j	
Develop research plan to refine emissions estimates	Reduction Potential: Undeter-mined
Description:	Develop research plan to better understand emission sources and refine emissions estimates.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	
Strategy: 2.41k	
Develop research plan to investigate emission control technologies	Reduction Potential: Undeter-mined
Description:	Develop research plan to look into potential emission controls.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	
Strategy: 2.41l	
Require % reduction from sector	Reduction Potential: Undeter-mined
Description:	Require % reduction from sector either through reduced use of mercury amalgams, or clinic emissions controls.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	Depends on effectiveness and outcomes of other strategies.
2.42 Cremation	
Strategy: 2.42a	
Crematoria Emission Control	Reduction Potential: 60 lbs
Description:	Reduce emissions from crematories through the addition of pollution control equipment
Timeframe:	Medium to long
Cost:	Assume an annual cost of $2.6 million for 45 crematoria to install and operate an add-on mercury control device
Feasibility:	Not technically feasible at this time. Effective mercury control equipment needs to be developed for very low flow stacks like these sources.
Measurement:	Emissions measurement
Implementation Issues and Barriers:	Recognition by industry of mercury emissions as an environmental problem; cost and physical challenges of stack controls.
Comments:	Assumes 75% reduction
Strategy: 2.42d	
Require % reduction by 20xx	Reduction Potential: Undeter-mined

Description:	
Timeframe:	Medium to long
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	Work with industry to develop reduction goals and milestones.
Strategy: 2.42e	
Refine emission estimates and research emission control technologies.	Reduction Potential: None
Description:	Refine emission estimates by through measurement of actual emissions. Investigate current research into control technologies.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	
Strategy: 2.42f	
Achieve 50% reduction by 2018, and 75% reduction by 2025	Reduction Potential: 60 lbs
Description:	Study emission rates and develop better understanding of future trends (1-2 yrs). Study abatement alternatives and emissions control options (2-3 years). (Abatement options include alkaline hydrolosis, pulling or decoronating teeth.) Study social issues of abatement options. Implement recommended alternatives to achieve reduction targets.
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	
2.51 Municipal Solid Waste Combustion	
Strategy: Addressed through reducing mercury in the solid waste stream	
2.52 Sewage Sludge Incineration	
Strategy: 2.52a	
Upgraded emissions control at MCES Seneca Plant	Reduction Potential: 5.6 lbs
Description:	New carbon injection or equivalent technology system at MCES Seneca Plant in 2020.
Timeframe:	Medium (2020)
Cost:	$11 mission capital cost - $1.2 million annual cost (capital and operating); $214,000/lb/yr
Feasibility:	Technology currently available
Measurement:	Stack Tests
Implementation Issues and Barriers:	Installation when incinerators and air pollution control equipment are rehabilitated or replaced in 2020.
Comments:	2005 emissions = 6.1 lbs. 5.6 lbs assumes 90% removal efficiency.
Strategy: 2.52c	
Require new facilities to control emissions	Reduction Potential: Undeter-mined
Description:	Require new facilities to install carbon injection or equivalent technology to control emissions
Timeframe:	
Cost:	
Feasibility:	
Measurement:	
Implementation Issues and Barriers:	
Comments:	

2.61 Products – Manufacture of Mercury-Containing Products in Mn			
2.7 Products – Miscellaneous Products (in the solid waste stream)			
Strategy: 2.7a			
Improved management of products/mercury in use or storage		Reduction Potential	44 lbs
Description:			
Timeframe:			
Cost:			
Feasibility:			
Measurement:			
Implementation Issues and Barriers:			
Comments:	Up to 25% reduction, overlap with other strategies, no more than 50% total		
Strategy: 2.7b			
Prohibit the sale of products currently allowed, to the extent alternatives exist		Reduction Potential	44 lbs
Description:			
Timeframe:			
Cost:			
Feasibility:			
Measurement:			
Implementation Issues and Barriers:			
Comments:	Up to 25% reduction, overlap with other strategies, no more than 50% total		
Strategy: 2.7c			
For products that are already prohibited from sale in Minnesota, phase out remaining uses to the extent possible.		Reduction Potential	44 lbs
Description:			
Timeframe:			
Cost:			
Feasibility:			
Measurement:			
Implementation Issues and Barriers:			
Comments:	Up to 25% reduction, overlap with other strategies, no more than 50% total		
Strategy: 2.7d			
Support legislation to prohibit open burning of solid waste		Reduction Potential	30 lbs
Description:	Support legislation introduced to 2008 Legislature to prohibit open burning of solid waste		
Timeframe:			
Cost:			
Feasibility:			
Measurement:			
Implementation Issues and Barriers:			
Comments:			
Strategy: 2.7e			
Encourage participation with Household Hazardous Waste programs		Reduction Potential	Undeter-mined
Description:	In order to reduce mercury inputs into municipal waste incineration facilities, encourage participation with Household Hazardous Waste programs, to maximize mercury product collection.		
Timeframe:			
Cost:			
Feasibility:			
Measurement:			
Implementation Issues and Barriers:			
Comments:			
2.8 Lamp/Product Recycling			

Strategy: 2.8a			
Air controls and improved processing practices		Reduction Potential	Undeter-mined
Description:			
Timeframe:			
Cost:			
Feasibility:			
Measurement:			
Implementation Issues and Barriers:			
Comments:	Need more information		

Strategies for Reducing Emissions from Materials Processing Sector

Source/Sector: 3.0 Materials Processing			
3.1 Taconite Processing			
Strategy: 3.1a			
By 2012, each plant evaluates potential methods and conducts at least one long-term plant demonstration project.		Reduction Potential	none
Description:			
Timeframe:			
Cost:			
Feasibility:			
Measurement:			
Implementation Issues and Barriers:			
Comments:			
Strategy: 3.1b			
Reduce emissions by 50% by 2025		Reduction Potential	420 lbs
Description:			
Timeframe:			
Cost:			
Feasibility:			
Measurement:			
Implementation Issues and Barriers:			
Comments:			
Strategy: 3.1c			
Increase energy efficiency of taconite plants		Reduction Potential	Undeter-mined
Description:			
Timeframe:			
Cost:			
Feasibility:			
Measurement:			
Implementation Issues and Barriers:			
Comments:			
Strategy: 3.1d			
Substitute biomass for coal as fuel source		Reduction Potential	Undeter-mined
Description:			
Timeframe:			
Cost:			
Feasibility:			
Measurement:			
Implementation Issues and Barriers:			
Comments:			

Minnesota Mercury TMDL Implementation Plan:

Taconite Industry Mercury Emission Reduction Strategy

February 7, 2008

Introduction

At less than half the mercury emissions of the Minnesota power industry, the Minnesota taconite industry is the second largest source of mercury emissions in the state. Because the power industry is the largest source of airborne mercury emissions in the State, it is useful to draw some comparisons between the power and taconite industries to better frame the understanding of mercury reduction efforts.

The power industry, with hundreds of facilities nationwide, commands a substantial capability for research, both internally and through organizations such as the Electric Power Research Institute, the Energy and Environmental Research Center, and the U.S. Department of Energy. Power boilers can typically accommodate a variety of emissions control strategies with the only significant operational penalty being a possible reduction in generation capacity – there are no concerns for 'quality' of electric energy produced. The power industry also has the ability to pass a significant percentage of emissions reductions costs on to the customer base.

The Minnesota taconite industry on the other hand, is comprised of only six currently operating facilities and a new combined taconite and steel plant for which permits have been issued but construction has not commenced. Few similarities exist between furnaces used among the sites. These entities must produce quality products and remain competitive in the global market place during both high and low portions of economic cycles. Research capabilities are extremely limited and have been augmented substantially only through assistance from the DNR. The Minnesota taconite industry is not aware of any mercury reduction research being conducted at iron ore processing plants elsewhere in the world. All investments by the mines in research and emissions reduction projects must be absorbed by the industry and costs cannot be passed on to the customer base. As significant power customers, the industry does in fact bear a significant portion of the cost of emissions reductions being implemented by the local power industry. While promising technologies are being developed for use in power plant mercury control, the differences between a taconite indurating furnace and a utility boiler are such that those technologies cannot be directly applied to the taconite industry, if they can be adapted at all.

In addition to the traditional taconite processing operations, a new technology iron nugget plant is under construction. However, the furnace, ancillary equipment, and process used to produce iron nuggets is significantly different from that used in the traditional taconite plants. As a result, mercury control technology developed for use in a traditional taconite plant may not be adaptable for use in an iron nugget plant.

The taconite industry is committed to striving for reductions of airborne mercury emissions. Because the understanding of mercury emissions and control in this industry remains relatively new, the industry can only commit to reductions insofar as the technologies being

researched can be demonstrated to be technically and economically feasible and practical applications.

Policy Issues
Mercury is a global pollutant, and the Minnesota Mercury TMDL notes that 90% of the mercury entering the state's waters through air deposition, originates from sources outside the state and a significant portion originates from sources outside the U.S. It is recommended that a federal trade policy be developed that deals with this fact. One option is to require tariffs on imported products that are produced without mercury emission controls. The tariffs could cover the incremental cost of mercury emissions reduction and would be charged to companies that export products to the U.S. that do not have a certain level of mercury emissions removing technology. This would place foreign and domestic companies on an even economic basis from a mercury emissions control perspective.

If domestic taconite producers cannot compete economically in the international market place they will be forced out of business. The business opportunities will then shift to third world producers that will likely not incorporate mercury emission controls for many years. Increase mercury emissions elsewhere in the world will only exacerbate air deposition of mercury in Minnesota.

Technical Resources
Efforts must be made to maximize the limited resources the industry has available to conduct mercury reduction research. One means to do this would be to adopt and formalize the cooperative mercury research approach begun by the DNR. Formalizing this effort as a mercury research program with dedicated funding would (1) decrease the amount of administrative work associated with collecting funding from multiple sources, (2) provide a nationally recognizable funding resource for mercury research to attract the best research scientists and engineers possible, and (3) foster the sharing of research results among otherwise competitive mining companies and research groups.

Energy Efficiency
The primary source of mercury emitted from taconite plants is the naturally occurring mercury present in the ore being processed. Even though a small percentage of the mercury comes from burning coal at some taconite plants, work must be done to make the plants more energy efficient. This will reduce actual mercury emissions as well as reduce the amount of electricity needed to process taconite. This in turn will reduce mercury emissions from power plants.

Biomass Utilization
Taconite plants that burn coal will explore the use of biomass as a substitute for all or a portion of the coal that is used as a means to reduce mercury emissions.

Mercury Emissions Reduction Target
All of the currently operating taconite facilities utilize wet scrubbers of various types for control of particulate emissions. Mercury reduction research conducted by the DNR has investigated methods that will also utilize these scrubbers for mercury removal. The most probable method to accomplish this will be to inject a material into the process that will oxidize vapor phase elemental mercury. Once oxidized, the mercury can be removed by the scrubbers. Research to date indicates chloride and bromide salts are among the most promising mercury oxidizing agents for use in the furnaces. However, their effectiveness has

varied significantly among the different taconite furnaces. An oxidant developed by EPA also shows promise but problems have been encountered with its use during limited tests and more work will be required to determine its potential for use in taconite furnaces.

Long-term tests must be conducted to verify the extent of mercury removal and to investigate any impacts that this process change may have on pellet quality. Existing pellet quality must be maintained to meet customer specifications for the steel making process. Another potential issue is the corrosive nature of these salts. Taconite furnaces and associated fans, air emission duct work, and the wet scrubbers are constructed of mild steel, and the replacement cost of this equipment is in the realm of $150 million. It must be verified through testing that the mercury oxidizing salts do not cause unacceptable levels of corrosion to the furnaces and associated components. If corrosion is excessive, the oxidizing agents cannot be used. A final matter to be addressed during the tests will be the possible generation and fate of any by-products that may result from a process change and any associated environmental impacts. An example might be the build up of chlorides in process water that would cause excessive corrosion to plant plumbing systems and the technical and economic feasibility of removing the chlorides.

A 50% reduction of mercury air emissions by 2025 from all plants collectively is the taconite industry target. The MPCA's most recent Minnesota Mercury Emission Inventory estimates taconite industry mercury emissions to be 841 lbs/year in 2010 and beyond, which includes projected future ore processing operations. Assuming the 50% target mercury removal rate can be achieved, it would equate to a reduction in mercury emissions of approximately 420 lbs/year. All mercury emission reductions achieved by any means are applicable to the reduction target. This may include, but may not be limited to, mercury emission reductions associated with reduction of other emissions.

Factors that will affect achievement of the reduction target include the ability of the injected material to oxidize the vapor phased elemental mercury, the ability of the scrubbers to remove this oxidized mercury, and the ability of tailings basin water treatment systems to permanently remove the absorbed mercury from the process water stream. In addition, the wet scrubbers must be able to continue meeting particulate removal requirements such as Taconite MACT emission limits.

The target date allows completion of the DNR's current short-term research tests through 2009. The results of this effort will provide guidance for longer-term tests over a period of several years starting in 2010 that will have to be conducted by each mine due to the differences among furnaces and products produced by each of the mines. Assuming technical and economic viability are demonstrated, each mine must proceed with engineering of the oxidizing agent injection system followed by procurement, installation, and commissioning of the system. Final tie-in of the equipment to the furnaces can only occur when furnaces are shut down for maintenance. The frequency of maintenance shut-downs varies among the plants and in some cases occurs only once per year. For plants that operate more than one furnace, the prudent approach will be to install a system on one furnace and determine its effectiveness before installing it on additional furnaces.

Following is a conceptual schedule for achieving the mercury reduction target, which is based on yet to be determined research results, details of the control technology, and equipment specifications:

2010

Each currently operating pellet plant would conduct one or more longer-term tests (20-30 days duration) of injection of chloride or bromide salts or the EPA oxidant or test other technology that may show promise to gain a better understanding of the effectiveness and possible impacts of these alternatives. The results will form the basis for much longer-term tests.

2011 – 2012

Each pellet plant would proceed with tests of 3-6 months duration (possibly longer) to fully understand the effectiveness and operating aspects associated with use of preferred oxidants. Test and equipment modifications are anticipated during the testing period, and test results would be fully analyzed. Further testing may be required in an attempt to overcome identified problems, which would result in modification of the schedule. Installation of the test equipment assumes contractors and skilled tradesmen are available in light of other major construction projects that may be in progress in the region at the same time. However, assuming the tests demonstrate the technology is technically and economically feasible, does not cause excessive corrosion to the furnaces, and does not impact pellet quality, the following steps will proceed.

2013

Scoping, pre-feasibility, and detailed engineering would be conducted to provide information to proceed with project budgeting. The installed cost of any control equipment will likely be several millions of dollars.

2014

Equipment and materials procurement would occur and installation of mercury control equipment would proceed on the first furnace. Commissioning of the equipment would follow. Installation of the equipment assumes contractors and skilled tradesmen are available in light of other major construction projects that may be in progress in the region at the same time.

2015 - 2016

Full-time operation of the mercury control equipment would proceed. It is likely that problems will be encountered and equipment or process modifications will be necessary to overcome the problems.

2017

Based on experience gathered, scoping, pre-feasibility, and detailed engineering would be conducted to provide information to proceed with project budgeting for installation of control equipment on the second furnace at facilities with multiple furnaces.

2018

Equipment procurement would occur and installation of mercury control equipment would proceed on the second furnace. Commissioning of the equipment would follow.

2019 – 2025

Engineering, budgeting, procurement, and equipment installation would proceed on successive furnaces at the rate of one furnace every two years. This would pertain in particular to the largest plant, which has five furnaces.

The objective of this conceptual schedule is to have mercury control equipment installed and operating efficiently on existing pellet furnaces to achieve the target emission reduction by 2025. New facilities may pursue a similar approach or possibly research of other potential technologies. Permitting for installation of the control equipment will be necessary and will be factored into the schedule in a manner to be determined in conjunction with the MPCA. Multiple permit modifications may be necessary at a given pellet plant where substantial differences exist among furnaces. It is also possible that other technologies may begin to show promise for use at taconite plants, and these may be pursued by either existing or new operations as alternatives to injection of the currently identified mercury oxidants.

Taconite facilities with mercury emissions of less than 20 lbs/year should not be required to make further emission reductions. In general, mercury removal costs rise exponentially at diminishing emission removal rates as emission rates get smaller and smaller. This will be particularly applicable at a taconite plant with low mercury emissions because of the large size of the furnaces and the corresponding large volume, low mercury concentration gas streams in the furnaces. The capital and operating costs of any mercury removal equipment will be excessive for the small amount of mercury emission reductions that might occur.

Economic Considerations

The results of the longer-term mercury emission reduction tests will be used to calculate the economic impact of the mercury removal technology. The cost will be calculated both on a dollar per pound of mercury removed basis and a dollar per ton of taconite pellets produced basis. The dollars per pound of mercury removed will be compared to values generated by the electric utilities. However, because utilities can pass the costs on to customers and taconite plants cannot, technology considered economically feasible for utilities may not be economically feasible for the taconite industry. The dollars per ton of pellets produced will be used to determine how the removal technology may affect the long-term viability of the taconite plants.

Summary

The taconite industry proposes a 50% reduction of mercury air emissions by 2025 from all plants collectively as a target. Assuming the 50% target mercury removal rate can be achieved, it would equate to a reduction in mercury emissions of approximately 420 lbs/year based on the current MN Mercury Emission Inventory estimate of 841 lbs/year in 2010 and beyond. All mercury emission reductions achieved by any means are applicable to the reduction target. Achieving this target reduction is contingent upon development of mercury removal technology that is technically and economically feasible, does not cause excessive corrosion to taconite processing equipment, and does not impair pellet quality.

To: Strategy Work Group Members

These comments relate to the draft air strategies (dated 2/20/08) for the taconite sector under section 3.1 that were presented at the last Partners group meeting on February 21.

As I mentioned at the taconite breakout session, the approach to have the taconite industry evaluate potential emission control measures (including on-site, long-term trials) parallels the approach taken for this industry in Minnesota's draft regional haze plan (see http://www.pca.state.mn.us/air/regionalhaze.html). As such, it is appropriate that the timelines in the regional haze rule and the mercury TMDL are in line since whatever piece of equipment is used to control NOx and SO_2 for visibility will likely also be used to control mercury, or at a minimum, affect whatever approach is used to control mercury. Therefore, the decisions the taconite companies must make on control equipment for their indurating furnaces must consider NOx, SO_2, and mercury together, rather than separately.

The due date to have the mercury control studies completed in the draft air strategy for the taconite plants is 2012. This date almost matches the corresponding due date for control studies in the regional haze plan, except that in the regional haze plan the MPCA needs to make a determination of appropriate emission controls by 2012. This implies that a report from the taconite facilities on their control trials should actually be due to MPCA sometime before 2012 to allow the agency sufficient time to review it and then make their determination of appropriate controls. The due date for the emission control study report is 2011 in the regional haze plan. This would also be an appropriate due date for the emission control study report for the mercury plan.

Another important date in both plans is the date by which new emission controls must be installed and their operation commenced. In light of the tie between the two plans, I am concerned that it is implied that the installation of controls under the mercury TMDL air strategy would not happen until 2025 (strategy 3.1b). In the regional haze rule this date has not been determined but it is expected that it would be before 2018. If a decision is made on appropriate mercury controls at the taconite plants by 2012, it should not reasonably take 13 years (i.e. until 2025) to install them. In new source permitting a source has only 18 months from permit issuance to begin construction or their permit expires. Therefore, I recommend that the strategy 3.1b timeline be changed to no later than 2018.

One last comment I'd like to make is that I don't subscribe to the assumption stated many times at the Partner Group meeting that the taconite industry knows very little about mercury emissions from their furnaces. They have been working on this issue as a group longer than the NOx emission issues which are important for regional haze (see the taconite mercury reports by Berndt et. al. going back to 2003), yet the timeline to evaluate and then install controls for NOx under the draft regional haze plan is much sooner than that proposed under the draft mercury air strategy timeline.

Trent Wickman
Partners Group Member
Superior National Forest

March 24, 2008
Dear Strategy Work Group Members,

Southern Minnesota Municipal Power Agency (SMMPA) is a municipal joint action agency responsible for providing wholesale electrical generation and transmission for eighteen municipalities located throughout the State. SMMPA has a 41% ownership interests in the Sherco 3 generating unit. SMMPA has informed the TMDL EGU strategy group that it does not support the implementation strategy proposed by this group. SMMPA also notified MEI that we did not support the EGU group's proposal, at which time MEI asked that we inform the full TMDL Strategy Group of our position. Listed below are the reasons SMMPA can not support the proposed EGU Implementation Strategy.

1. The Implementation Strategy as proposed by the EGU group requires SMMPA's 41% share of Sherco 3 to achieve 90% reduction in mercury from current baseline emission levels. Sherco 3 currently removes approximately 40-50% of the mercury input to the boiler. The engineering firm of Black & Veatch was hired to evaluate the plant and they have determined that increasing mercury removal an additional 90% above this current level is not technically feasible. Black and Veatch also stated that there is no equipment manufacturer capable of designing or building a system that will guarantee such a removal rate.

2. The Implementation Strategy proposed by the EGU group does not consider the adverse affect that such plan would have on the reliability of power supply to the consumer. Sherco 3 currently provides over 90% of the energy requirements for SMMPA's 18 cities and mercury removal systems are currently an experimental technology. If Sherco 3 is forced to shut down due to mercury equipment failure or damage to other critical systems caused by the mercury equipment, the economic impact to our communities could be devastating. A shut down of Sherco 3 can cost these local municipals $1,000,000 per day. A prolonged shutdown caused by an experimental mercury removal system would cause a severe financial hardship to these communities and their residents. The EGU proposed plan does not address the impact of plant reliability on these communities. (Please note: such a shutdown does not financially harm Xcel or MPLT shareholders since the MPUC allows them full recovery of replacement energy costs.)

3. The Implementation Strategy proposed by the EGU group singles out SMMPA by requiring a relatively short timeframe for compliance. No other source or sector under the TMDL, (with the exception of those covered under the 2006 MMERA), are being asked to comply with this accelerated timeframe. The 2006 MMERA legislation was a negotiation package between the State on MN, Xcel Energy, and Minnesota Power whereby the two utilities agreed to an accelerated timeline for mercury removal in exchange for multi-million dollar incentives, including, but not limited to, an extension of the Emissions-Reduction Ryder and performance based incentives for their shareholders. Both the MPCA and Xcel have acknowledged that this legislation does not apply to SMMPA owned generation nor does SMMPA receive any financial incentives for an accelerated implementation schedule. In spite of this fact, the proposed EGU plan places the same accelerated timeframe for compliance on SMMPA. No other source within the entire TMDL process is subject to this same accelerated timeframe. It is unfair and possibly even illegal for the TMDL group to attempt to single out SMMPA in this manner.

4. The proposed EGU Implementation Strategy suggests that SMMPA should comply

regardless of cost. In essence, it is asking SMMPA to "sign a blank check". Even the 2006 MMERA allows the MPUC to review Xcel's & MPLT's Plans for cost prudency and to reject the plans if the costs were too high. It also gives Xcel and MPLT full cost recovery PLUS a guaranteed rate of return for their investors. **Unlike other industry sectors which must absorb the cost of mercury removal, the mercury reduction projects proposed by Xcel and MPLT are actually a profit generating business venture for these companies.** To our knowledge, no other company or source within the TMDL process have been asked to "sign a blank check". It is unrealistic to expect SMMPA to do so.

5. One of the primary goals of the TMDL process was to take into consideration the "socially acceptable" aspects of any proposal. The EGU proposal does not consider the financial and social impact to the communities who will be burdened with this cost. Any proposed plan must take into consideration the electric rate impact to the customers and communities. For example, the cost to an Xcel customer may be less then $12/year whereas the cost impact to a SMMPA customer may be over $200/year. A $12/year increase to a family living in the metro area that earns over $100,000 per year has significantly less impact then a $200/year increase to a family who lives in rural MN earning less then $20,000/year. The current proposal makes no attempt to identify what is or is not an acceptable level of cost burden to the customer.

6. To my knowledge, no analysis has yet been performed to identify the most cost affective removal options among the various sources and/or sectors in an effort to optimize the overall efficiency of the TMDL process. Without this analysis, the TMDL process may be spending millions of dollars but only achieving a fraction of the mercury removal that you could achieve if the same million dollars were spent at another location.

In closing; when Sherco 3 was built, SMMPA and its 18 member cities made significant financial investment to make sure the unit had the most modern and efficient environmental control equipment available. To our knowledge, Sherco 3 is still the cleanest coal fired boiler in the entire State. For the past 20 years, Sherco 3's scrubber/baghouse system has already been removing up to 50% of the mercury that goes into the boiler. It is not only technically impossible to remove an additional 90%, it is also unreasonable for the TMDL group to expect SMMPA to do so when no other sources or sectors have yet to achieve even a 50% removal rate. Before SMMPA offers to make any additional investments to increase mercury removal, we first want to see a commitment from the other industry sectors to at least match our current performance level.

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Minnesota Mercury TMDL Implementation Plan:

Flint Hills Resources Mercury Emissions Identification Strategy Summary

April 3, 2008

Flint Hills Resources is committed to helping Minnesota achieve mercury reduction goals and has been working since 2000 to better understand and reduce the risk of mercury contamination to the environment from our refinery. Flint Hills completed, and submitted to the MPCA as part of the Voluntary Mercury Reduction Project, a mercury mass balance in 2000 with updates in 2004 that thoroughly sampled and analyzed inlet and outlet streams in the refinery. This balance identified the distribution of mercury in crude oil feed to the various refinery output streams such as fuel products, facility air emissions, wastes and water effluent. During that timeframe, mercury in devices and equipment used at the refinery was identified and removed from service. Unfortunately due to the complexity of the refinery operations, the chemical properties of mercury in crude oil, and inadequacy of mercury analysis methods at the time of the mass balance, FHR was unable to allocate all of the mercury coming in with the crude oil to products or wastes that leave the facility.

Flint Hills recognizes the value of updating our facility mass balance, trying to close the gap in the mass balance, and improving the integrity of the mercury inventory for the refining sector. We are thereby proposing a strategy that incorporates both a data gathering and analysis phase and an adaptive management phase to help Minnesota reach the TMDL goals.

Phase I – Data Gathering and Analysis
Flint Hills will update and submit the mercury mass balance for the Pine Bend refinery to the MPCA by July 1, 2009. The updated mass balance will be developed using currently accepted sampling and analytical methods and the scope will be consistent with the work done in 2000 and 2004. FHR will include a discussion in the report of FHR product distribution trends within the state toward the goal of revising initial MPCA inventory assumptions that all unaccounted for mercury is in fuel products and is released in the state to the air.

Flint Hills commits to reviewing the refinery process every 2 years after the 2009 update for possible changes that would have the effect of significantly altering the mass balance. FHR will submit each review to the MPCA. If in the future, FHR determines that the level of mercury emissions from the refinery is somewhat stable, we will at that time propose a review timeline to the MPCA that better fits the variability of the data (ex. once every 5 years).

Phase II – Adaptive Reduction Strategy
Industry proven technology does not currently exist for removing mercury from crude oil or liquid fuels and technology to remove air emissions from the refinery point sources is likely economically infeasible. Therefore, achieving a mercury reduction goal will rely on the use of an adaptive strategy.

If FHR identifies a cost effective and industry proven option for reducing mercury from the facility's air emissions through discoveries made during the mass balance reassessment, FHR would implement that option to achieve a goal of 50% facility air emission reduction by 2018. The refinery's air emissions are currently estimated at roughly 10 lbs/yr and a 50%

reduction would result in 5 lbs/yr by 2018. These estimates are subject to change upon completion of the mass balance update.

Phase III – Collaborative Strategy

Given our concern that industry proven technology will not be available for mercury reduction in petroleum streams, Flint Hills proposes to the MPCA and Stakeholders the possibility of partnership and / or financial collaboration with a more feasible mercury reducing sector to remove the estimated 5 lbs/yr of mercury discussed above. Potential areas for partnership might include funding assistance for education programs in the mercury products sector, control technology research grants or funding assistance for mercury sampling and analysis in areas where better inventory data is needed. It could also include full or partial funding of a mercury reduction effort undertaken by another company or the MPCA.

GERDAU AMERISTEEL ST. PAUL

ACTION PLAN

Mercury Reduction
Improvement
Date: 04/09/2008
Sheet: 1/1

Proposed Air Strategy - Minnesota Environmental Initiative

	Goal
Objective	**Site specific plan for Mercury switches in accordance with Area Source Rule (EPA 40 CFR subpart YYYYY)**
Value	**1) Comply with 40 CFR subpart YYYYY 2) Reduce mercury emissions from Gerdau Ameristeel St. Paul Mill to average 2 x 10E-5 lbsHg/ton steel produced (10 lbsHg based on 500,000 tons steel per year produced) - by year 2025 - if the 80% reduction of mercury switch goal is achieved**
Deadline	2025
Responsible	Environmental Manager
Last Update	8-Apr-08

WHAT	HOW (Planned Actions)	WHO	by WHEN	WHY	STATUS
Replace Minnesota Environmental Initiative Mercury TMDL Strategy Work Group proposed strategies 2.31a, 2.31c, 2.31d, 2.31e, and 2.31f with new proposed strategy	Meet with Minnesota Environmental Initiative Mercury TMDL Strategy Work Group and discuss proposed strategy	Doug Stolowski and Sean Mullan	4/9/08	Propose Gerdau Ameristeel's strategy of compliance with EPA established Area Source Rule regulations	
Establish measurement guidelines	All mercury reporting will be done in **lbsHg/ton** of steel produced	Gerdau Ameristeel	4/9/08	Tie Mercury reduction to Gerdau Ameristeel St. Paul Mill production rates	
Achieve 80% reduction in Mercury Switch removal from automobiles shredded at Gerdau Ameristeel St. Paul Mil	Update Local Scrap (raw material) specifications to include language requiring mercury switch removal	Gerdau Ameristeel	12/31/08	Remove source of Mercury from raw material feed	In progress
	Meet with suppliers to encourage participation in ELVS program	Gerdau Ameristeel	begin 4/23/08	Educate suppliers	Planned
	Audit suppliers yards	Scrap Buyer	ongoing	Ensure compliance with specifications (part of ISO9002:2000)	
	Audit supplier participation in ELVS	Environmental Manager	ongoing	Ensure participation in ELVS to achieve 80% switch removal rates	
	Continue to offer bounty program for Mercury Switch collection	Gerdau Ameristeel	ongoing since 1996	Provide collection point for any supplier not yet in ELVS program	
	Inspect shredder feed on a regular random interval	Gerdau Ameristeel Scrap Inspectors	ongoing	Ensure compliance with specifications (part of ISO9002:2000)	
Update Hg Mass Balance Equation	Update Hg Mass Balance Equation (lbs Hg/ton steel produced)	Environmental Manager	by 12/31/08	Establish trend start point	
			Every 5 Years until 2025	Monitor progress toward reduction goal	

April 8, 2008

TMDL STRATEGY GROUP

- Policy should not include permits in Minnesota that enable adjacent states to increase their mercury deposition in Minnesota (eg: powerlines for coal plants, in order for new powerlines to be built across Minnesota to new coal capacity in adjacent states, negotiated settlements on community based renewable energy and other leveraged emission requirements should be part of the certificate of need proceedings).
- Retorting/recycling should not just be mercury that is reemitted elsewhere, particularly in countries or states with less stringent control laws. Local law should be enacted to prohibit such activity. A "bounty" paid by the state to recyclers could keep it from being sold for reemission.
- Coal ash dumps should not be abandoned after an initial 20-50 year monitoring program and require perpetual liability and care by the Utility that profits from the generation of the waste. The State has ultimate responsibility to safe guard the public health and needs to have the option of taking title to the waste if it is abandoned. It would need to be part of a permanent register of sites of concern.
- Coal ash volatilization, peat mining must be included in the inventory.
- Land application of mercury contaminated sludges/ash/fertilizers and erosion needs to be further investigated.
- Agricultural run of is not accounted for in the inventory.
- Program needs to consider the mercury transformation processes (Pavlish slide).
- Homeowners still need a list of items that have mercury switches, and better education on mercury containing products on a repeating routine basis. Recycling as a whole needs to be made mandatory and can be incented through tax credits and or subtractions on state taxes.
- Cremation Industry can use incentives to families in pre-death negotiations.
- Veterinary medicines may be preserved with mercury. There is no id of ingredients. This is a law making need.
- Baby teeth disposal with dental amalgams education for parents.
- Alternative product recommendations should not be more or equally harmful (bisphenol A resin composite fillings vs mercury amalgams).
  Dental composites do not have to contain bisphenol A. Products should be required to demonstrate no harmful health impacts.
- Inventory must be based on real time mercury emissions. Clean up actions based on low-confidence emission numbers is a real problematic policy, and could be costly to enforce. Better to spend the money up front for good science.

NAWO comments

April 21, 2008
Kabby,

As per our phone conversation, I have put together a quick list of possible solutions to the issues which I sent to you on March 24th. I know you're on a short timeframe so I scribbled this out quickly. It may not be a comprehensive list. Most of these suggestions come straight out of the 2006 MMERA. It only seems logical that something that is acceptable by all parties under the MMERA should also be acceptable under the TMDL.

Issue #1, can be solved quite easily by following the same guidelines as used in the 2006 MMERA. The MMERA realized that 90% may not be achievable so they asked for plans that would "most likely to achieve 90% removal". I proposed this solution earlier but I did not see it in the latest draft plan. Since there is a high probability that it would be technically impossible to achieve 90%, the draft TMDL should be worded to require the power plant to submit a plan to the MPCA which would achieve as close to 90% as possible and then to allow the MPCA to determine the most technically feasible removal rate.

Item #2 is an extremely important issue to SMMPA. A derate our outage of any kind will have significant financial impacts to our communities. However, this issue can be resolve by adding two conditions to the TMDL draft. First, the TMDL should clearly state that any permitted removal rate placed on a power plant as a result of this process should be based on a compliance cycle of no shorter then a calendar year average (or a 12 month rolling average). The Hg content of coal varies significantly, from 0.03 to 0.16 ppm. If a plant receives coal with a high Hg content for 2 or 3 weeks straight, it may be difficult to comply and they may be forced to reduce production needlessly. By giving a longer averaging period, the Hg content may be high some weeks and low other weeks but the annual average should be close to 0.09 ppm which would increase the ability to comply. Second, the TMDL should clearly state the derates and outages are extremely expensive and that any permit criteria placed on a plant must not require any plant to reduce production if for any reason if it is not able to comply with removal criteria. If the Hg removal equipment or monitoring equipment is malfunctioning or become inoperable, the power plant will not be required to reduce load or shut down. The plant should be allowed to remain on line at full load as long as they employ best efforts to maximize Hg removal for the rest of the averaging period when the Hg removal or monitoring equipment return to service.

Regarding Issue #3, the 2006 MMERA as currently written, applies only to Xcel, not to SMMPA. In addition, the contracts between Xcel and SMMPA for operation of Sherco 3 does not allow Xcel to implement their proposed Hg Plan without approval of SMMPA's Board of Directors. However, SMMPA may be willing to allow Xcel to install Hg removal equipment on Sherco 3 and allow Xcel to remove up to 90% Hg for their share of the unit on the accelerated timeline as laid out in the Xcel plan. SMMPA would then submit their own plan for Hg removal for the SMMPA share of Sherco 3 under the TMDL process. The timing for the SMMPA Plan and its implementation schedule would be set as described in Issue #6 below. The SMMPA plan would incorporate many of the ideas described in this document in order to provide viable solutions to SMMPA's concerns

Issues #4 and #5 address the same general problem about determining an acceptable cost criteria. The current TMDL draft implies a goal of 90% remove regardless of cost. SMMPA would suggest resolving this issue by implementing the same cost criteria is defined in the 2006 MMERA. The MMERA requires the utility to include in its Hg Plan an estimate of

the cost of implementing and an assessment of the financial impact that this Plan would have on its customers. The MMERA then gives the MPUC the responsibility to determine the economic acceptability of the plan. SMMPA would propose the same strategy where the SMMPA Hg Plan would be submitted to the various Public Utility Commissions responsible for regulating each of the SMMPA municipal utilities. These PUC's would then determine the economic acceptability.

Item #6 could be resolve by waiting to set an implementation schedule and removal rate for the SMMPA plan until after the TMDL evaluation process is completed and the necessary data has been collected to determine the most cost effective methods of Hg reduction among all emission sources. An economically justifiable removal rate and implementation schedule could then be set for SMMPA and all other emission sources. This analysis is fundamental in order to develop removal plans based on sound economic principles.

Kabby, again I threw this together very quickly in order to get something to you ASAP so I did not spend any time proofing the document nor did I get approval from SMMPA Directors for these proposals but I think the document captures the general concepts for each of the issues.

Peter J. Reinarts, P.E.
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May 19, 2008

Kabby Jones **Via E-Mail and US Mail**
Jack Hogin
Minnesota Environmental Initiative
211 First Street North
Suite 250
Minneapolis, MN 55401

Re: Mercury TMDL Strategy for Recycling Mercury Products in Minnesota

Dear Ms. Jones and Mr. Hogin:

Mercury Technologies of Minnesota, Inc. (MTM) has reviewed the proposed Mercury TMDL Strategy for Recycling Mercury from Products in Minnesota, and we would like our following comments considered in the final decision making process and we ask that you forward this letter to the Strategy Work Group.

MTM has operated its recycling facility in Pine City since 1993, recycling fluorescent lamps and relatively small amounts of high intensity discharge ("HID") and neon lamps from Minnesota and other states. Most of these lamps are mercury-bearing, but their mercury content varies significantly.

All materials accepted at our facility are recycled. Nothing from our process is landfilled, and none of our residuals are hazardous. We conduct indoor air monitoring for employee health and safety, and results demonstrate that levels of mercury are well below the permissible exposure level for mercury established by OSHA.

We operate pursuant to a Compliance Agreement with the Minnesota Pollution Control Agency (MPCA) that establishes strict testing and monitoring requirements, as well as recycling performance standards. We have had a good working relationship with the MPCA, our customers and our recycling markets, and we intend to continue our service, which we believe is needed and valuable, for the foreseeable future.

We are concerned about several issues that are raised in the draft Strategy for Recycling Mercury Products:

1. The overall goal of a 90 percent reduction in air emissions by 2018 is based on initial data for which there is not a high degree of confidence, and is instead a rough estimate. Therefore, the goal of reducing sector emissions to 8 pounds per year cannot be viewed as a strict, verifiable requirement.

2. An exact mass balance cannot be conducted at mercury lamp recycling facilities because the mercury content of the incoming spent lamps varies significantly. An estimate based upon averages per lamp has and can continue to be used, but this means that the specific output data will not exactly match the estimated input data. Therefore, lamp recycling facilities cannot be expected to account for missing mercury that may have never arrived at their facilities because the incoming mercury amount could not be exactly determined.

3. The need for mercury lamp recycling facilities to conduct expensive mass balance studies every 5 years is questionable. In fact, because of the existing testing and quarterly reporting requirements in our Compliance Agreement, MPCA already has much of this data.

4. Submission of information to the MPCA has and will continue to include trade secret data, as defined in the Minnesota Data Practices Act. When we submit confidential trade secret data, the State must treat it as such under the Minnesota Data Practices Act.

5. The strategy should focus not only on recycling facilities but on all entities that handle, transport and process mercury-containing products.

6. Preventing the sale of mercury recovered from products to parties that have a high likelihood of resulting in an environmental release is a very difficult standard to develop and enforce. It is very subjective and presumes that a party with a high likelihood of environmental release can be readily identified. There are also potential interstate commerce issues that could prevent a prohibition on recycled mercury products leaving the State.

7. The State of Minnesota should assess how it manages its own spent mercury-bearing lamps. It is our understanding that many of the spent lamps generated by state agencies and local governments in Minnesota are managed at facilities in Wisconsin. These facilities are not subject to all the stringent performance standards and testing requirements that the MPCA has established for recycling facilities in Minnesota. In other words, before implementing a mercury TMDL strategy, the State should practice what it preaches.

MTM does not believe it is a contributor to mercury emissions in Minnesota. Rather, we help minimize mercury emissions through our lamp recycling service.

Thank you for your consideration of these comments. If you have any questions, please contact me at 320.629.7888 or merctech@ecenet.com.

Sincerely,

Kelly Gribauval-Hite
Chief Executive Officer

Cc: Kevin D Johnson, Esq
Stoel Rives, LLP

Memorandum Regarding New and Expanding Sources of Mercury Air Emissions
to Strategy Work Group
from Kris Sigford, Minnesota Center for Environmental Advocacy
Nancy Schuldt, Fond du Lac Reservation
Nancy Lange, Izaak Walton League of America
Len Anderson, St. Louis River TMDL
May 19, 2008

The above environmental and tribal representatives on the Mercury TMDL Strategy Work Group (SWG) have number of concerns with the draft strategy regarding new and expanding air sources of mercury. These concerns and some potential solutions are presented here in the interest of insuring they are addressed in our discussion May 22nd.

The SWG is faced with several unanswered questions bearing directly on this strategy and how it will be applied by the MPCA going forward.

We believe that these issues must be worked out in some detail through agency rulemaking. Absent promulgation of rules that clearly spell out how the MPCA intends to apply this strategy, the agency will necessarily be faced with case-by-case negotiations and permit procedures, leaving it open to charges of arbitrary decision making.

Several of these are discussed below both in bulleted format below, and others in the form of questions inserted into the draft strategy itself at the end of this document.

- ***Mercury impaired waters with no TMDL***—the SWG has briefly discussed but never resolved the issue of how a strategy allowing new mercury emissions comports with the lack of a mercury TMDL for the state's most impacted waters. Clean Water Act regulations require TMDL preparation within 13 years of impairment listing on the 303(d) list and scores of impaired waterbodies not covered by the TMDL were listed in 1998. In other words, Minnesota needs to have a more stringent TMDL in place within the same time frame that a new source could be proposed, reviewed, permitted and built.

- ***There is no reserve capacity for air emission (nonpoint) sources under the TMDL***— the TMDL itself clearly states this: "Reserve capacity refers to load that is available for future growth when actual loads are less than the load allocation. There is no reserve capacity for nonpoint sources, because actual nonpoint source loads are far in excess of the Load Allocation."[7] USEPA's approval letter also clearly states this: "Although Section 6.5 of the TMDL Report contains a discussion of reserve capacity, the TMDLs do not contain a specific allocation that is reserved for future growth. …Any future growth of point or nonpoint sources will need to be consistent with the applicable regional load and wasteload allocations of these TMDLs and the assumptions that were used in development of these TMDLs."[8] Despite these clear and blunt statements, the SWG, even at this late date, is

[7] ***Minnesota's Total Maximum Daily Load Study of Mercury***, Minnesota Pollution Control Agency, draft May 24, 2005, page 39.
[8] ***TMDL Decision Document for Revisions to Minnesota Statewide Mercury TMDL***, USEPA, March 27, 2007.

grappling with questions such as "Is reserve capacity defined based on achieved reductions or on planned reductions associated with strategies?"

- ***Key trading/offset principles are missing or vague***—the MPCA has long adhered to three bedrock principles of trading or "offsetting" between sources:

    - ***additionality***—new pollution may only be offset by measures undertaken elsewhere that would not otherwise have taken place (due to regulatory or other requirements of the entity undertaking them). In the mercury emissions context, it is unclear when a given measure may be counted as an offset for new emissions or when it is a measure that the reducing party needs to take on its own behalf (in-state partner). Regarding out-state reductions, it is entirely unclear whether this principle will be followed at all. Consider the recent happenstance where MCEA learned of a proposed new steel mill in Ohio that would emit 1,800 pounds of mercury per year. How would MPCA have responded if a proposed new MN mercury source had contacted the Ohio mill proponents and arranged an "offset" of 200 pounds? Further straining the additionality principle is that fact that massive out-of-state reductions are needed to meet the load allocation, whereas the draft strategy allows crediting of out-of-state emission reductions to "offset" new in-state loads. It is entirely unclear how the agency would handle this issue in negotiating plans for new and expanding in-state mercury sources.

    - ***equivalence***—the offset needs to provide (on a scientific basis) equivalent protection for the resource most affected by the new or expanding source. The current draft strategy states only that out-of-state offsets need to be "at a ratio greater than 1:1, based on the location of the source." Previous versions contemplated an offset ratio of 1 to 1.5 (any other US state) to 1 to 3 (other continents). At this point, it is unclear what offset ratio would be used, apparently leaving this up to case-by-case negotiations between the MPCA and project proposer. It is even less clear what the scientific basis for the chosen trade ratio would be. In water quality trading, the agency has applied a high trade ratio (2.6 to 1 nonpoint source offset to new point source loading) due to uncertainty of nonpoint performance alone, despite enforceable conditions written into an MPCA-issued permit governing both trading partners. Further, these trades also incorporated geographic equivalency in recognition of differing impacts of a unit of pollution removed in one place and placed in the hydrologic system elsewhere.

    - ***accountability***—this principle means that trading conditions will be contained in MPCA-issued permits, publicly understandable, and there will be an account "ledger" whereby it is possible for anyone to understand the terms of and adherence to any trade agreements or conditions.

The current draft strategy for new and expanding Minnesota air sources of mercury is reproduced below, with comments and additional questions in **bold.**

New and Expanding Sources of Air Emissions
After May 1, 2008, new and expanding air emission sources will be allowed provided the following measures are employed to ensure that the new sources do not result in an eventual exceedance of the TMDL goals.

Assumptions:
• The strategy framework is implemented to reduce existing emission sources to below the 789 lb/year goal by 2025.
• New emission sources permitted as of May 1, 2008, but not yet operational are counted as existing emission sources.
• Existing emission sources and sectors will be assigned a final cap used to achieve the 789 lb goal. **Will in-state offsets only be created when an individual source or sector emits less than this cap?**

Description:
Proposed new or expanded sources:
1. Required to achieve best control. **What actually constitutes "best control" is unclear and needs to be spelled out for different regulated and unregulated industries.**

2. Must complete environmental review as applicable, including demonstration of no significant local or cumulative impacts. **It is unclear which new or expanding sources need to undertake environmental review and how those that do not will be handled. For those projects undergoing review (and all new or expanded mercury sources should) specificity is needed regarding the process by which the presence or absence of significant local or cumulative impacts will be determined. A recently published article from the peer reviewed journal Limnology and Oceanography (Engstrom/Balogh/Swain), indicates a potential local effect in mercury flux to lakes in the area surrounding the concentration of taconite mining, while it is actually decreasing in most of the rest of the state. (http://www.aslo.org/lo/toc/vol_52/issue_6/2467.pdf) This study involved lake core sampling, laboratory analysis and intensive scientific review, and covered only 55 lakes in the state (which were being studied for a variety of purposes). In other words, a level of effort unlikely to be re-created in environmental review was required to make the necessary observations of local effect.**

3. Submit a plan to the MPCA to account for the proposed emission. New sources must first seek permanent offsets with an existing source or sources in Minnesota at a 1:1 ratio.
If enough existing sources are not available, new sources must propose a plan (**the content and form of this plan should be set forth in rule**) to achieve at least a 90 percent reduction of the proposed emission by 2025 (**this date should be more like 2018 considering that the logical time to impose technological controls is at the time of facility planning, construction and investment. Allowing new in-state emissions that do not need to be controlled to 90% until the end date of the TMDL is risky, especially for the taconite industry**), and in addition must secure temporary offsets prior to operation from either:
a. Existing sources in Minnesota at a 1:1 ratio.
b. Out-of-state sources at a ratio greater than 1:1, based on the location of the source. (**See above discussion of the unacceptable vagueness of the offset ratio and lack of calculation of the offset based on equivalent effects on receiving water resources**)
The plan will include research and reduction targets and timetables. (**This is very vague and unclear and needs clarification through rulemaking. Typically, pollution trading is only**

allowed after concrete reductions and timetables for achieving them are established for each individual source, and credits or offsets are only generated when reductions go above the targets/dates.)
If an expanding source can demonstrate no net increase from their proposed project, no additional offsets are required. (**It is unclear how this relates to reductions needed from the individual source or sector**)
By 2025 (**see above comment re: 2018**), the new source must have secured a permanent offset from a source or sources within Minnesota at a 1:1 ratio for the remaining emission. The MPCA will issue permits with enforceable conditions for new or expanded sources based on the MPCA-approved plan.

VIEW POINTS ON AIR POLLUTION BY Hg, CO2, SO2 and NOx

writer
Charles F. Prokop
director
Minnesota Trout Association
and
TMDL Stakeholder

The total mercury delivered load or TMDL stakeholders has worked specifically on the lowering of mercury pollution in the entire state of Minnesota. Major and minor stakeholders have been involved. This group started in June of 2007and is expected to finished with a report to the Minnesota Pollution Control Agency in March of 2008. It is the hope of this writer that the issues that are raised will not be cast aside as not being possible. the following observations can be readily made:

1) Air pollution consists not only of mercury abut also CO2, SO2 and NOx.
2) Nobody wants this air pollution to occur.
3) Much of this pollution comes from sources outside of Minnesota, but is similar to Minnesota sources.
4) Minnesota sources are partially listed here:
   a) Coal burning electrical power companies.
   b) Taconite processing companies.
   c) Waste treatment and incineration companies.
   d) Metal recycling and smelting companies.
5) We cannot control pollutant quantities that come to Minnesota from not only other states but other countries, but we can try to influence them to also work towards pollutant elimination.
6) We can reduce pollutants emitted within the boundaries of Minnesota but we cannot now nor in the future eliminate them unless we revisit some methods that have been legislatively eliminated.
7) We can also point out directions that we should be working towards and deal with any angst that the recommendations may cause.

Let us consider a major source of these pollutants. The coal fired electrical power plants are major causes of these pollutants, however at Red Wing, MN there are twin nuclear reactors that have been operating for decades without emitting any of the pollutants discussed here. True, there is the problem of storage of the spent fuel rods since the federal government is still working on a place to store them.On the positive side, in addition to not emitting air pollutants, nuclear reactant technology has progressed to the point that hardly any of the rods' fissionable material is left.This reprocessing of the material is the type of method used by a number of foreign countries such as France and Germany where their

electrical power is 75% nuclear generated. We seem to be afraid of doing something like this.

It seems that opponents of nuclear power generation also want no pollutants coming out of the exhaust smoke stacks of coal fired power plants. As they protest, some suggest other power generation methods such as solar, wind generation, and biomass collection and combustion. Each of these have signifigant shortcomings which are:

a) Solar-Not enough daylight hours during much of the year to be useful. Large storage cells need DC current not AC so conversion from to DC to AC would be necessary to provide AC during the long winter nights.

b) Wind-It would take many, many, many windmills to generate the equivalent of what the power companies currently produce plus that many windmills running 24/7 would be disastrous to migrating birds as has been reported. Also what would be done on a calm day to produce electricity??

c) Biomass-Collecting enough biomass would require harvesting over most of the state with the complications of gathering, hauling etc. In addition, the nutrients that the biomass represents would eventually have to be replaced and the winter cover it provides for wild animals and birds would also need to be provided at considerable cost.

d) Combinations-Using all of the above without considering cost, the most that can be expected is to obtain 25 to 30% of the present demand for electricity. This does not meet present needs much less the expansion of needs as time goes by.

So a problem presents itself. The problem is:

a) Do not want air pollutants as described earlier.

b) Cannot by legislative fiat expand existing nuclear generation capabilities or construct new nuclear facilities.

c) Alternatives will not provide for needs.

What should we consider? First of all we need to realize that the protestors cannot have it both ways. One cannot be negative to air pollutants and also negative to nuclear power plant expansion and/or construction. A choice has to be made!! To this writer, the legislation preventing the construction of new or expansion of current plants must be revisited and new legislation allowing expansion and/or construction of

new nuclear power plants be passed. This seems to be the only reasonable choice in view of all the foregoing.

Now this does not mean that we can ignore the current air pollution situation. Current emission levels should be reduced and as mentioned earlier, the TMDL group is working on this. There is however, a concern over one part of the mercury contamination process, and that is the methylation of mercury which makes it hazardous to humans and other mammals. It has been shown that airborne mercury becomes ionized at a plus 2 ionization. This means that a mercury atom loses 2 electrons as it bounces around in the air and comes down to waters in rain in what is known as a mercury ion and is capable of reacting with other charged atoms or parts of molecules. When the mercury ion gets to the bottom of a wetland, lake, or river, it can react with bacteria to form methyl mercury. Unfortunately we do not have all the details about this reaction. It may be a simple, straight forward reaction or it may require many intermediate steps. If we knew just what goes on in this reaction, it might be possible to inhibit a step or two and essentially stopping the methylation of mercury. Would it be possible to financially support a graduate chemistry student at a university in making this determination to see if inhibiting this reaction is possible?

So in conclusion, let the following be recommended:

1) Expanding nuclear power generation is the way to reduce the air pollution by mercury, CO2, SO2, and NOx in a safe manner.
2) Determining the reaction sequence that forms methyl mercury should be supported to see if a way to inhibit this reaction to signifigantly reduce methyl mercury formation and the damage to humans and other mammals.

Let us hope that those concerned in the state government will do their part by supporting these recommendations.

Charles F. Prokop
Director
MN Trout Ass'n

NORTH AMERICAN WATER OFFICE

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Phone 651-770-3861 Fax: 651-770-3976

ELECTRIC UTILITY MERCURY REDUCTION STRATEGIES
11/07

Electric utility mercury emissions remain one of the largest, if not the largest remaining source of uncontrolled mercury contamination of the environment. Pursuing any mercury emission reduction strategy that is not designed to achieve **MAJOR** reductions in electric utility emissions is programmed failure.

In addition to flue-gas scrubbing, a viable electric utility mercury emission reduction program will have a demand-side component and an additional supply-side component.

DEMAND-SIDE

Decouple electric utility earnings from sales.
It is foolish if not disingenuous to proclaim a desire to reduce mercury and other electric utility wastes while enhancing the financial health of the electric utility industry as more kilowatt hours are sold, and hence, as more wastes are produced. Whether a utility is an Investor Owned Utility, a Co-op, or a Municipal is irrelevant. If the financial health of the institution is based on the sales of energy, instead of on the efficient use of energy, the incentive is perverse and efforts to manage wastes produced as a result of the perversion have not been, are not, and will not be effective.

SUPPLY-SIDE

Renewable energy development provides a solution to the mercury problem, particularly if society gets serious about decoupling and capturing demand-side efficiency opportunities. But to get enough renewable energy development in a relevant time-frame means major near-term industrial development in many rural communities.

If that development does not produce major local economic benefit for people in the communities that experience the impacts of the major industrial development, and for the people who are paying for it, there will be resistance, and rightly so.

Community-Based Energy Development (C-BED) must therefore be at the center of any viable supply-side electric utility mercury reduction strategy. If this program is serious about reducing electric utility mercury emissions, it will direct C-BED developers, state regulators, and electric utilities to negotiate solutions to problems in the following areas, and impose inducements sufficient to ensure successful negotiations:

- Standardized Power Purchase Agreements (PPA's) and timelines, with provisions for a "feed-in tariff" that allows all qualifying projects that meet production cost criteria to be developed and operated.

- The exercise of all possible state and utility authority to simplify, expedite, standardize, and reduce the cost to C-BED projects of interconnecting to the grid.
- Establishment of a realistic standard offer tariff price and standard offer contract for projects less than 2 MW, with different prices for different technologies.
- Transmission planning and development that optimizes the efficiency of the existing grid, strategically enhances the existing grid to maximize the development of C-BED electrical generation capacity, and that uses strategic enhancements of the lower voltage system to inform decisions regarding size, location and timing of extra-high voltage powerlines.
- Establishment of a revolving fund that all utilities could fund at market interest rates to help with turbine down payments to facilitate the securing of turbines for C-BED projects.
- Support CBED projects by having the utility participate as equity partner (CBED participation entity) just as John Deere and Edison Capital do now. This would be part of their regulated business in the case of Xcel.
- Utilities provide a commitment for meeting or exceeding the 2010 and 2012 Renewable Energy Standard (RES) goals with CBED projects.
- A very large percentage of the Renewable Portfolio Standard to go to CBED and to be built in MN.

Product Sector Mercury Reduction Strategies

Recycling of compact fluorescent bulbs (and all fluorescents) needs to be made easy for the consumer and cost free or part of the purchase price.

Recycling of mercury switches in products is currently not possible because consumers do not know what products contain these switches or safe ways to remove them.

Foods, beverages, medicines, vaccines should not contain mercury.

Dental mercury should be phased out for less harmful substances. Mercury amalgams should only be used with the informed consent of the patient and have no reasonable alternative.

Medical assistance and dental insurance policies need to be changed to allow the patient to use the nonmercury fillings. The existing medical assistance and some insurance policies which provide no coverage for non-mercury dental fillings is a barrier to mercury reduction.

Appendix I: Technical Advisory Group Guidelines

Description:

The Technical Advisory Group (TAG) will provide input on issues of monitoring, prevention, and control options and other issues identified by the Strategy Work Group (SWG). It will consist of a core group, and several auxiliary members from industry, government, and academia. The Strategy Work Group will formulate technical questions or issues statements as needed to give to the core group. The core group will then assemble small working groups or committees from the list of auxiliary members to address the stated questions or issues as appropriate. TAG responses will be communicated back to the SWG via the core group.

Composition:

- Made up of core team and auxiliary members
- Auxiliary members may be added throughout process as needs develop
- Core team and auxiliary members may be identified by SWG, MPCA, MEI or other TAG members
- Public and private sector participants are allowed as auxiliary members of TAG
- SWG members may participate as auxiliary members of TAG
- SWG approves appointment of core team and auxiliary members
- Auxiliary members called upon based on needs/questions of SWG
- Members participate on a voluntary basis
- One MPCA staff member designated to coordinate and facilitate TAG activities

Function:

- Deals with issues of science and technology
- Operates independent of policy and politics
- Members use best professional judgment
- Addresses only issues identified by the SWG
- Attempts to agree, and will report disagreement
- Meets separate from the SWG
- Presents findings to the SWG
- Does not have standing in the stakeholder process
- SWG members allowed to participate and/or observe TAG activities
- Members listed on website
- Activities and reports to SWG documented
- May suggest additional issues to address or explore

Proposed Core Team:

- Keith Hanson, Barr Engineering
- Ann Jackson, MPCA
- Ed Swain, MPCA
- Mike Murray, NWF

Suggested Members (from SWG members):

- John Engesser, Minnesota DNR
- Mike Berndt, Minnesota DNR
- Mike Cashin, Minnesota Power
- Energy & Environmental Research Center at UND
- Mike Murray, NWF
- San Francisco Bay Mercury TMDL Resource
- Gary Glass, retired EPA
- Mike Durham, ACI
- Steve Colvin, Minnesota DNR
- Al Stevens, Minnesota DNR
- Keith Hanson, Barr Engineering
- Jeff Jeremiason, Gustavus Adolphus College
- Russ Bullock, EPA
- Drew Bodaly, Canada
- Charles Driscoll, Syracuse University
- Dwight Atkins
- Jeff Broberg, Minnesota Trout Association
- Neil Kamman, Vermont Department of Environmental Conservation
- Pat McCann, MDH
- Stacy Davis, Cap and Trade Resource
- Mike Wall, NRDC
- Carrie Lucy Hanson, MPCA

Goals

The primary task of the Strategy Work Group is to produce a set of recommendations for implementing the state's mercury TMDL. Recommendations produced by the Strategy Work Group should address the provisions and goals for reducing mercury emissions from sources in Minnesota. The MPCA will consider the recommended strategies when preparing the implementation plan for mercury-impaired waters.

MEI's Role

The Minnesota Environmental Initiative is responsible for the design, management and facilitation of the stakeholder process. MEI will schedule and convene meetings, keep meeting minutes, post meeting summaries, compile stakeholder input over the course of the project, and work with the Strategy Work Group to develop the final project document. Correspondence regarding meeting announcements, agenda, meeting summaries, and other information related to the process will be distributed by MEI. Information will be made available to participants via email, and will be posted on a webpage dedicated to the Mercury TMDL Stakeholder Process hosted on the MEI website.

Facilitator's Role

MEI will provide a facilitator to chair the stakeholder process and lead each of the stakeholder meetings. The facilitator will assist in focusing discussions, assure fair opportunity to stakeholders to participate in the meetings, draw out participants' perspectives as necessary, will work to resolve conflicts that arise, and assist in designating tasks to advisory or sub-groups. The facilitator will also chair the Steering Team.

Strategy Work Group Membership

New individuals may be added to the Strategy Work Group throughout the course of the process if it is determined that important stakeholder interests are not represented by the existing participants. MEI will make the final determination of when and if new members should be added. Should a stakeholder choose to vacate his or her seat on the Strategy Work Group, MEI may seek a replacement.

Open Meetings

All Strategy Work Group meetings are open to the public. Anyone may attend a Strategy Work Group meeting, and, if time permits, will be given an opportunity to offer an opinion on the subject of the meeting at a time designated by the meeting facilitator.

Participation

Strategy Work Group participants are expected to attend all Strategy Work Group meetings, will make every effort to be on time, participate in conversations with the facilitator and MEI staff between meetings, review documentation prior to meetings, and actively participate in the meetings. Participants are asked to keep their member organizations and constituencies informed about the process proceedings, and to bring their views to the discussions. In addition, participants are asked to participate in two Partners Group meetings, and one Stakeholder Input Group meeting to be held during the process.

Participants are responsible for selecting 3-5 key stakeholders to serve on a Steering Team with one designated MPCA representative.

Alternates

Each stakeholder group member is asked to designate an alternate representative for their organization or constituency. Members who cannot attend a meeting should make arrangements with the designated alternate, and inform MEI's project manager prior to the meeting. One designated representative or alternate, but not both, will have a seat at the table and be asked to participate in decisions at each meeting.

TMDL Acceptance

Strategy Work Group participants agree to work within the context of the approved TMDL, and accept the TMDL assumptions and reduction goals, as approved by EPA. The stakeholder process and meetings are not forums for debating specific provisions or assumptions that were used in developing the TMDL. Discussion and debate should be focused on shared data and factual information.

Good Faith Participation

All participants agree to act in good faith in all aspects of the process. The participants are expected to present their own opinions based on their experience, perspective and training, and agree to participate actively, constructively and cooperatively in the process. Debate and discussions of the Strategy Work Group should be based on shared facts and technical knowledge.

No Surprises

Participants agree to be forthcoming about potential conflicts with the proceedings and with decisions that are developed by the group. Disagreements should be identified and shared with the group as early as possible.

Respect

All participants are expected to act as equals during the process and will respect the experience and perspective of the other participants. Participants should refrain from characterizing the viewpoints of others during discussions. Personal criticisms of other stakeholders will not be tolerated.

Consensus

Decisions will be based on consensus of the group, generally defined as reaching an agreement that all participants can live with. Participants agree to be supportive of the process, but are allowed the ability to disagree with specific decisions or outcomes of the process.

Communications and Confidentiality

When making statements about the process or its outcomes in public, Strategy Work Group participants agree to make clear that they speak on their own behalf, and do not necessarily represent the opinions of other participants, MEI, or the Minnesota Pollution Control Agency. Strategy Work Group members will give at least 48 hours notice to other participants before communicating with the media about the process.