Best Management Practices and Data Needs for Groundwater Protection

Minnesota Pollution Control Agency

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Executive Summary

The Groundwater Protection Act of 1989 (GWPA) requires the Minnesota Pollution Control Agency (MPCA) to develop, promote and monitor the effectiveness of best management practices (BMPs) that prevent, minimize, reduce, and eliminate sources of groundwater degradation. These requirements apply to MPCA programs with activities that may cause or contribute to groundwater pollution for non-agricultural pollutants (Appendix A - GWPA).

To address the requirements of the GWPA the MPCA has set goals in the agency's strategic plan to identify and evaluate groundwater BMP effectiveness. The goals direct the MPCA to: 1) identify groundwater BMPs, 2) highlight BMPs where more data is needed to evaluate their effectiveness, and 3) develop a plan to address data needs that will enhance program groundwater BMPs.

This report provides a review of MPCA programs that identifies 1) groundwater BMPs, and 2) highlights areas where additional data is needed to evaluate the effectiveness of BMPs in preventing groundwater contamination. The report focuses on MPCA programs that typically conduct less groundwater monitoring or have limited information of their program's impacts to groundwater quality and include the following programs:

- Subsurface Sewage Treatment Systems (SSTS)
- Animal Feedlots
- Biosolids
- Land and Water Quality Permits for land applied industrial wastewaters and by–products
- Stormwater
- Solid Waste Demolition Landfills
- Municipal Inflow and Infiltration (I&I)

A review of the MPCA remediation programs was not included in this effort because these programs routinely collect and analyze an extensive amount of groundwater data to verify that their program practices are effectively protecting groundwater resources.

Individualized program reviews were conducted by gathering information from program documents that describe program groundwater BMPs that included: fact sheets, permits, policy and rule, and through interviews with program staff to identify program data needs. The interviews with program staff highlighted program data needs that can be used to prioritize data collection efforts to evaluate the effectiveness of program BMPs. The data needs analysis will also serve as a framework to develop plans to evaluate MPCA program groundwater BMPs, to address the third goal of the MPCA's strategic plan.

Minnesota Pollution Control Agency groundwater best management practices

Minnesota Pollution Control Agency programs use numerous BMPs to prevent groundwater contamination that are incorporated into their programs' rules, permits, policies, and guidelines. These program BMPs are specifically designed to address the contaminants of concern managed by each of the programs and contain additional requirements that address sensitive groundwater settings, a key requirement of the GWPA.

Examples of BMPs that apply to sensitive groundwater settings include: set back distances for land applied manure, biosolids and industrial by-products (Industrial by-products); locational restrictions for manure storage and demolition landfills based on groundwater sensitivity; design guidelines for stormwater infiltration in the Minnesota Stormwater Manual; more stringent nitrogen application rates on highly permeable soils for biosolids, and more rigorous design guidelines for SSTS that are based on aquifer sensitivity.

Summaries of program groundwater BMPs are presented within individual program write-ups under the heading "Program practices used to protect groundwater" under the "Program Best Management Practices and Data Needs" section of the report.

Data needs

Several programs have recommended the collection of groundwater quality data to evaluate the impacts of their program BMPs. More specifically, BMP effectiveness could be evaluated from additional groundwater data collection at: mid to large-sized SSTS sites, select animal feedlot manure storage basins, stormwater infiltration sites in sensitive groundwater settings, and at industrial wastewater sprayfield land application sites.

Programs that manage land-applied solid wastes do not require the collection of groundwater quality data because their BMPs have been specifically designed to prevent groundwater contamination (biosolids, land-applied manure from feedlots, and industrial by-products). These programs have not recommended groundwater monitoring as a priority data need. Research suggests that when these program BMPs are properly applied, impacts to groundwater quality are minimal.

Analysis of water quality data was also identified as a need to assess the impacts of ongoing program BMPs. The Demolition Landfill Program has a pressing need to conduct a statistical data analysis of groundwater monitoring data collected over the last eight to ten years at demolition landfills to assess the impacts of program BMPs contained in their Demolition Landfill Guidelines. The Animal Feedlot Program would also benefit from an analysis of a water quality database collected from larger permitted facilities from a limited number of monitoring wells and tile drainage stations.

In addition to data analysis a mechanism is needed to collect and store data in databases that will allow for data sharing and meaningful analysis. Currently, the bulk of data generated by the Solid Waste Demolition Landfill Program and for industrial wastewater land application sites is stored in Delta. Data from stormwater infiltration sites should also be collected, assessed, and made available where appropriate.

An abbreviated list of the program data needs is included in the table below. More detailed descriptions are provided at the end of each individual program write-up and in tabular form in the report *Summary*.

MPCA Programs	Program Data Needs & Recommendations
Demolition Landfills	1. Groundwater data analysis of existing data set. 2. Groundwater monitoring system analysis. 3. Leachate testing of demolition waste.
SSTS Program	1. Groundwater monitoring at MSTS sites. 2. Assess impacts of smaller ISTSs to groundwater. 3. Monitoring for contaminants of emerging concerns (CECs).
Animal Feedlot Program	1. Water quality testing of drain tile discharge at manure storage basins. 2. Data analysis of groundwater & tile discharge at permitted facilities. 3. Evaluate older manure storage basins in SE Minnesota.
Industrial Wastewater & Industrial By-product Land Application	1. Groundwater evaluation of high BOD irrigation sites (As, Fe & Mn). 2. Unusual wastes and their environmental fate for land application scenarios. 3. Program data review – Delta database.
Stormwater Program	1. Promote creation of statewide GIS layers to evaluate stormwater infiltration. 2. Develop case studies to assess groundwater impacts for stormwater infiltration BMPs. 3. Data collection for stormwater infiltration projects.
Biosolids Program	1. No specific recommendations for groundwater monitoring.
Inflow & Infiltration	1. Limited groundwater impact concerns.

Program Best Management Practices and Data Needs

This section presents the program groundwater BMPs and their data needs within individual programs. The program groundwater BMPs are summarized under the heading "Program practices used to protect groundwater", followed by descriptions of the data needed to evaluate the effectiveness of their groundwater BMPs.

Solid Waste Demolition Landfill Program

This program review identifies the BMPs used by the MPCA's Solid Waste Demolition Landfill Program (SWDLP) to prevent groundwater contamination from construction and demolition landfills (C&D landfills). It also identifies program areas where additional data is needed to better evaluate the effectiveness of these program practices in the protection of groundwater resources and makes recommendations to address some of these data gaps.

Overview

The SWDLP uses a combination of regulatory tools to protect groundwater resources at C&D landfills that include: the Demolition Landfill Guidance (DLG), permit requirements, and policies that emulate the mixed municipal solid waste landfill rules. Other regulatory tools used by the SWDLP that indirectly protect groundwater resources, include: environmental and technical reviews, facility inspections, operator training, technical assistance, compliance and enforcement, fact sheets, and guidance documents.

Construction and demolition landfills are located in a number of different hydrogeologic settings across the state and vary in size, design and in their contents of construction and demolition debris. These landfill characteristics affect whether contaminants in landfill wastes are likely to leach to groundwater and impact groundwater resources in excess of program intervention limits and drinking water limits. As stated in a recent report to the Minnesota Legislature that evaluates land disposal facilities, "The degree to which protection of human health and the environment is achieved through landfill regulations is the result of interactions of multiple "environmental performance" parameters that are grouped into three categories: 1) toxicity characteristics of the waste, 2) hydrogeologic characteristics of the landfill site, and 3) engineered controls and monitoring systems of the landfill."

A recent tabulation of C&D landfills indicates there are 109 permitted demolition landfills distributed across the state; 65 percent of which have groundwater monitoring systems. Historically, C&D landfills were thought to contain mostly inert materials and would have little to no impacts on groundwater quality and no need for groundwater monitoring. However, in 2003 the MPCA evaluated the available groundwater monitoring data from C&D landfills and found that some of these landfills do impact groundwater. This evaluation has led to a more thorough approach in evaluating the hydrogeologic settings of C&D landfills and an increase in groundwater monitoring systems at these facilities.

Nature of concern related to groundwater

Construction and demolition landfills may impact groundwater quality through leaching of contaminants from landfill wastes through the soil to groundwater. The degree to which this occurs is greatly affected by the characteristics of the wastes, hydrogeologic setting, and engineering controls at the landfill. These concerns are presented in greater detail in the report to the Minnesota Legislature on "Management of Industrial Solid Waste and Construction and Demolition Debris in Land Disposal Facilities", January 15, 2009 (Landfill Report), pages 15-17, at the web link http://www.pca.state.mn.us/index.php/view-document.html?gid=41.

The SWDLP applies groundwater standards at C&D landfills to protect groundwater as a drinking water source and for groundwater that may discharge to surface waters of the state. Exceeding these standards triggers permit required actions at the compliance boundary of a C&D landfill, as set forth in the solid waste rules, Minn. R. 7035, subp. 4.

Contaminants of concern

Based on reviews of groundwater data collected from C&D landfill monitoring wells, the MPCA staff has identified a limited number of contaminants that occur at some of the C&D landfill facilities. The most frequently detected inorganic compounds, with health based drinking water standards, include: boron, arsenic, manganese and nitrates. Boron is the major contaminant of concern and is believed to be from flame retardants used to treat sheetrock, lumber, and insulation. Arsenic and manganese contaminants are believed to be primarily due to natural background sources with limited contributions from landfill wastes. Nitrates have also been detected in C&D landfill groundwater monitoring systems, but are more likely a result of regional anthropogenic sources and less likely due to wastes contained in the C&D landfills.

Testing for volatile organic compounds (VOCs) in C&D landfill groundwater monitoring systems has shown a limited number of detections at relatively low concentrations at most facilities. VOCs detected include: tetrahydrofuran and vinyl chloride with infrequent detections of Freon and hydrocarbon compounds.

Minnesota Pollution Control Agency staff has also reviewed C&D landfill leachate data, which provides an indication of what contaminants could potentially enter groundwater systems. Results from this review show that several metal and VOC contaminants are present; however, few of these contaminants have been detected in the groundwater systems at these facilities. This indicates where facilities have liners they appear to be providing a high degree of protection to groundwater resources.

More recent testing of groundwater at C&D landfills has identified the presence of perfluorinated chemicals (PFCs). In a survey of 20 unlined C&D landfills, PFCs were detected at most facilities; however, at concentrations significantly below groundwater intervention limits for most sites. Based on these results, limited testing for PFCs is currently being conducted at most C&D landfills, with the exception of one C&D landfill that has shown somewhat higher concentrations of PFCs (Summit Avenue Demo).

Overall, groundwater monitoring data from C&D landfills indicates limited impacts to groundwater resources and currently there are no known impacts to private or municipal wells from these facilities.

It is important to note that all significant detections of groundwater contamination are from unlined landfills that pre-date the MPCA's current regulatory regime. Current landfill practices include more rigorous waste screening procedures, increased use of liners and landfill cover, and groundwater monitoring, all help to reduce and prevent impacts to groundwater resources at C&D landfills.

Program practices used to protect groundwater

As mentioned previously, the SWDLP applies the DLG, permit requirements, and policies based on solid waste landfill rules to protect groundwater resources at C&D landfills. The DLG and the Landfill Report describe many of the program practices that protect groundwater resources, as listed below:

1. **Locational requirements and site evaluations** - the DLG states "The single most effective action that owners/operators of demolition landfills can take is to locate the demolition landfills in areas that will inherently protect ground water and surface water from the risks of contamination. Prohibited locations which must be avoided include active karst topography, flood plains and other areas likely to result in groundwater contamination."

a) The solid waste rules prohibit the placement of demolition landfills in areas that would result in groundwater contamination. An existing permitted landfill that does not meet the location standards above will not be re-permitted.

b) Permitting or re-permitting a C&D landfill requires that a site evaluation be conducted to identify potential risks and the need for groundwater monitoring. The site evaluation must verify whether a site meets location standards, has an adequate separation distance between the fill and water table, and provides sufficient information on groundwater flow directions.

2. **Facility classification** - The MPCA has developed a three class system to better manage the potential risks to groundwater from C&D landfills. The three class system sets different groundwater monitoring and design requirements, and waste acceptance criteria for C&D landfills that are based on waste characteristics and hydrogeologic setting.

   a) In general, larger C&D landfills have more significant safeguards, such as liners, leachate collection systems, and groundwater monitoring. These landfills are primarily located within the Twin Cities Metropolitan area. Many smaller C&D landfills are located in rural areas and serve fewer businesses and people and are less likely to have liners or groundwater monitoring; however, use more rigorous waste screening practices to control unacceptable wastes that could contaminate the groundwater.

   b) The DLG sets BMPs for waste screening for the different classes of C&D landfills and defines acceptable waste streams and the requirements for waste stream screening procedures, and Industrial Solid Waste Plans.

3. **Groundwater monitoring** – The SWDLP policy states that "all Class II and III Landfills should conduct groundwater monitoring."

   a) The DLG provides a groundwater monitoring decision matrix to determine whether monitoring is necessary, based on the depth to the water table and the soil type beneath the C&D landfill.

   b) Decisions to require groundwater monitoring are made upon initial permit issuance or during permit reissuance, which occurs on a five year cycle. As noted previously, roughly 65 percent of all C&D landfills now have some type of groundwater monitoring in place.

   c) Groundwater monitoring information is reviewed annually and is used to determine if a facility is impacting groundwater quality. Exceedances of groundwater performance standards can lead to permit required actions to reduce and prevent contaminant impacts that may include: additional monitoring, addition of a less permeable cover atop landfill wastes, or possibly installation of liners beneath the waste to prevent and reduce leaching of contaminants to groundwater.

   d) In addition to groundwater monitoring requirements, some C&D landfill facilities must also conduct groundwater receptor surveys to identify groundwater users in the vicinity of their facility that may potentially be impacted.

Program data needs and recommendations

The MPCA staff identified three main areas where additional data would be helpful in determining the effects of C&D landfills on groundwater quality.

1. **Groundwater data analysis** – The SWDLP needs to conduct a rigorous statistical analysis of the groundwater monitoring data from C&D landfills. The last major summary of this data was conducted in 2003, at a time when there was a limited amount of groundwater data to review. A significant amount of groundwater monitoring data has been collected since 2003. This type of data review is necessary to formally evaluate whether the current program practices are providing adequate protection of groundwater resources. To date, less formal reviews indicate there are no impacts from lined facilities and no known contamination of private or municipal wells at any of the C&D landfills.

2. **Groundwater monitoring systems** – There is a need to evaluate the effectiveness of groundwater monitoring systems at C&D landfills and their ability to detect potential contaminant releases. This evaluation would involve constructing groundwater models for C&D landfills with a goal of determining whether there are an adequate number of monitoring wells in the proper locations to detect contaminant releases. To conduct a statistical analysis of groundwater monitoring data and develop groundwater flow models for each C&D landfill will require additional expertise to conduct the statistical analysis and significant program staff time to perform the groundwater modeling.

3. **Leachate testing of demolition waste** – This is an area of concern that was cited by the MPCA staff and in the Legislative Landfill Report. Leachate data is needed for "pure demolition" waste at Class 1 unlined landfills because these landfills do not have liners and depend entirely on good waste screening procedures to keep out any hazardous materials and unacceptable wastes. Minnesota Pollution Control Agency staff noted it would be beneficial to do additional leachate testing of concrete, wood products and sheet rock that commonly go into C&D landfills. The Landfill Report notes that without liners it is impossible to test leachate at the base of these types of landfills and the MPCA could fill this information gap with a test-cell research study.

The Landfill Report to the Minnesota Legislature contains 14 conclusions and recommendations to examine groundwater sensitivity and financial issues at C&D landfills. These findings were developed by a work group with an in-depth understanding of landfill issues with a stated goal to protect human health and the environment, as set forth in Groundwater Protection Act of 1989, Minn. Stat. 103H.001. Several of these comments are provided below with the complete listing found in the link to the Landfill Report, above.

1. **Environmental performance at demolition landfills**. The work group feels that the Demolition Landfill Guidance is working well enough that it should continue to operate for at least two more years before being incorporated into eventual rulemaking.

2. **Groundwater sensitivity test for siting landfills**. Hearings in the 2008 Legislature raised the possibility of using the tritium concentrations in groundwater as the definitive test for groundwater sensitivity when siting landfills. The work group recommends that a single test for site suitability should not be used and that site-specific hydrogeologic investigations would better define groundwater characteristics at proposed sites, rather than a single criterion such as tritium concentration, or geologic sensitivity maps.

3. **Permit-by-rule demolition landfills**. Current regulations require no monitoring or inspection of demolition permit-by-rule (PBR) landfills. The work group recommends tighter limits to the size, duration of operation, and usage of PBR landfills with counties retaining authority to make exceptions in cases of public need. The work group suggests increased notification of neighbors and improved recording on deeds. The MPCA should consider a groundwater study to better understand risk.

4. **A changing demolition waste stream going to landfills**. As part of its general oversight role, the MPCA needs to monitor the long-term trend in changing waste streams going to landfills. Metals, concrete, asphalt, wood, and now shingles, are being separated more effectively which leaves a higher percentage of materials of concern: gypsum wallboard, unused glues and paints, and painted or treated wood. Good pre-demolition preparation and screening is necessary to minimize unused glues, paints, or treated wood entering C&D landfills in addition to the introduction of new building materials. The environmental risks associated with changing C&D debris will need to be continually evaluated and studied.

5. **MPCA analysis of monitoring well data.** The MPCA has not been updating its 2003 broad analysis of groundwater data from wells around demolition landfills. Meanwhile more wells are being added. At least every five years, MPCA staff should evaluate and report on what is known from well data about landfill effects, if any.

a. **Validation needed for computer tools.** The waste management industry and the state utilize modeling tools to predict the environmental performance of C&D and industrial landfills under specific circumstances, one of which is the Industrial Waste Evaluation Model (IWEM). The MPCA should validate the IWEM and other modeling assumptions using real-world data collected from Minnesota landfills.

b. **Need leachate data for "pure demolition" waste at Class 1 unlined landfills**. Such landfills do not have liners and depend entirely on good waste screening procedures to keep any hazardous materials out. Without liners, it is impossible to test leachate at the base of the landfill. Therefore, nothing is known in Minnesota about the leachate generated at such landfills. Other types of demolition landfills do have liners and therefore leachate to test, but are not representative because they accept a wider range of wastes. The MPCA could fill this information gap with a test-cell research study.

Recommendations for additional data

As identified during interviews with MPCA staff, three areas need additional data; a statistical analysis of groundwater monitoring data from C&D landfills, modeling of groundwater monitoring systems at C&D landfills, and performing leachate tests of wastes that typically enter Class 1 unlined C&D landfills. These same areas are also listed in the recommendations and conclusions presented in the Landfill Report sent to the Legislature.

In comparing the recommendations from the MPCA staff and those in the Landfill Report, it seems reasonable to give additional consideration to the recommendations cited by both groups. Conducting the statistical data analysis is necessary to determine whether the current management of C&D landfills is protective of groundwater resources. Results from this analysis could also be useful in the development of demolition landfill rules and guidelines so they are more protective of vulnerable groundwater resources.

The Landfill Report also recommends using models to predict environmental performance at C&D landfills. This recommendation is similar to the second proposal by the MPCA staff to evaluate groundwater monitoring systems at C&D landfills through groundwater modeling. Results from this type of analysis could lead to improvements in the ability to detect contamination from landfills. Furthermore, groundwater modeling predictions, coupled with the statistical analysis of groundwater quality data, could greatly improve the understanding of groundwater monitoring results from C&D landfills.

Beyond the scope of work cited above, the MPCA technical staff and recommendations in the Landfill Report describe a need for leachate data of demolition wastes in a test cell, groundwater monitoring at PBR landfill sites, and groundwater sensitivity at C&D landfills. Spending recommendations from the Landfill Report include the following tasks (not in order of priority):

a) A test cell to sample leachate from Class 1 demolition landfills
b) Rulemaking/guidance to update the existing rules
c) A broad analysis of groundwater data on the scope of the study done by Mike Trojan of the MPCA in 2003
d) Groundwater testing around PBR demolition landfills

Subsurface Sewage Treatment Systems

This program review identifies program practices implemented by the MPCA's Subsurface Sewage Treatment Systems (SSTS) program to prevent the contamination of groundwater. It also identifies program areas where additional data is needed to better evaluate the effectiveness of SSTS program practices to protect groundwater resources and makes recommendations to address some of these data gaps.

Overview

The SSTS program oversees the treatment of sewage discharge to SSTS in accordance with state statute (Minn. Stat. 115.55) and rules (Minn. R. ch. 7080-7083). Subsurface or soil-based treatment systems treat approximately one third of Minnesota's domestic wastewater (sewage). There are roughly 470,000 SSTS in the state; 98 percent of these systems are smaller individual sewage treatment systems (ISTS) serving flows of 2,500 gallons per day (gpd) or less. The remaining 2 percent include mid-sized sewage treatment systems (MSTS) serving flows between 2,501 and 10,000 gpd, and large sewage treatment systems (LSTS) serving flows of 10,000 gpd or greater. Individual sewage treatment systsms and MSTS are regulated by local units of government (i.e. city, township, or county). Minnesota rules require the MPCA to regulate LSTS due to the greater volume of wastewater treated and their associated potential for environmental and health risks.

Overall, groundwater protection increases based on SSTS size and proximity to sensitivity aquifers. Larger ISTS, MSTS, and LSTS have additional monitoring requirements, permit conditions, and BMPs applied to their location, design, installation, use and maintenance.

Nature of concern related to groundwater

Subsurface Sewage Treatment Systems discharge treated sewage into the ground, ultimately traveling to the groundwater and surface waters. The wastewater in SSTS contains organic matter and solids, pathogenic organisms (bacteria, viruses, and parasites), nutrients, and some chemicals. A properly operating SSTS will convert a large percentage of the total nitrogen in the sewage to nitrate. Once the nitrate-laden effluent reaches the groundwater, concerns arise about its use as a drinking water supply.

Of the approximate 470,000 septic systems across the state, slightly over 100,000 of them are estimated to be failing to protect groundwater (i.e. have less than three feet of suitable soil below the system) and could be sources of pollution to groundwater resources. Because of the large number of ISTS, there are more sites than can reasonably be evaluated for compliance on an individual basis; therefore there is insufficient information to know whether many of the smaller ISTS are adequately treating sewage.

In addition, a number of larger MSTS and LSTS systems (cluster systems) were constructed during the latest housing boom. These systems must also be monitored and tracked to ensure they are achieving treatment goals.

Contaminants of concern

Nitrate/nitrogen is the main concern for septic system impacts to groundwater because pathogens and phosphorus generally adsorb to the soil and are treated adequately by these systems. Nitrates, once formed, will move with groundwater and will likely not denitrify, except in some favorable soil and groundwater conditions. Pathogens are usually attenuated in soil treatment systems; but there are a few cases of bacterial and viral transport in groundwater. Phosphorus typically precipitates in the unsaturated zone or is adsorbed in the aquifer close to drain fields; less so in older systems where phosphorus saturation can occur.

In addition to pathogen and nutrient concerns noted above, contaminants of emerging concern, such as pharmaceuticals, personal care products, and endocrine active compounds are present in septic effluents. The SSTS program has limited capacity to assess the presence of these compounds and their focus is directed at controlling and preventing nitrate/nitrogen and pathogens from entering the groundwater.

Program practices used to protect groundwater

As noted previously, the SSTS program applies Minn. R. ch.7080 through 7083 to oversee the treatment and dispersal of sewage discharge to subsurface treatment systems. These rules include a large number of requirements for the proper location, design, installation, use and maintenance of SSTS systems to protect our state's water resources from the discharge of treated sewage to the groundwater, that include the following:

- Nitrogen BMPs for MSTS and LSTS based on system size and the sensitivity of the aquifer
- Registration of treatment products for nitrogen and phosphorus reduction
- Identifying imminent threats to public health and safety from uncontrolled surface discharges
- A plan to strengthen local county programs to reduce the percentage of failing SSTS from 39 percent to less than five percent by January 1, 2014
- Design guidelines for larger ISTS and MSTS that require the assessment of soil and groundwater conditions so that systems are protective of groundwater resources, that include:
    - Groundwater sensitivity and mounding assessments
    - Nitrogen modeling and nitrogen BMPs to reduce total nitrogen, and nitrogen limits
    - Determining whether a site is located in a Drinking Water Supply Management Area
    - Vertical separation distances to groundwater
    - System design criteria based on the above factors
- A groundwater nitrate nitrogen policy that provides a technical basis for permitting decisions as well as a means to ensure the best, reasonable protection of groundwater resources
- Well testing (nitrates), point of sale requirement (not a state requirement)
- Education, certification, and training
- Compliance and enforcement

Program data needs and recommendations

1. **Mid-sized sewage treatment systems** – The SSTS program would greatly benefit from groundwater monitoring data collected at MSTS sites to verify whether these systems are meeting groundwater nitrogen limits set in design guidance. In addition, monitoring of groundwater mounding is needed to evaluate system performance and to compare these results to predictions from numerical (Modflow) and analytical (Kahn & Hantush) groundwater models. This type of research is needed in both sand and gravel and finer textured glacial till soils that occur across the state. Assessment of the predictive ability of groundwater mounding models in different geologic settings will help support program decisions regarding system performance and ultimately lead to reduced review times and site assessment work.
2. **Individual sewage treatment systems** – The assessment of impacts to groundwater from smaller ISTS is also needed because of their large numbers. There is little to no groundwater monitoring conducted for these types of systems, and many were installed prior to the enactment of minimum statewide standards for ISTS in 1996.
3. **Monitoring for contaminants of emerging concerns** – As noted previously, the SSTS program does not have the capacity to test for contaminants of emerging concerns (CECs) that may contain endocrine active compounds. It is known that sewage effluent contains CECs; however their occurrence has not been investigated for SSTS in Minnesota.

Based on discussions with program staff, the most immediate data needs, with respect to groundwater protection concerns, are for MSTS as described in #1 above. Next would most likely be groundwater data from ISTS sites; however, a number of homes and businesses have straight pipe discharges of sewage effluent to surface waters, which represents an even greater immediate concern to surface water resources. Currently, the SSTS program has limited capacity to investigate the above listed data gaps and any work in these areas would need to be conducted with local partners and stakeholders outside of the program.

Animal Feedlot Program

This program review identifies some of the program practices and BMPs used by the MPCA's Animal Feedlot Program (Feedlot Program) to prevent the contamination of groundwater resources. It also identifies program areas where additional data is needed to better evaluate the effectiveness of feedlot program practices to protect groundwater resources and makes recommendations to address some of these data gaps.

Overview

The Feedlot Program regulates the land application and storage of animal manure for over 25,000 registered feedlots in Minnesota in accordance with Minn. R. ch.7020. In addition, there are approximately 5,000 to 10,000 smaller, unregistered feedlots across the state. Overall, there are more feedlot sites than can be evaluated on an individual basis, and therefore, there is limited monitoring of their impacts on groundwater quality, with the exception of a few of the larger facilities.

Feedlots are located in agricultural areas across the state with the greatest number occurring in the southern and central portions of the state. Feedlots vary in size, as measured by the number of animals they manage (animal units), and in the quantity of manure they land apply or store in manure storage basins. In general, larger feedlots have more rules and regulations they must follow to protect groundwater resources.

Nature of concern related to groundwater

Groundwater can be contaminated by nutrients (primarily nitrate-nitrogen) and microbial pathogens from animal manure. Animal manure contains significant quantities of nitrogen and if not properly managed, can lead to nitrate contamination of groundwater. The main concern regarding feedlot contaminant impacts to groundwater systems is through the application of manure to the land and its storage in manure storage basins. The land application of manure, if not conducted properly, can overload the soil/crop system and lead to leaching of contaminants to the groundwater. In addition, the design, construction, and maintenance of manure storage basins and their location relative to vulnerable groundwater settings play a big role in whether manure storage systems are likely to affect groundwater quality.

Many feedlots are located in areas of the state with vulnerable aquifers where groundwater quality is highly susceptible to contamination from land surface activities. Nitrate contamination of groundwater has shown to be a problem in areas having coarse-textured soils with shallow groundwater and solution weathered bedrock. Pathogens can also move directly to groundwater through cracks in the soil, especially near old wells, sinkholes, quarries, and areas having shallow soils over fractured bedrock.

Contaminants of concern

As stated above, nitrate-nitrogen and pathogens have been identified as the contaminants of greatest concern from feedlots that may impact groundwater quality. Groundwater studies of manure storage systems by the MPCA have also identified high concentrations of ammonia, organic nitrogen, phosphorus, organic carbon, potassium, chloride, manganese, and iron in groundwater plumes downgradient of manure storage areas. In these same studies, high nitrate concentrations were measured where sites were underlain with a thick unsaturated zone; indicating the conversion of organic nitrogen and ammonia most likely resulted in the higher nitrate concentrations. In general, MPCA studies showed the greatest impacts to groundwater quality occurred at sites lacking a constructed liner for their manure storage basins.

Program practices used to protect groundwater

The Feedlot Program protects groundwater quality primarily through the application of Minn. R. ch. 7020, in addition to a mix of BMPs, program policies, fact sheets, and guidelines that contain specific requirements and recommendations for water quality protection. Some examples of Feedlot Program practices that protect groundwater quality include:

- Manure management plans are considered one of the primary program practices that protect groundwater quality. Manure management plans regulate the rate and timing of the land application of manure to prevent overloading the soil/crop system with excess nitrogen and phosphorus, reducing the potential for nitrogen leaching to groundwater.
- Feedlot general permit conditions place additional constraints on manure applications in areas with vulnerable aquifers (sand and gravel aquifers) and restrict applications in the winter for concentrated animal feedlot operations.
- Rules for liquid manure storage basins (7020.2100) set the liner design standards and location restrictions for feedlots to prevent leakage of liquid manure to underlying soils and groundwater.
- Feedlot water quality discharge standards (7020.2003) require that manure, its runoff and process wastewaters are prohibited from flowing into a sinkhole, fractured bedrock, well, surface tile intake, mine or quarry. Feedlots and manure storage areas must comply with Minn. R. ch. 7050 effluent limit standards.
- Location restrictions and expansion limitations (7020.2005) apply to new animal feedlots or manure storage areas within a shoreland, a floodplain, 300 feet of a sinkhole, 100 feet of a private well, or 1,000 feet of a community water supply well, or other wells serving schools or day care centers.
- Program policy memorandum - "MPCA Feedlot Program Ground Water Monitoring at New Liquid Manure Storage Areas", June, 2008 Memo.
- Guidelines for the land application of manure, "Applying Manure in Sensitive Areas" developed by the MPCA and Natural Resources Conservation Service (NRCS), provides feedlot operators with a user friendly overview of state requirements and recommended program practices to protect water quality.

Program data needs and recommendations

Feedlot Program staff identified several areas where additional data would be helpful in determining the effects of feedlot impacts on groundwater quality, as follows:

1. **Water quality data from drain tile discharge at manure storage basins** - Conduct testing of drain tile discharge waters for drain systems around manure storage basins. There are a large number of tile drainage systems around manure storage basins with concrete or earthen construction that could number in the thousands across the entire state. The drain systems are set around the base of the storage basins to lower the water table beneath the basin and maintain a separation distance of four feet between the bottom of the basin and the underlying water table. The drain tiles typically discharge to county ditches which flow to surface waters of the state. The water from the drain tiles is representative of the groundwater beneath the manure storage basins and would indicate if there is contaminant leakage from the basins to the groundwater.
2. **Groundwater and tile drainage data analysis** - Perform a statistical analysis of data from the 30 or so facilities that have drain tile and groundwater monitoring systems to determine if there are significant impacts to groundwater.
3. **Evaluate manure storage basins in southeast Minnesota karst region** – In southeastern Minnesota, a number of manure storage basins were built in the mid 1990s, prior to when manure storage basins were required to have double liners. Basins or lagoons built without double liners have a greater potential for catastrophic failure in karst settings. Feedlot staff have conducted some visual inspections of these facilities; however, it would be good to evaluate the condition of the older storage basins (>15 years old) more rigorously. This evaluation could determine the locations of older basins, depth to bedrock, proximity to springs, sinkholes, streams, and include any soil data or construction information available on these structures from the NRCS, Soil and Water Conservation District, Joint Powers Boards, etc. A pilot

study could be conducted for a county where good geologic information is available from county geologic atlases, groundwater data, hydrogeologic studies, and where cooperation from local government units is likely, such as Wabasha, Fillmore, or Olmsted Counties. MPCA groundwater studies from 2001 for these types of structures could supplement this type of analysis (look at old field log books from sample collection efforts.

4. **Investigate groundwater quality at larger manure storage basins** – Conduct focused investigations at manure storage basins that pose a greater risk to groundwater quality. Use information from MPCA Groundwater Monitoring and Assessment Program studies, a comprehensive literature review, and experiences from other states to prioritize site investigations. Collect samples of soil and groundwater with a geoprobe at basins with the following characteristics: unlined basins and or earthen basins, liquid storage greater than 5 million gallons, locations in hydrogeologic sensitive areas of the state with either sand/gravel or fractured bedrock beneath the basin, locations in areas that supply drinking water to wells or springs, and or the uppermost water bearing unit is an aquifer, located in a vulnerable drinking water supply management area, and with liner design seepage rates of 1/56"/day vs. 1/560"/day).

The testing of hormones and antibiotics should be considered for any of the monitoring efforts mentioned above because of their use in animal production and likely presence in manure.

Land application sites for industrial wastewaters and industrial by-products

This program review identifies program practices implemented by the MPCA Water Quality Permits Program to prevent the contamination of groundwater from the land application of industrial wastewaters and industrial by-products. It also identifies whether additional data is needed to better evaluate the effectiveness of program practices to protect groundwater resources and discusses other areas of potential concern.

Overview

The Water Quality Permits Program oversees the regulation and permitting of the land application of industrial wastewaters and industrial by-products, primarily generated by the food and beverage processing industry. The land application of industrial wastewaters is regulated primarily through National Pollutant Discharge Elimination System (NPDES) and State Disposal System (SDS) permits. These permits set limits on the land application of nutrient rich process wastewaters for its beneficial use as a fertilizer on agricultural fields. There are currently 25 facilities with NPDES/SDS permits that land apply industrial wastewaters, located mainly in southern and central Minnesota. At most of these facilities industrial wastewaters are applied by spray irrigation to fields planted to a forage crop during the growing season. These facilities have annual application rates that range between several million gallons up to 100 million gallons for larger facilities, in any given year. The regulations in the NPDES/SDS permits emphasize groundwater protection predicated upon good crop and irrigation management and set requirements for land application activities with the goal to protect both groundwater and surface water.

The land application of industrial by-products is regulated by the MPCA SDS general permit (MNG960000) for wastes generated from the food and beverage processing industry. Under the general permit, industrial by-products may be land applied for their beneficial use as a fertilizer and soil amendment to agricultural lands. Industrial by-products include materials such as: liquid or dewatered wastewater treatment sludges, wash water from small food preparation, whey from cheese processing, sweet corn silage, ethanol by-products and materials with similar characteristics. The total number of permitted facilities is approximately 70, with a lesser number applying biosolids in any given year. A gross estimate of land applied industrial by-products in 2009 indicates 61,700 dry metric tons of Industrial by-products were land applied, which is typical of most years. This is roughly 40 percent more than that reported for land applied biosolids in 2009.

A majority of industrial by-product management requirements were adopted from the biosolids rules (Minn. R. ch. 7041). The permit requirements for both industrial wastewater and industrial by-products have stated goals to protect water quality in accordance with Minn. Stat. chs. 115 and 116, and Minn. R.chs. 7001, 7050, 7060, and the U.S. Clean Water Act.

Nature of concern related to groundwater quality

Industrial wastewaters and industrial by-products are considered to be high strength organic wastes that may contain nutrients, salts, organic matter, and to a lesser degree, pathogens. Potential impacts to groundwater quality can occur from their over-application or improperly timed applications which can exceed the capacity of the soil/crop treatment zone to assimilate the nitrogen they contain, leading to nitrate contamination of the groundwater. In addition, salts in these materials can build up in soils and shallow groundwater leading to contamination of groundwater with chlorides.

Industrial wastewaters are typically applied through spray irrigation to the same fields continuously for many years. These types of applications have shown impacts to shallow groundwater in the form of nitrate-nitrogen and chlorides at some application sites. Most land application sites receiving high strength industrial wastewaters are required to monitor the groundwater, tile line discharge, soils and crops, and effluent water quality as a part of their permit requirements.

A number of industrial spray sites show elevated nitrate and chloride concentrations in the shallow water table adjacent to the application fields. Concentrations of nitrates or chlorides in excess of permit limits requires actions on the part of the facility to remedy these conditions that include; increased monitoring, reductions in applications, or entirely eliminating applications to a field. In general, groundwater contamination at most facilities have shown decreasing trends in recent years and continue to be monitored. There are currently no known cases of groundwater contamination in private or public water supply wells that are directly linked to industrial spray activities in Minnesota, in excess of drinking water standards.

In contrast to industrial wastewaters, most industrial by-products are surface applied or injected into soils and are routinely applied to different fields or different areas of a field from year to year. Conducting groundwater monitoring at industrial by-product application sites was considered in the development of the industrial by-product general permit; however, because of the characteristics of food and beverage industrial by-products and the numerous conservative management practices required in the general permit, they are considered to pose a limited environment risk to groundwater if managed properly. For these reasons, industrial by-product land application sites are not required to have groundwater monitoring systems in place.

Contaminants of concern

As noted above, the contaminants of concern in industrial wastewaters and industrial by-products include: nutrients (nitrogen and phosphorus primarily), salts, organic matter, and may contain pathogens. The risk from pathogen contamination in these materials is considered minimal because these materials are generated from food grade by-products. Overall, nutrients, organic matter, and pathogens are considered to be adequately treated where land application is conducted properly and should not create groundwater contaminant problems.

However, the Water Quality Permits Program is routinely faced with permitting decisions regarding the land application of “unusual industrial by-products” that do not fit the definition or characteristics of food and beverage industrial by-products. The industrial by-product general permit is designed to address by-products from the food and beverage industry and may not have appropriate requirements that are protective of human health and the environment for “unusual industrial by-products”. The program currently has a pressing need to better understand the fate and transport of constituents contained in “unusual industrial by-products” to avoid contamination of groundwater resources. Examples of unusual industrial by-products include petroleum compounds in wash waters generated from car washes (oil, grease and fuels); constituents contained in personal care products discharged by beauty shops, and wastes generated from various manufacturing facilities located outside of sewer service areas.

Program practices used to protect groundwater

As noted above, the Water Quality Permits Program regulates the land application of both industrial wastewaters and industrial by-products through NPDES and SDS permits. The permits set limits and conditions on the locations, quantities and characteristics of land applied industrial wastewaters and industrial by-products that are designed to prevent groundwater contamination.

Historically, program policy has required that land applied industrial wastewaters and industrial by-products must provide a beneficial use as a fertilizer or soil amendment and not be land applied solely for the purpose of waste disposal. However, if land application of some of the unusual wastes is approved, the policy on beneficial use may need to be changed. A number of the permit requirements provide specific protection of groundwater and several provide indirect protection of groundwater resources through management practices that prevent releases of pollutants to the environment, as follows:

- Industrial wastewater facilities that spray irrigate high strength effluent, which receives limited treatment, are required to conduct groundwater monitoring around their spray fields. In addition, these facilities are required to conduct rigorous environmental monitoring throughout the irrigation season that includes monitoring of: tile line discharges, wastewater effluent, cooling water, county ditches, soils, crops, and offsite monitoring of private wells.
- The permits for industrial wastewater application sites include intervention limits in groundwater for nitrate-nitrogen that are one-quarter of the drinking water standard for nitrate of 10 mg/l. In addition, the industrial wastewater permit sets a total chloride intervention limit at the secondary drinking water standard of 250 mg/l. An exceedance of either of these limits requires actions by the permittee to prevent these exceedances.
- Industrial wastewater facilities must have a Type V certified operator responsible for the day-to-day operations of the wastewater treatment disposal system.
- Industrial wastewater facilities must prepare a Sprayfield Management Plan that includes details of monitoring, irrigation scheduling, loading rates, soil moisture monitoring, runoff collection, drain tile discharge or collection, and crop management practices.
- Tile drainage systems beneath land application sites are also monitored and have limits set for ammonia-nitrogen and biological oxygen demand. Monitoring data from the tile line discharge is representative of the water quality that may be infiltrating to groundwater.
- Industrial by-products must be completely characterized before a permit can be issued for industrial by-product land application. Industrial by-products must not exceed specific concentration limits for metals, dioxin and PCBs, and cannot be a hazardous waste.
- The industrial by-product general permit requires that a Type IV certified operator oversee the land application of industrial by-products and ensure they are properly applied. Industrial by-product application sites must also be reviewed by the Type IV operator and their soils tested.
- Land-applied industrial by-products are subject to a number of limitations and restrictions that protect groundwater resources that include:
    1. Hydraulic loading limits based on soil texture
    2. Separation distances from drinking water wells, and sinkholes
    3. No industrial by-product applications on fallow ground for the cropping year
    4. Limits on nitrogen applications
    5. Additional restrictions on Industrial by-products that contain pathogens

The industrial by-product program has implemented an Unusual Waste Review that includes a multi-program task group to determine the proper management of unusual wastes, such as vehicle carwash wastewaters. These wastes may contain constituents that are not typically found in Industrial by-products that could impact groundwater quality and must be addressed accordingly.

Program data needs

1. **Groundwater evaluations** – A plan to determine if monitoring the groundwater for additional parameters of concern at industrial wastewater land application sites is strongly suggested by the Water Quality Permits Program to evaluate the impacts of spray irrigation of high biochemical oxygen demand (BOD) wastewaters from the food processing industry. Recently, the land application of high BOD wastewaters from the food processing industry in Michigan has been linked to the contamination of both public and private drinking water wells. The land application of high BOD wastewaters can create anaerobic conditions in the soils and surficial groundwater at spray fields and mobilize natural sources of arsenic, iron, and manganese into the groundwater. In addition, high strength BOD in combination with ethylenediaminetetraacetic acid (EDTA) (an additive used by some dairy and juice processors) has been shown to enhance mobilization of cobalt, nickel, cadmium and other heavy metals into groundwater. Because of the link between the land application of high BOD wastewaters and groundwater contamination, the Michigan Department of Environmental Quality has made changes in their permitting strategy for food processors.

   The Water Quality Permits Program is currently evaluating possible changes to the monitoring requirements in individual NPDES/SDS permits that will test for the presence of these groundwater contaminants. Implementing changes to groundwater monitoring requirements and possibly the management of land applied effluent at these facilities will likely require some technical assistance and a significant coordination effort with the permitted facilities to address this potentially significant concern.

2. **Unusual wastes** - the Water Quality Permits Program is routinely faced with permitting decisions regarding the land application of unusual wastes that do not fit the definition or characteristics of typical food and beverage Industrial by-products. For these waste streams, program staff must develop new requirements and limits to address contaminant constituents present in these materials. The program requires information on the fate and transport and toxic effects of contaminant compounds contained in unusual wastes in order to develop scientifically based application requirements. Examples of unusual wastes include petroleum compounds in wash waters generated from car washes (oil, grease and fuels), constituents contained in personal care products discharged by beauty shops (personal care products), and wastes generated from various manufacturing facilities located outside sewer service areas.

3. **Data review and reporting** - data regarding industrial by-product land application activities is entered into the MPCA Delta permit database each year; however, the volumes and acreages of land applied industrial by-products have been difficult to extract from the database. Program staff would like access to this data to evaluate the current status and trends of industrial by-product management. In addition, industrial by-product data provided to some facility operators in the MPCA's "Big Report" has been incorrect. MPCA program staff has corrected the Big Report; however, these corrections have not been successfully incorporated into the Report. This has led to instances where facilities are still receiving incorrect information for their permit required land application activities.

Stormwater Program

This program review identifies program practices implemented by the MPCA's Stormwater Program (SWP) that reduce and prevent the degradation of groundwater from stormwater runoff. It also identifies program areas where additional data is needed to better evaluate the effectiveness of SWP practices to protect groundwater resources and makes recommendations to address some of these data gaps.

Overview

The MPCA's SWP regulates the discharge of stormwater and snow melt runoff from municipal separate storm sewer systems (MS4), construction activities, and industrial facilities, mainly through the administration of NPDES/SDS permits. The SWP program oversees the permitting of approximately 240 municipal systems, 2,000 construction stormwater sites, and 2,500 industrial facilities, in any given year. Each program area

administers a general permit (and in some cases, individual permits) that incorporate state (Minn. R. ch. 7090) and federal Clean Water Act requirements to reduce the amount of sediment and pollution in stormwater runoff that enters surface and groundwater.

The SWP manages urban stormwater runoff by a combination of volume control practices (infiltrate, evaporate or reuse) along with traditional rate control practices (stormwater ponds) and new pollutant removal technologies (e.g. chemically enhanced treatments such as iron enriched sand filters). On a national scale, the U.S. Environmental Protection Agency (EPA) has strongly encouraged federal facilities and states to adopt low impact development, primarily for infiltration-based BMPs, and Better Site Design practices that protect forest and stream corridors.

In 2009, the Legislature directed the MPCA to develop standards or other tools to enable and promote the implementation of low-impact development and other stormwater management techniques. Minimal Impact Design Standards (MIDS) Minn. Stat. 2009 § 115.03, subd. 5c. Regulation of stormwater discharges…

(c.) The agency shall develop performance standards, design standards, or other tools to enable and promote the implementation of low-impact development and other stormwater management techniques. For the purposes of this section, "low-impact development" means an approach to stormwater management that mimic's a site's natural hydrology as the landscape is developed. Using low-impact development approach, stormwater is managed on-site and the rate and volume of predevelopment stormwater reaching receiving waters is unchanged. The calculation of predevelopment hydrology is based on native soil and vegetation.

A diverse group of stakeholders from the public and private sectors and the Minnesota Stormwater Steering Committee have worked with the MPCA to better manage stormwater runoff. Many of these parties now comprise a work group that meets monthly to advise the MPCA through the development of the voluntary MIDS tool. The MIDS products will include 1) site runoff rate and volume control goals, 2) a method to determine credits for those goals, and 3) a user-friendly calculator to input site conditions and credits. In addition, the EPA provided a grant to supplement the work occurring in Minnesota for model ordinance development and pilots of the products.

The project is on track for meeting the legislative requirements. The MPCA contracted with several consulting firms to conduct research and develop tools scheduled for completion in 2011. Minnesota Pollution Control Agency staff work and on-going input from the stakeholder work group will continue until the summer of 2011 to finalize the work products.

Nature of concern related to groundwater

The management of stormwater runoff is increasingly relying upon the infiltration of stormwater into the soil unsaturated zone, which ultimately leads to groundwater. To control stormwater runoff volume, a number of BMPs infiltrate stormwater into the soil where it can recharge groundwater aquifers. There are relatively few stormwater studies of the long-term performance, operation and maintenance of these BMPs and their groundwater recharge potential.

The MPCA has contracted with the University of Minnesota to summarize the state-of-the-art of infiltration science (Weiss, et.al, 2008) as well as awarded a 319 research grant ("Performance of Low Impact Practices on Stormwater Pollutant Load Abatement") to examine pollutant retention via laboratory column tests.

As noted in a University of Minnesota review on this subject "In summary, increased application of stormwater infiltration practices necessitates examination of possible contamination to soil and groundwater—a legitimate concern for the protection of human and environmental health. This review provides a valuable synopsis of the state of current research regarding stormwater infiltration and the associated possibilities for contamination. Although a fair number of studies in this pioneering field are available, some areas have been neglected and most warrant further study. Therefore, the appropriate information regarding the pollution risks associated with choosing infiltration—and the often greater pollution risks of *not* choosing infiltration—must be available to optimize and execute appropriate water resources management decisions."

Currently, there is a lack of empirical data to fully understand the impacts of different stormwater BMPs on groundwater quality. Stormwater permits do not require monitoring of groundwater or subsoil infiltration systems to determine whether stormwater management is having an impact on groundwater quality.

Contaminants of concern

Stormwater runoff, including snowmelt, contains pollutants, such as nutrients, pathogens, heavy metals, solids, organic compounds such as oil and pesticides, and chlorides. Mobile chemicals such as chloride, nitrate, and some organic compounds are of primary concern and other chemicals, such as heavy metals, may be a concern for BMPs that are not properly constructed and maintained.

Program practices used to protect groundwater

The SWP program applies a variety of program BMPs that provide treatment of stormwater runoff prior to it entering surface waters or infiltrating to groundwater. These BMPs are incorporated into permits as requirements of stormwater pollution prevention plans, presented as guidelines and recommendations in the Stormwater Manual, and promoted through fact sheets and control standards.

- Stormwater permits regulate the discharge of stormwater and snow melt runoff through administration of a general permit, and in some cases, individual permits, for MS4, construction activities, and industrial facilities. These permits require stormwater pollution prevention plans that include BMPs which are described in the Stormwater Manual.
- The Minnesota Stormwater Manual provides guidelines, recommendations and design options for stormwater BMPs that address stormwater infiltration to groundwater. More specifically, Chapters 12-8 and 14 of the Manual address stormwater infiltration to groundwater that includes considerations for sensitive groundwater settings such as karst bedrock, areas with shallow bedrock and groundwater, and soils with low infiltration capacity. Additional BMPs are also provided in Issue Paper H "Potential Stormwater Hotspots, Pollution Prevention, Groundwater Concerns and Related Issues." which address BMP design and groundwater protection. These BMPs may be incorporated into SWPPs and become an enforceable part of SWP permits.
- Minimum Impact Design Standards - the SWP is currently working on the development of low impact design standards for stormwater BMPs that will mimic the site's natural hydrologic conditions for new development and redevelopment sites. A part of this effort includes plans to evaluate the effects of infiltration practices on water quality beneath these BMPs to better understand their potential impacts to underlying groundwater. The MIDS workgroup has identified areas where stormwater infiltration may be restricted or not feasible, that include: karst topography, poor soils, shallow bedrock, shallow confining layer/rough terrain, shallow groundwater, and potential hotspots as identified in the BMP position paper cited above.
- The SWP has also supported research efforts to better understand the impacts of stormwater infiltration impacts on groundwater that includes a 319 research grant ("Performance of Low Impact Practices on Stormwater Pollutant Load Abatement") which is examining pollutant retention via laboratory column tests and the University of Minnesota Report, "Contamination of Soil and Groundwater Due to Stormwater Infiltration Practices", June, 2008.

Program data needs

1. Promote the creation of statewide GIS data layers to evaluate options to infiltrate stormwater in new development and redevelopment areas in relation to wellhead protection zones, extremely vulnerable aquifers (e.g. sand/gravel outwashes over bedrock), depth to shallow groundwater, and hydrologic soil groups (A, B, C, and D).
2. Develop case studies to assess groundwater impacts for stormwater infiltration BMPs in collaboration with outside partners, such as: MIDS partners, municipalities, watershed districts, and other state agencies. The case studies would be designed to evaluate the long-term performance, costs and operation/maintenance of

BMPs and assess the quantity and quality of infiltrated water to the groundwater below the BMPs. Data needs objectives for these studies would focus on:

1. Identification of petroleum constituents (DRO/GRO), nutrients, chlorides/bromine and heavy metals, estimated infiltrated volumes, groundwater mounding potentials and general corroboration of MIDS calculators
2. Measurement of long term volumes infiltrated using simple to complex assessment methods, largely relying upon partnering agencies for primary financial support
3. Assessment of changes in shallow groundwater that relate to potential issues for buried utilities and structure basement flooding (e.g. groundwater mounding potential)
4. Locations of BMPs relative to wellhead protection areas and their emergency response areas for source water protection
5. Residential new development projects
6. Evaluation of failed infiltration projects to determine causes (case studies) via MIDS Work Group Team partner participation
7. Brownfield sites where stormwater BMPs involving infiltration, filtration, storage or evaporation are in-place

3. Data collection for stormwater infiltration projects should be conducted for the case studies mentioned above and other stormwater projects where BMPs may affect groundwater quality. Components of this effort could include:
    1. Advancement of standardized data collection protocols through development of recommendations and guidelines for sample collection and analysis
    2. Collection of monitoring data for input to a common database that allows for access by outside stakeholders
    3. Data interpretation and reporting

Biosolids Program

This program review identifies program practices implemented by the MPCA Biosolids Program to prevent the contamination of groundwater. It also identifies whether additional data is needed to better evaluate the effectiveness of biosolids program practices to protect groundwater resources and notes other areas of potential concern related to the land application of biosolids and groundwater quality.

Overview

The Biosolids Program oversees the land application and storage of municipal sewage sludge or biosolids for its beneficial use as a fertilizer or soil conditioner in accordance with Minn. R. ch. 7041. Biosolids are a nutrient-rich solid, semisolid, or liquid organic material that results from the treatment of domestic wastewater (sewage sludge) by municipal treatment plants. Biosolids are land applied to improve the fertility of cropland and forestland, as well as to restore and re-vegetate land impacted by the mining of iron and taconite (Met Council).

In Minnesota, the total biosolids produced for 2009 was approximately 148,723 metric dry tons, 30 percent was land applied, 16 percent was landfilled and 54 percent was incinerated. The number of facilities generating biosolids on a regular basis is 281 (MPCA). On a tonnage basis, the majority of Minnesota biosolids are incinerated in St. Paul and Eagan. Many municipal wastewater treatment facilities manage biosolids by land application with Grand Rapids being the only municipality that landfills biosolids continuously. In 2009, biosolids were land applied on approximately 18,500 acres, a majority of which was applied to agricultural fields planted to field corn and soybeans.

Nature of concern related to groundwater

Biosolids contain nutrients (nitrogen and phosphorus), pathogens, trace metals and persistent organic compounds and are routinely applied to agricultural lands as a soil amendment. If biosolids are improperly applied, some pollutants such as nitrogen could potentially leach past the soil/crop treatment zone and negatively impact groundwater quality.

The primary concern with the improper land application of biosolids to groundwater quality is from nitrate/nitrogen impacts, and to a lesser degree, pathogens. However, the conservative management requirements for land-applied biosolids make the likelihood of impacting groundwater quality negligible. The management of biosolids requires that all land applied biosolids must be processed and tested before use and be low in potential contaminants and treated to reduce the levels of pathogens and odor.

As previously mentioned, biosolids were land applied on 18,500 acres in 2009; this represents less than 0.1 percent of the land planted to principal crops across the state, based on state agriculture statistics for 2009. Overall, the conservative management of land applied biosolids and the relatively small acreage they are applied to suggest land applied biosolids pose a limited risk to groundwater quality, as long as they are managed in accordance with Minn. R. ch. 7041.

Contaminants of concern

As noted above, the contaminants of concern in biosolids include: nutrients (nitrogen and phosphorus primarily), trace metals, pathogens, and persistent organic compounds. Nitrogen application rates in biosolids are regulated to meet the agronomic needs of crops grown on the application sites to avoid potential nitrate impacts to groundwater quality. In general, phosphorus is considered to be readily adsorbed to soil and not a threat to groundwater quality. Pathogens are treated in biosolids prior to land application and in the soil when land applied, and trace metals are tracked and regulated to prevent their excess accumulation. Overall, nutrients, pathogens, and trace metals are considered to be adequately regulated by the Biosolids Program requirements and should not create groundwater contaminant problems.

Persistent organic compounds that include pharmaceuticals, personal care products, steroids, and hormones may be present in biosoilds and are not specifically addressed within the scope of the Biosolids Program. However, the Environmental Protection Agency (EPA) has conducted a study to evaluate these compounds in treated sewage sludge, the Targeted National Sewage Sludge Survey. Treated sewage sludge was tested from facilities across the contiguous United States for 145 analytes that included: metals, organics, polybrominated diphenyl ethers, pharmaceuticals, steroids, and hormones. Test results from this study will be used by the EPA to evaluate biosolids from the nation's municipal treatment plants. The results may also support the risk analysis for biosolids and development of pollutant limitations that is related to EPA's comprehensive requirements for biosolids, set forth under Part 503 of 40 CFR. The current MPCA biosolids rules (Minn. R. ch. 7041) incorporate all of 40 CFR Part 503 requirements for land applying public and private biosolids. In the event the EPA promulgates new requirements for biosolids related to persistent organic compounds, it is reasonable to assume these requirements will be considered by the Biosolids Program.

Program practices used to protect groundwater

The Biosolids Program applies Minn. R. ch. 7041 to biosolids land application operations in Minnesota. Minn. R. ch. 7041 includes all of EPA's 40 CFR Part 503 requirements for land applying public and private biosolids. Together these rules regulate the pathogen and vector attraction treatment standards and chemical monitoring of biosolids that are land applied, and establish criteria for the permitting, land application site approval, storage, pollutant limits, management practices and limitations, recordkeeping, and reporting of biosolids that are land applied in Minnesota.

Biosolids land application must follow minimum design requirements. A number of these requirements provide specific protection of groundwater and several provide indirect protection of groundwater resources through management practices that prevent releases of pollutants to the environment, as follows:

- Stricter management practices are required for highly permeable soils that receive biosolids, based on the time of year of biosolid applications.
- Nitrogen application rates must comply with agronomic application rate requirements set in federal rule. The agronomic rate is the sludge application rate which is designed to 1) provide the amount of nitrogen needed by the food crop, feed crop, fiber crop, or vegetation grown on the land, and 2) to minimize the amount of nitrogen in the sewage sludge that passes below the root zone to the groundwater.
- Biosolids rules require a minimum separation distance to bedrock and the seasonal high water table of three to five feet to allow for soil conditions which are necessary to treat the sewage sludge, as well as provide a good growing environment for crops.
- Biosolids may not be applied within 1000 feet of a public water supply well or within 200 feet of private wells to avoid possible direct contamination of a well or water supply.
- Biosolids applications are prohibited on fallow land because there is no crop growing which will remove the nitrogen supplied by the sewage sludge.
- A crop must be growing on the site if sewage sludge is applied in June, July, and August so that any nitrogen applied is taken up by the crop rather than potentially lost to groundwater.
- Sewage sludge application is not allowed on cropland when the soil phosphorus test is greater than 200 part per million unless an NRCS conservation plan is in place.

Program data needs and recommendations

Specific to groundwater protection concerns, no recommendations for additional data collection or program work are needed for the Biosolids Program.

The Biosolids Program deals with thousands of biosolid land application sites which have their locations recorded in the MPCA's Delta database. Should the need arise, the Biosolids Program may want to update their land application site information in Delta to reflect changes in site locations and acreages if this data is to be used for any type of analysis.

There is a program interest to better understand the fate of persistent organic compounds likely to be present in biosolids (pharmaceuticals, personal care products, steroids, and hormones). However, the financial and staff resources necessary to conduct this type of work are beyond the scope of the program's resources. Currently, the testing of persistent organics in biosolids is being conducted by the EPA. It is reasonable to expect the Biosolids Program will stay current with EPA's research in this area and look for results from any risk analysis or development of pollutant limitations resulting from EPA's work.

Inflow and Infiltration

Nature of concern related to groundwater

The concern has been raised that leakage from municipal wastewater piping systems or city sewers may be contributing to groundwater pollution and should be addressed within the scope of a review of MPCA groundwater protection practices. City sewers are known to have problems with Inflow and Infiltration (I&I), or excess water entering sewer systems from groundwater and stormwater through holes, cracks, joints and faulty connections. However, the reverse process of wastewater leaking out of sewer pipes or exfiltration may also affect groundwater quality. The following comments were gathered from conversations with MPCA staff in the Municipal Wastewater Section.

There are thousands of miles of city sewer piping and infrastructure in various conditions throughout the state; however, there are no known volumes of wastes that can realistically be estimated as impacting groundwater from systems that do leak. Inflow and infiltration could be occurring anywhere there are city sewer systems, so it is

probable this would be occurring within wellhead protection areas and vulnerable aquifers. There is no list of sites where I&I impacts to groundwater are being investigated or targeted for investigation.

I&I is recognized as a concern from the engineering perspective of groundwater leaking into old or broken sewer pipes and increasing the volume of water going to the treatment plant (POTW). There is a wastewater infrastructure funding program that funds sewer rehabilitation projects where I&I may be a problem. These projects are ranked on the Clean Water Project Priority List and overseen by the Minnesota Public Facilities Authority and other state agencies, MPCA included (see January 27, 2010 Report to House Environment and Natural Resources Finance Division.). Rehabilitation projects do fix leaky sewer problems and they test the sewers for leakage when new systems are installed. Sewer rehabilitations use materials that are less likely to leak than materials used in the past and sanitary sewer piping is separated from stormwater piping systems (Dave Sahli).

The main contaminants in sewage include: bacteria measured as fecal coliform, biological oxygen demand (BOD), nitrogen, phosphorus, and numerous other parameters from improper disposal of household wastes and industrial wastes that could contain contaminants of emerging concern (CECs).

The MPCA staff noted the biggest potential impacts to groundwater from city sewers would likely be from a complete pipe failure; however, that would likely result in a sewer back-up or overflow and would be identified. In addition, dry weather flow into the POTW can also be used to determine if significant leakage is occurring. If there is less flow volume than predicted by user inputs, the piping system probably leaks into the surrounding soils and groundwater.

Overall, the ability to locate and assess the impacts of leaking sewer pipes to groundwater would be very difficult to assess and monitor without exact locations of leakage. Leakage can flow along the pipe trench within the gravel sub base most pipes are laid in and enter soils or groundwater in a different area from that of the leakage. Methods such as dye tracing or video logs of piping could be used to locate leakage that may affect groundwater; however, as stated previously there is no list of sites that are being monitored or investigated for leakage impacts to groundwater.

Summary of Findings

A review of MPCA program documents and interviews with program staff indicate that several MPCA programs require groundwater quality monitoring data to verify whether their groundwater BMPs are protective of groundwater resources. More specifically, this includes groundwater monitoring of mid-sized septic systems (MSTS sites), select animal feedlot manure storage basins, stormwater infiltration sites, and enhanced monitoring at specific industrial wastewater land application sites.

In addition, analysis of existing groundwater quality data sets was also identified as a need to assess the impacts of program BMPs. The Demolition Landfill Program has a pressing need to conduct a statistical data analysis of groundwater monitoring data collected over the last eight to ten years from demolition landfills to assess the impacts of program BMPs contained in their Demolition Landfill Guidelines. The Animal Feedlot Program would also benefit from an analysis of a water quality database collected from larger permitted facilities collected from monitoring wells and tile drainage discharge stations.

Furthermore, program staff has identified a need to collect and store data in a database that allows for meaningful analysis and data sharing. Currently, the bulk of data generated by the Solid Waste Demolition Landfill program and for the land application of Industrial wastewaters and Industrial by-products is stored in the MPCA Delta database. Furthermore, data generated from the monitoring of stormwater infiltration sites should also be collected, assessed and made available to outside parties.

Summaries of the MPCA program data needs are provided in Appendix B in table form and more detailed descriptions are found at the end of each program write-up under the “Program BMPs and Data Needs Findings” section of the report.

Work plans

The next step in this process is to execute the third goal of the Agency's strategic plan which is to develop work plans to address program data needs that will enhance program groundwater BMPs. Developing work plans must be conducted with program staff and management and will need to consider a number of factors, some of which include: available funding, staff resources, program readiness, scope or length of project, material costs, and whether the BMP evaluation should be conducted solely by the MPCA staff or jointly with outside stakeholders, consultants, responsible parties, other government entities, or contracted out entirely.

Several programs are moving forward with their priority data needs collection; however, these are limited by staffing resources. Both the Demolition Landfill and Stormwater Programs have taken initial steps to collect data for their priority needs, and the SSTS program and IW land application programs have set their priority data needs and are looking for resources and outside partners to initiate data collection.

Appendix A

Groundwater Protection Act – Chapter 103H

CHAPTER 103H
GROUNDWATER PROTECTION

GENERAL PROVISIONS

103H.001 DEGRADATION PREVENTION GOAL.

It is the goal of the state that groundwater be maintained in its natural condition, free from any degradation caused by human activities. It is recognized that for some human activities this degradation prevention goal cannot be practicably achieved. However, where prevention is practicable, it is intended that it be achieved. Where it is not currently practicable, the development of methods and technology that will make prevention practicable is encouraged.

History: *1989 c 326 art 1 s 1*

103H.005 DEFINITIONS.

Subdivision 1. **Applicability.** The definitions in this section apply to this chapter.

Subd. 2. **Agricultural chemical.** "Agricultural chemical" means a pesticide, fertilizer, plant amendment, or soil amendment.

Subd. 3. **Health risk limits.** "Health risk limits" means a concentration of a substance or chemical adopted by rule of the commissioner of health that is a potential drinking water contaminant because of a systemic or carcinogenic toxicological result from consumption.

Subd. 4. **Best management practices.** "Best management practices" means practicable voluntary practices that are capable of preventing and minimizing degradation of groundwater, considering economic factors, availability, technical feasibility, implementability, effectiveness, and environmental effects. Best management practices apply to schedules of activities; design and operation standards; restrictions of practices; maintenance procedures; management plans; practices to prevent site releases, spillage, or leaks; application and use of chemicals; drainage from raw material storage; operating procedures; treatment requirements; and other activities causing groundwater degradation.

Subd. 5. **Common detection.** "Common detection" means detection of a pollutant that is not due to misuse or unusual or unique circumstances, but is likely to be the result of normal use of a product or a practice.

Subd. 6. **Degradation.** "Degradation" means changing groundwater from its natural condition by human activities.

Subd. 7. **Fertilizer.** "Fertilizer" has the meaning given in section 18C.005, subdivision 11.

Subd. 8. **Groundwater.** "Groundwater" means groundwater as defined in section 115.01, subdivision 6.

Subd. 9. **Pesticide.** "Pesticide" has the meaning given in section 18B.01, subdivision 18.

Subd. 10. **Plant amendment.** "Plant amendment" has the meaning given in section 18C.005, subdivision 25.

Subd. 11. **Pollutant.** "Pollutant" means a chemical or substance for which a health risk limit has been adopted.

Subd. 12. **Pollution.** "Pollution" means degradation of groundwater by a pollutant.

Subd. 13. **Sensitive area.** "Sensitive area" means a geographic area defined by natural features where there is a significant risk of groundwater degradation from activities conducted at or near the land surface.

Subd. 14. **Soil amendment.** "Soil amendment" has the meaning given in section 18C.005, subdivision 34.

Subd. 15. **Water resource protection requirements.** "Water resource protection requirements" means requirements adopted by rule for one or more pollutants intended to prevent and minimize pollution of groundwater. Water resource protection requirements include design criteria, standards, operation and maintenance procedures, practices to prevent releases, spills, leaks, and incidents, restrictions on use and practices, and treatment requirements.

History: *1989 c 326 art 1 s 2*

PROTECTION OF SENSITIVE AREAS

103H.101 PROTECTION OF SENSITIVE AREAS.

Subdivision 1. **Criteria for determination of sensitive areas.** The commissioner of natural resources in consultation with the Minnesota Geological Survey, soil and water conservation districts, local water planning authorities, and other interested parties shall develop specific criteria for identifying sensitive groundwater areas and adopt the criteria by rule.

Subd. 2. **Identification of sensitive areas.** The commissioner of natural resources shall, in consultation with the Minnesota Geological Survey, identify the location of sensitive areas by mapping and other appropriate methods after consulting the Minnesota Geological Survey, soil and water conservation districts, and local water planning authorities.

Subd. 3. **Notification of location of sensitive areas.** The commissioner of natural resources shall:

(1) notify political subdivisions with planning or zoning authority and provide maps and other materials that show where sensitive areas are located and indicate the type of risk of groundwater degradation that may occur from activities at or near the surface; and

(2) publish notification of sensitive areas in a newspaper of general circulation in the county where the sensitive areas are located.

Subd. 4. **Information gathering.** The commissioner of natural resources shall coordinate the collection of state and local information to identify sensitive areas. Information must be

automated on or accessible to systems developed at the Minnesota Geospatial Information Office.

Subd. 5. **State protection of sensitive areas.** (a) The commissioner of agriculture for pollution resulting from agricultural chemicals and practices and the Pollution Control Agency for other pollutants must consider the type of risk identified under subdivision 3 when adopting best management practices, water resource protection plans, and water resource protection requirements to prevent and minimize groundwater degradation in sensitive areas.

(b) To prevent and minimize groundwater degradation, state agencies must consider the type of risk identified under subdivision 3 when undertaking an activity within a sensitive area.

Subd. 6. **Actions by regulating authorities.** Upon adoption of a comprehensive local water plan as defined in section 103B.101 to 103B.355 or a water management plan under chapter 473 or sections 103B.201 to 103B.255, a regulating authority must take into account the plan and any geological assessments referenced in the plan when taking appropriate actions in sensitive areas.

Subd. 7. **State agencies.** Each state agency that has a program affecting activities that may cause or contribute to groundwater pollution shall identify and develop best management practices to ensure that the program is consistent with and is effective in achieving the goal of section 103H.001. For those activities which may cause or contribute to pollution of groundwater, but are not directly regulated by the state, best management practices shall be promoted through education, support programs, incentives, and other mechanisms.

History: *1989 c 326 art 1 s 3; 1990 c 391 art 10 s 3; 1991 c 345 art 2 s 16; 2009 c 101 art 2 s 107*

103H.105 CONSERVATION EASEMENTS TO PROTECT SENSITIVE AREAS.

(a) Agricultural land within a sensitive area identified in section 103H.101, subdivision 2, or by the Board of Water and Soil Resources and land in or immediately surrounding a sinkhole is marginal agricultural land for purposes of section 103F.515, subdivision 2, and is eligible for the reinvest in Minnesota reserve program under section 103F.515.

(b) Notwithstanding section 103F.515, subdivision 2, paragraph (c), clauses (1) and (4), and subdivision 4, the Board of Water and Soil Resources may authorize acquisition of hillside easements that restrict hillside pasturing or grazing of livestock.

History: *1989 c 326 art 1 s 4; 1990 c 391 art 10 s 3; 2009 c 176 art 1 s 50*

103H.111 LIABILITY AFTER PROTECTION OF SENSITIVE AREA.

(a) A landowner within a sensitive area, identified under section 103H.101, has a complete defense to liability for degradation of groundwater caused by surface water from the sensitive area recharging groundwater if:

(1) the landowner's portion of the sensitive area is subject to a plan adopted by the soil and water conservation district to protect the groundwater from degradation through surface water recharge;

(2) the projects and practices required by the plan have been implemented and have been certified as having been implemented by the soil and water conservation district;

(3) the projects and practices required by the plan are maintained according to the plan; and

(4) the landowner has not allowed unlawful practices on the property that disrupt the projects and practices required by the plan.

(b) The soil and water conservation district's plan must include appropriate best management practices and water resource protection requirements.

History: *1989 c 326 art 1 s 5*

103H.151 BEST MANAGEMENT PRACTICES.

Subdivision 1. **Development by Pollution Control Agency.** Except as provided in subdivision 2 for agricultural chemicals and practices, the Pollution Control Agency in consultation with local water planning authorities shall develop best management practices for the prevention of groundwater degradation for specific activity categories. The Pollution Control Agency shall contact and solicit comments from affected persons and businesses in developing the best management practices. The Pollution Control Agency must publish notice and also solicit comments and recommendations from state agencies and local governments affected by or regulating the activities.

Subd. 2. **Agricultural chemical best management practices.** The commissioner of agriculture, in consultation with local water planning authorities, shall develop best management practices for agricultural chemicals and practices. The commissioner shall give public notice and contact and solicit comment from affected persons and businesses interested in developing the best management practices.

Subd. 3. **Education and promotion.** The commissioners of the Pollution Control Agency and agriculture, in conjunction with the Board of Water and Soil Resources, soil and water conservation districts, and the Minnesota Extension Service, must promote best management practices and provide education about how the use of best management practices will prevent, minimize, reduce, and eliminate the source of groundwater degradation. The promotion and education shall include demonstration projects.

Subd. 4. **Evaluation.** The commissioners of agriculture and the Pollution Control Agency shall, through field audits and other appropriate means, monitor the use and effectiveness of best management practices developed and promoted under this section. The information collected must be submitted to the Environmental Quality Board, which must include the information in the report required in section 103A.43, paragraph (d).

History: *1989 c 326 art 1 s 6; 1995 c 220 s 94*

GROUNDWATER QUALITY MONITORING

103H.175 GROUNDWATER QUALITY MONITORING.

Subdivision 1. **Monitoring results to be submitted to Minnesota Geospatial Information Office.** The results of monitoring groundwater quality by state agencies and political subdivisions must be submitted to the Minnesota Geospatial Information Office.

Subd. 2. **Computerized database.** Agencies monitoring groundwater shall maintain computerized databases of the results of groundwater quality monitoring using standards adopted by the Office of Enterprise Technology and geospatial technology standards and guidelines published by the Minnesota Geospatial Information Office. The database must be accessible to the Pollution Control Agency, Department of Agriculture, Department of Health, and Department of Natural Resources.

Subd. 3. **Report.** In each even-numbered year, the Pollution Control Agency, in cooperation

with other agencies participating in the monitoring of water resources, shall provide a draft report on the status of groundwater monitoring to the Environmental Quality Board for review and then to the house of representatives and senate committees with jurisdiction over the environment, natural resources, and agriculture as part of the report in section 103A.204.

History: *1989 c 326 art 1 s 7; 1991 c 345 art 2 s 17,18; 1994 c 557 s 16; 1999 c 86 art 3 s 11; 2009 c 101 art 2 s 107; 2010 c 392 art 1 s 12*

HEALTH RISK LIMITS

103H.201 HEALTH RISK LIMITS.

Subdivision 1. **Procedure.** (a) If groundwater quality monitoring results show that there is a degradation of groundwater, the commissioner of health may promulgate health risk limits under subdivision 2 for substances degrading the groundwater.

(b) Health risk limits shall be determined by two methods depending on their toxicological end point.

(c) For systemic toxicants that are not carcinogens, the adopted health risk limits shall be derived using United States Environmental Protection Agency risk assessment methods using a reference dose, a drinking water equivalent, and a relative source contribution factor.

(d) For toxicants that are known or probable carcinogens, the adopted health risk limits shall be derived from a quantitative estimate of the chemical's carcinogenic potency published by the United States Environmental Protection Agency and determined by the commissioner to have undergone thorough scientific review.

Subd. 2. **Adoption.** (a) Health risk limits shall be adopted by rule.

(b) If the commissioner determines that emergency conditions exist and the public health and welfare require the health risk limits to be adopted as soon as possible, the commissioner shall promulgate the adopted health risk limits notwithstanding chapter 14 but the adopted health risk limits adopted under this paragraph are only effective for one year.

Subd. 3. **Review and revision.** (a) The commissioner shall review each adopted health risk limit at least every four years.

(b) The commissioner may revise health risk limits under subdivision 2.

Subd. 4. **Adoption of existing recommended allowable limits.** (a) Notwithstanding and in lieu of subdivision 2, until November 1, 1994, the commissioner may adopt recommended allowable limits, and related toxicological end points, established by the commissioner on or before February 15, 1994, as health risk limits under this subdivision. Before a recommended allowable limit is adopted as an adopted health risk limit under this subdivision, the commissioner shall:

(1) publish in the State Register and disseminate through the Minnesota Extension Service and through soil and water conservation districts notice of intent to adopt a recommended allowable limit as an adopted health risk limit for specific substances and shall solicit information on the health impacts of the substance;

(2) publish the recommended allowable limit in the State Register and disseminate through the Minnesota Extension Service and through soil and water conservation districts allowing 60 days for public comment; and

(3) publish the adopted recommended allowable limit in the State Register and, at the same time, make available a summary of the public comments received and the commissioner's responses to the comments.

(b) A recommended allowable limit adopted by the commissioner as an adopted health risk limit under this subdivision may be challenged in the manner provided in sections 14.44 and 14.45.

(c) During the comment period under paragraph (a), clause (2), 25 or more persons may submit a written request for a public hearing as provided under section 14.25 for any health risk limits as adopted under this subdivision.

History: *1989 c 326 art 1 s 8; 1994 c 557 s 17,18*

EVALUATION AND COMMON DETECTION OF POLLUTION

103H.251 EVALUATION OF DETECTION OF POLLUTANTS.

Subdivision 1. **Methods.** (a) The commissioner of agriculture for pollution resulting from agricultural chemicals and practices and the Pollution Control Agency for other pollutants shall evaluate the detection of pollutants in groundwater of the state. Evaluation of the detection may include collection technique, sampling handling technique, laboratory practices, other quality control practices, climatological conditions, and potential pollutant sources.

(b) If conditions indicate a likelihood of the detection of the pollutant or pollutant breakdown product to be a common detection, the commissioner of agriculture or the Pollution Control Agency must begin development of best management practices and continue to monitor for the pollutant or pollutant breakdown products.

Subd. 2. **Analysis of pollution trend.** The commissioner of agriculture for pollution resulting from agricultural chemicals and practices and the Pollution Control Agency for other pollutants shall develop and implement groundwater monitoring and hydrogeologic evaluation following pollution detection to evaluate pollution frequency and concentration trend. Assessment of the site-specific and pollutant-specific conditions and the likelihood of common detection must include applicable monitoring, pollutant use information, physical and chemical properties of the pollutant, hydrogeologic information, and review of information and data from other local, state, or federal monitoring databases.

History: *1989 c 326 art 1 s 9*

103H.275 MANAGEMENT OF POLLUTANTS WHERE GROUNDWATER IS POLLUTED.

Subdivision 1. **Areas where groundwater pollution is detected.** (a) If groundwater pollution is detected, a state agency or political subdivision that regulates an activity causing or potentially causing a contribution to the pollution identified shall promote implementation of best management practices to prevent or minimize the source of pollution to the extent practicable.

(b) The Pollution Control Agency, or for agricultural chemicals and practices, the commissioner of agriculture may adopt water source protection requirements under subdivision 2 that are consistent with the goal of section 103H.001 and are commensurate with the groundwater pollution if the implementation of best management practices has proven to be ineffective.

(c) The water resources protection requirements must be:

(1) designed to prevent and minimize the pollution to the extent practicable;

(2) designed to prevent the pollution from exceeding the health risk limits; and

(3) submitted to the house of representatives and senate committees with jurisdiction over the environment, natural resources, and agriculture.

Subd. 2. **Adoption of water resource protection requirements.** (a) The Pollution Control Agency, or for agricultural chemicals and practices, the commissioner of agriculture shall adopt by rule water resource protection requirements that are consistent with the goal of section 103H.001 to prevent and minimize the pollution to the extent practicable. The proposed rule must be submitted to the house of representatives and senate committees with jurisdiction over the environment, natural resources, and agriculture before adoption. The water resource protection requirements must be based on the use and effectiveness of best management practices, the product use and practices contributing to the pollution detected, economic factors, availability, technical feasibility, implementability, and effectiveness. The water resource protection requirements may be adopted for one or more pollutants or a similar class of pollutants. A water resource protection requirement may not be adopted before January 1, 1991.

(b) Before the water resource protection requirements are adopted, the Pollution Control Agency or the commissioner of agriculture for agricultural chemicals and practices must notify affected persons and businesses for comments and input in developing the water resource protection requirements.

(c) Unless the water resource protection requirements are to cover the entire state, the water resource protection requirements are only effective in areas designated by the commissioner of the Pollution Control Agency by order or for agricultural chemicals and practices in areas designated by the commissioner of agriculture by order. The procedures for issuing the order and the effective date of the order must be included in the water resource protection requirements rule.

(d) The water resource protection requirements rule must contain procedures for notice to be given to persons affected by the rule and order of the commissioner. The procedures may include notice by publication, personal service, and other appropriate methods to inform affected persons of the rule and commissioner's order.

(e) A person who is subject to a water resource protection requirement may apply to the Pollution Control Agency, or for agricultural chemicals and practices the commissioner of agriculture, and suggest an alternative protection requirement. Within 60 days after receipt, the agency or commissioner of agriculture must approve or deny the request. If the Pollution Control Agency or commissioner of agriculture approves the request, an order must be issued approving the alternative protection requirement.

(f) A person who violates a water resource protection requirement relating to pollutants, other than agricultural chemicals, is subject to the penalties for violating a rule adopted under chapter 116. A person who violates a water resource protection requirement relating to agricultural chemicals and practices is subject to the penalties for violating a rule adopted under chapter 18D.

History: *1989 c 326 art 1 s 10; 1999 c 86 art 3 s 12*

103H.280 AUTHORITY IS SUPPLEMENTAL.

The authority of the Pollution Control Agency and the commissioner of agriculture in this chapter is supplemental to other authority given by law and does not restrict other authorities.

History: *1989 c 326 art 1 s 11*

Appendix B

Minnesota Pollution Control Agency Program Data Needs to Enhance Best Management Practices for Groundwater Protection

MPCA program data needs to enhance best management practices for groundwater protection

MPCA Programs	Program Data Needs & Recommendations
Solid Waste Demolition Landfill Program	1. Groundwater data analysis of existing data set. 2. Groundwater monitoring system analysis. 3. Leachate testing of demolition waste. 4. Additional Legislative Report recommendations (sensitivity siting, rule writing, waste stream testing).
Subsurface Sewage Treatment Systems (SSTS) Program	1. Groundwater monitoring at MSTS sites. 2. Assess impacts of smaller ISTS to groundwater. 3. Monitoring for CECs.
Animal Feedlot Program	1. Water quality testing of drain tile discharge at manure storage basins. 2. Groundwater & tile discharge analysis at permitted facilities. 3. Evaluate older manure storage basins in SE Minnesota karst region. 4. Investigate groundwater quality at larger manure storage basins.
Land Application of Industrial Wastewaters and IBPs	1. Unusual wastes and their environmental fate for land application scenarios. 2. Groundwater contamination at high BOD irrigation sites (As, Fe & Mn). 3. Program data review – Delta database. 4. Data reporting – MPCA "Big Report".
Stormwater Program	1. Promote creation of statewide GIS layers to evaluate options to infiltrate stormwater in new development and redevelopment areas. 2. Develop case studies to assess groundwater impacts for stormwater infiltration BMPs. 3. Data collection for stormwater infiltration projects.
Biosolids Program	1. No specific recommendations for groundwater monitoring. 2. Update site information for land application sites in the Delta database. 3. Better understand the fate of persistent organic compounds in biosolids, i.e. pharmaceuticals, personal care products, steroids, and hormones).
Inflow and Infiltration (I&I)	1. Limited groundwater impact concerns. Concerns relate to groundwater leaking into wastewater infrastructure. Investigating leakage to groundwater would be difficult and has not been done in the Municipal Program.