LEGISLATIVE REPORT OF THE FEEDLOT HYDROGEN SULFIDE PROGRAM.

1997 Minn. Laws Chap. 216 Sec. 159

LEGISLATIVE REPORT OF THE FEEDLOT HYDROGEN SULFIDE PROGRAM.

Submitted to the State of Minnesota
Legislature on February 1, 1998
by the
Minnesota Pollution Control Agency

TABLE OF CONTENTS

Commissioner's Letter ..... *i*
Executive Summary ..... *ii*

I. INTRODUCTION ..... page 1
A. Overview of Feedlot Regulation and Enforcement ..... page 1
B. Summary of Feedlot Air Quality Regulation ..... page 2

II. OUTLINE OF FEEDLOT HYDROGEN SULFIDE PROGRAM DEVELOPMENT ..... page 5
A. Equipment Purchases ..... page 5
1. Jerome 631-X and Optional Software ..... page 6
2. MDA Scientific "Chemcassette" ..... page 6
3. Trailer and Generator ..... page 6
B. Existing Equipment ..... page 7
1. Total Reduced Sulfur Gas Analyzer ..... page 7
2. Badges ..... page 7
C. Staffing and Training ..... page 7
1. Staffing ..... page 7
2. Training ..... page 8
D. Citizen Complaint Response ..... page 9
1. Citizen Complaint Response Protocol ..... page 10
2. Anonymity of Complainant ..... page 10
E. Monitoring and Screening ..... page 11
1. Hydrogen Sulfide Ambient Air Standard ..... page 11
2. Purpose of Screening and Monitoring ..... page 11
a. Compliance Screening ..... page 12
b. Compliance Monitoring ..... page 12
c. Air Sampling for Research Purposes ..... page 13
3. The Role of Citizen Monitoring ..... page 13
4. Data Analysis ..... page 13
F. Development of Compliance Strategy ..... page 14
1. Compliance and Enforcement Flow Chart ..... page 14
2. Discussion of Existing Technology ..... page 14
a. Known Technology ..... page 15
1. Chemical Addition ..... page 15
2. Aeration ..... page 15
3. Lagoon Covers and Gas Incineration ..... page 16
4. Biofiltration ..... page 17
5. Miscellaneous Technology ..... page 17
G. Miscellaneous ..... page 18
1. Outreach and Informational Meetings ..... page 18
a. Public Information Requests ..... page 19
2. Biosecurity ..... page 19

III. HYDROGEN SULFIDE PROGRAM GOALS ..... page 20
A. MPCA Response to Citizen Complaint ..... page 21
B. Feedlot Hydrogen Sulfide Sampling ..... page 21
1. Compliance Level Air Quality Screening ..... page 21
2. Research Sampling ..... page 22
C. Compliance, Enforcement and Penalties ..... page 22
D. Partnerships ..... page 23
1. Technology and Management Demonstration Projects ..... page 23

Table of Appendices

1997 FMMAC Report ..... Appendix A
Feedlot Odor Log ..... Appendix B
MPCA Air Sampling Data ..... Appendix C
1997 Sampling Protocol ..... Appendix D
Compliance Method ..... Appendix E
1998 Sampling Protocol ..... Appendix F
Continuous Ambient Air Monitoring Method ..... Appendix G
Citizen Air Sampling Data ..... Appendix H
Environmental Response Plan ..... Appendix I

Minnesota Pollution Control Agency

January 30, 1998

Legislative Reference Library
Attn: Kim Gunderson
645 State Office Building
100 Constitution Avenue
St. Paul, Minnesota 55155

Dear Ms. Gunderson:

Minn. Stat. § 116.0713 (Supp. 1997) directs the Minnesota Pollution Control Agency (MPCA) to monitor and identify potential livestock facility violations of the state ambient air quality standards for hydrogen sulfide, using a protocol for responding to citizen complaints regarding feedlot odor and its hydrogen sulfide component, including the appropriate use of portable monitoring equipment that enables monitoring staff to follow plumes. The statute also provides that when the MPCA identifies livestock production facilities in violation of the ambient hydrogen sulfide standards, the Agency may take appropriate actions necessary to ensure compliance, utilizing appropriate technical assistance and enforcement penalty authorities provided to the MPCA by statute and rule.

Pursuant to 1997 Minnesota Laws Chapter 216 § 159, the MPCA is required to submit a report to the legislature by February 1, 1998, which details the efforts of the MPCA to comply with the requirements of Minn. Stat. § 116.0713. The enclosed report is submitted to you in accordance with that requirement.

If you have any questions regarding the enclosed report or need additional copies of this report, please feel free to contact either Beth Lockwood, of my staff, at (612)296-7780 or Dave Nelson at (612)296-9274.

Sincerely,

Peder A. Larson
Commissioner

PAL:jeh

Enclosure

EXECUTIVE SUMMARY

Since the enactment of Minn. Stat. §116.0713 (Supp. 1997), the Minnesota Pollution Control Agency (MPCA) has developed an effective program to address and enforce feedlot hydrogen sulfide emissions. The statute gives the MPCA specific authority to monitor and regulate hydrogen sulfide emissions from feedlots and puts Minnesota at the national forefront for regulating hydrogen sulfide. The program development process involved using past experience in the field, research, outreach and trial and error. During the program development process the MPCA conducted outreach, designed, documented and validated monitoring and screening protocols, conducted field work, created a compliance strategy and established and published an approved compliance method in the Minnesota State Register.

The MPCA conducted air monitoring and screening which was foundational in developing an effective, consistent protocol for responding to citizen complaints. The MPCA identified potential problem livestock facilities based on citizen complaints and continues to evaluate whether these facilities violate the state ambient air quality standards for hydrogen sulfide.

One of the legislative mandates required the MPCA to develop a protocol for responding to citizen complaints regarding feedlot odor and its hydrogen sulfide component. The feedlot hydrogen sulfide team has responded by creating a central database which records and archives this information. The program has also developed a priority system for addressing these situations in order to provide the appropriate level of attention to citizen complaints.

Currently, the program has four portable hand held monitoring devices that enable staff to follow plumes and screen facilities for compliance. The MPCA has also purchased continuous ambient air monitoring devices (CAM's) that will be used to determine compliance. The Commissioner approved two measurement methods for determining compliance with ambient standards for hydrogen sulfide and published this information in the State Register on January 5, 1998.

It is likely that livestock production facilities will be found in violation of the ambient hydrogen sulfide standards during this next season. The MPCA has anticipated this situation and responded by creating an animal feedlot hydrogen sulfide enforcement response plan flowchart. The hydrogen sulfide flowchart is an amendment to the Air Quality Division's overall Enforcement Response Plan (ERP). The hydrogen sulfide flowchart, in conjunction with the Air Quality Division's Enforcement Response Plan, is used to ensure compliance by utilizing appropriate technical assistance, enforcement tools and penalty authorities provided to the MPCA by statute and rule.

The MPCA has created an effective program to regulate feedlot hydrogen sulfide emissions in the State. During the 1998 season the program will focus on:

1) determining whether facilities are in compliance with the state hydrogen sulfide standard ;

2) enforcing the state hydrogen sulfide standard when violations are found; and,

3) continuing to work toward the identification of sound technical solutions that control hydrogen sulfide and odor emissions.

I. INTRODUCTION

This legislative report discusses the development of the Feedlot Hydrogen Sulfide Initiative as required by 1997 Minnesota Laws, Chapter 216 § 159. The report outlines the activities that the Minnesota Pollution Control Agency (MPCA) has taken subsequent and prior to the enactment of Minn. Stat. § 116.0713 (Supp. 1997). This document is organized into three sections. Section one provides an overview of the history of feedlot regulation and the purpose of the feedlot hydrogen sulfide initiative. Section two is dedicated to the development of the feedlot hydrogen sulfide initiative. Section three outlines the goals and objectives of the hydrogen sulfide program for 1998.

A. Overview of Feedlot Regulation and Enforcement

State rules regulating feedlots have been in effect since 1971, and were revised in 1979. See Minn. R. ch. 7020. These rules govern pollution from feedlots and apply to animal feedlot permits issued by counties. The emphasis of this program has been manure management for the purposes of protecting the waters of the State.

Presently there are an estimated 35,000 to 45,000 feedlot facilities regulated under the this program. One third of these facilities have received permits issued by either the MPCA or county feedlot officers. An average of 750 permits have been issued annually over the last five years. The majority of these permits have been for new construction or expansion of existing facilities.

A primary benefit of this program is that it requires feedlot operators to evaluate their manure management practices and propose environmentally sound nutrient management. This goal is achieved through the requirements of the feedlot permit process. The feedlot permit process includes the submission of an application with various supporting documents. Documents include soil maps, aerial photographs, diagrams or blueprints of the proposed construction and land application agreements. Both existing and proposed livestock facilities are reviewed for potential water pollution hazards. A benefit of the feedlot permitting process is the corrective action feature of the interim permit.

An interim permit is issued if pollution hazards are created by existing facilities. The interim permit grants a specified period of time of no more than 10 months that allows the owner to correct the deficiencies in its feedlot operations. Once these conditions have been corrected, the interim permit can be converted to a Certificate of Compliance.

The Certificate of Compliance is issued to existing or proposed facilities which do not pose water pollution hazards. These certificates are documents which note that the facilities have been reviewed by MPCA staff or a county feedlot officer, and if operated as described in the permit application, will not cause a water pollution problem.

In some cases facilities require greater scrutiny than the standard permit review process can provide. The Environmental Quality Board (EQB) administers the Minnesota Environmental Review Program which provides a formal public review process of certain permit actions. This program is governed by the EQB with delegation to or assistance from other state agencies like the MPCA. At the MPCA the Environmental Planning and Review Office (EPRO) administers this program.

Under EQB regulations a mandatory Environmental Assessment Worksheet (EAW) must be prepared for livestock facilities that are either new or expanding, and equal to or greater than 2,000 animal units (au) for total confinement operations or equal to or greater than 1,000 au for partial confinement operations. The actual scope of a project can include both phased and connected projects. A phased action analyzes the expansion of a facility to determine the need for an EAW. The connected action looks at various facilities that may be connected through ownership patterns and determines whether these facilities can operate without existence of the other sites. EPRO has also used its discretionary power to mandate an EAW when there is sufficient need and a public interest.

In the majority of cases where existing feedlot pollution problems must be corrected, producers work cooperatively with the MPCA, making use of cost-share and technical assistance programs through the Soil and Water Conservation Districts (SWCD), Natural Resource Conservation Service (NRCS) and the Farm Services Agency (FSA). This approach, and the availability of assistance programs helps make the correction of pollution problems relatively straightforward for the producer. However, enforcement tools are available to enforce state feedlot regulations should cooperative efforts fail to resolve a pollution problem.

The feedlot unit also has a programmatic enforcement component. Many of these actions involve the joint efforts of the MPCA, the Minnesota Department of Natural resources (MNDNR) and county attorneys. MPCA serves as the lead agency in directing these efforts, with MNDNR and county attorneys providing support during investigations and other enforcement roles. This type of cooperative effort is a recent development requiring considerable staff training and coordination of activities. This interrelationship between agencies has been very useful in implementing enforcement actions.

B. Summary of Feedlot Air Quality Regulation

Historically, a common assumption has been that the only significant air quality issue associated with feedlots was odor. Thus, little or no attention was given to monitoring specific air pollutants emitted from feedlot facilities. Moreover, MPCA viewed odors as a natural result of animal agriculture that could best be addressed through good land use planning. Officially the MPCA believes the primary responsibility for land use planning is at the local level (Minn. R. 7020.0100). Thus odors have been considered a land use issue best handled through zoning. Little attention was paid to odors during the feedlot permit review process. The MPCA position on odors began changing in 1993.

Nationally, the movement from pasture-based or partially enclosed to totally enclosed livestock production first occurred in the early 1970's. This transformation was patterned in part after similar changes in the poultry industry in the 1960's. The trend for large scale swine operations began in Minnesota in the late 1980's and early 1990's and has continued to evolve.

During discussion of the EAW for certain large hog facilities, much attention was

focused on the odor issue. The discussion was motivated in part because it appeared that the typical zoning setbacks were not adequate to address odors from these facilities. As a result, special conditions to control odor were added to these feedlot permits. With the increased awareness of the significance of odor several programmatic developments occurred which have improved MPCA staff's ability to regulate odor.

First, hydrogen sulfide was determined to be the pollutant the MPCA staff would focus its attention on to provide a solution to the growing concern for the effects of odor from feedlots and the gases identified with it. Because of its very nature, it is difficult to define the quantity and character of an odor. There are many odorous compounds coming from feedlots. To effectively regulate odor, it was necessary to identify a quantifiable component that could be objectively regulated. Hydrogen sulfide has been identified as one of the significant constituents contributing to feedlot odors. Hydrogen sulfide (H_2S) is a quantifiable gas with a known toxicology. There is considerable documentation of its effects on human health. The State of Minnesota has ambient air quality standards for hydrogen sulfide (Minn. R. 7009.0080).

Second, in 1995 with funding from the Minnesota State Legislature, the Feedlot and Manure Management Advisory Committee (FMMAC) was formed. It is charged by the Minnesota Legislature with advising the MPCA and the Minnesota Department of Agriculture regarding the issues related to feedlots and manure management. FMMAC created a Livestock Odor Task Force to produce recommendations for a state response to livestock odor issues and released its findings in the Spring of 1997 (Appendix A).

Third, new facilities with suspect zoning setbacks have been required to monitor for hydrogen sulfide. These facilities are using the Vici Metronic "Colortec" passive detector badge, a comparative colorimetric monitoring system commonly referred to as a badge (see Section II B. Existing Equipment). During the anticipated odor season, from March 15 to November 15, monitoring is conducted at the property line on a daily basis. The detector color is then compared with five identified colors that are each given a numerical value of 0, 1, 2, 3, or 4. In addition, each permit also requires that a facility have a contingency action plan for controlling hydrogen sulfide. If a badge indicates a level of 3 or 4 two or more times in a one year period, the permit triggers a requirement for a facility to initiate mitigative measures described in the permit contingency action plan.

Fourth, ambient air-quality monitoring was conducted in the vicinity of large swine facilities in 1995 and 1996 by concerned citizens, Renville County, the MPCA, and the Minnesota Department of Health (MDH). At times hydrogen sulfide levels appeared to exceed the ambient air quality standards. The MPCA responded to this series of air-quality monitoring events by installing a continuous monitoring station for reduced sulfur compounds in the vicinity of two swine facilities and operating it from November, 1996 through November, 1997.

The hydrogen sulfide standard contains several components. Understanding each of these components is important to understanding when there is a violation of the standard. First, each gas sample which is measured against the standard must

represent an average value of the gas over a continuous 30 minute period. Second, the hydrogen sulfide ambient air quality standards contain two numerical analytic thresholds: one of 30 parts per billion (ppb) and one of 50 ppb. Third, if the 30 ppb threshold is exceeded more than twice in any five day period there is a violation of the standard. If the 50 ppb threshold is exceeded more than twice per year there is a violation of the standard. Essentially, once an analysis indicates an exceedence of the analytic threshold, the "clock begins ticking" and it is necessary to wait up to five days or 365 days, respectively, to determine if more than two samples are found above the respective analytic threshold; indicating a violation of the ambient air quality standard.

At the MPCA operated continuous hydrogen sulfide sampler located near the two swine facilities previously mentioned, the thirteen month continuous analysis of the ambient air quality indicated there were two exceedences of the thirty minute average for the 30 ppb hydrogen sulfide analytic threshold. However, there were no violations of the 30 ppb **standard** because the required two additional exceedences of the analytic threshold did not occur in the 5 day period following the initial exceedence of the 30 ppb analytic threshold. For the 50 ppb analytic threshold there were no exceedences. Thus there were no recorded violations of the state ambient air quality standards for hydrogen sulfide during the entire 13 month period the continuous monitor operated.

Finally, through a Governor's feedlot initiative based on MPCA and citizen input, the Minnesota Legislature addressed the feedlot hydrogen sulfide issue by passing legislation to regulate hydrogen sulfide emissions from feedlot facilities (Minn. Stat. § 116.0713 (Supp. 1997). The statute states:

> The pollution control agency must:
>
> (1) monitor and identify potential livestock facility violations of the state ambient air quality standards for hydrogen sulfide, using a protocol for responding to citizen complaints regarding feedlot odor and its hydrogen sulfide component, including the appropriate use of portable monitoring equipment that enables monitoring staff to follow plumes;
>
> (2) when livestock production facilities are found to be in violation of ambient hydrogen sulfide standards, take appropriate actions necessary to ensure compliance, utilizing appropriate technical assistance and enforcement penalty authorities provided to the MPCA by statute and rule.

The statute gives the MPCA specific authority to monitor and regulate hydrogen sulfide emissions from feedlot facilities and puts Minnesota at the national forefront for regulating feedlot hydrogen sulfide emissions. The statute also allows the MPCA to integrate existing rules and statutes into this effort. On July 1, 1997, the MPCA, acting under authority of this statute and funds appropriated by the legislature, the MPCA formally established the feedlot hydrogen sulfide team. This team began developing the feedlot hydrogen sulfide program as described in this report.

II. Feedlot Hydrogen Sulfide Program Development

The purpose of this section is to discuss the development of the feedlot hydrogen sulfide initiative since the authorization of the program in July, 1997. This discussion focuses on equipment purchases, staffing and training, citizen complaint response, MPCA air monitoring and screening activities, compliance and enforcement, biosecurity and outreach efforts.

A. Equipment Purchases

Equipment purchases included four Jerome hydrogen sulfide gas analyzers (Jerome meters), calibration and data management software, two MDA Scientific "Chemcassettes"® (MDA "Chemcassettes"®) ambient air quality monitors, an enclosed trailer, a generator and miscellaneous equipment such as compasses, wind gauge meters, barometers and a camera. With each piece of monitoring equipment, a period was necessary to evaluate its performance and develop an air sampling protocol. Because MPCA staff were familiar with the operation of the Jerome meters, they were evaluated and ready for use by the week of August 23, 1997. The MDA "Chemcassettes"® were received September 22, 1997 and were not used in the fall of 1997 for research or compliance monitoring. More time was required to develop a useful monitoring protocol. Lab and field evaluation of the MDA "Chemcassettes"® in the fall of 1997 has resulted in MPCA staff development of a monitoring protocol. All monitoring equipment has been evaluated and will be ready for the 1998 monitoring program.

The following table lists new equipment which the MPCA staff will use for the feedlot hydrogen sulfide initiative, additional important information about the equipment, and some cost information.

Equipment Type	Equipment Quantity	Power Source	Date Ordered	Date Received	Cost per Unit	Cost of all Units
Jerome 631X	4	Battery powered	June 16, 1997	August 4, 1997	$ 9,900	$ 39,600
Jerome 631X Software	4	Battery powered	June 16, 1997	August 4, 1997	$ 1,650	$ 6,600
permeation tube audit module	4	Alternating current	June 16, 1997	August 4, 1997	$950	$ 3800
MDA Scientific- "Chemcassette"®	2	Battery or alternating current	June 20, 1997	September 21, 1997	$ 5400	$ 10,800
Grant model 1001 portable MDA Data Logger	2	Battery or alternating current	June 27, 1997	October 21, 1997	$ 2860	$ 5720
Glass lined air sampling canister	4	Not applicable	June 18, 1997	August 22, 1997	$ 580	$ 2320
Trailer for TRS monitor	1	pulled by a truck	June 23, 1997	Not yet received	$ 12,300	$ 12,300
Generator	1	gasoline	June 23, 1997	July 24, 1997	$ 1675	$ 1675
Total Expenditure for Newly Purchased Equipment						**$ 82,815**

1. Jerome 631-X and Optional Software

The Jerome 631-X is a truly portable hand-held hydrogen sulfide gas analyzer. Its sensitivity and accuracy make it an excellent tool for ambient air quality survey work. It is the "backbone" of MPCA hydrogen sulfide data collection for both routine research and compliance screening. The device is not a true continuous monitor but is designed for sampling at nominal 30 second intervals up to a few hours on a single charge. For MPCA program purposes, it appears that its best use is as an indicator or screening tool for evaluating compliance. It can be used for establishing an episode of non-compliance with hydrogen sulfide standards; but because it is not a continuous monitor, it is not an approved method for monitoring for compliance with the hydrogen sulfide standards.

Each Jerome meter is produced by Arizona Instrument Corporation. Each unit includes a functional test module (permeation tube audit module) which can quickly determine if the unit is operating properly. MPCA also purchased the optional computer software which can be used to store and analyze data.

2. MDA Scientific "Chemcassette"® (MDA "Chemcassettes"®)and MDA Data Logger

The MDA "Chemcassette"® is a portable hydrogen sulfide gas analyzer which uses a chemically sensitized paper tape or "Chemcassette"® to monitor hydrogen sulfide. It is the only system that the MPCA staff has found for continuous hydrogen sulfide monitoring which the manufacturer claims total specificity for hydrogen sulfide. The system is fully automated and suitable for long-term unattended operation. The MPCA staff intends to use this system for both routine research and compliance monitoring when data collection is required for extended periods. This monitor is one of the two continuous air monitors (CAMs) approved by the Commissioner for hydrogen sulfide monitoring. The MDA Data Logger allows for long term data storage and analysis for each unit.

3. Trailer and Generator

MPCA ordered an 8 ft. by 12 ft. enclosed trailer designed to assure security of the equipment and an environmentally acceptable work area for staff. The trailer will be used to transport continuous total reduced sulfur monitoring equipment for ambient air quality survey work. In the past, total reduced sulfur (TRS) monitoring has been conducted at fixed sites where power is available. Some situations may require the accuracy of TRS monitoring equipment and a permanent station may not be technically feasible. The trailer and generator will allow continuous TRS ambient monitoring at remote locations, such as at the property line, where power may not be available.

B. Existing Equipment

1. Total Reduced Sulfur (TRS) Gas Analyzer

The MPCA owns and maintains several gas analyzers which can be used to monitor for total reduced sulfur (TRS). These units consist of an EPA-approved sulfur dioxide gas analyzer, a sulfur dioxide gas scrubber, and a thermal oxidizer. The sulfur dioxide gas scrubber is necessary to eliminate any preexisting sulfur dioxide gas in the sample, so that only reduced sulfur compounds are monitored. The thermal oxidizer is used to oxidize reduced sulfur compounds contained in the sample. These oxidized sulfur compounds are then analyzed by the equipment as sulfur dioxide to determine the level of reduced sulfur in the gas sample.

This type of analyzer is the most accurate and sensitive hydrogen sulfide gas analyzer. It has excellent sensitivity and is capable of monitoring for extended periods. These characteristics are precisely what make it appropriate for compliance demonstrations. This is the same type of continuous monitoring equipment that was employed at the two swine facilities previously mentioned. This monitor is one of the two continuous air monitors (CAMs) approved by the Commissioner for hydrogen sulfide analysis.

2. Badges (Vici Metronic "Colortec" passive detector)

The Vici Metronic "Colortec" passive detector is a passive comparative colorimetric hydrogen sulfide detector known as a "badge". The badges produce a qualitative measurement through the use of a lead acetate paper which changes color with increased exposure to hydrogen sulfide. The detector color is compared with five identified colors that are each given a numerical value: 0, 1, 2, 3, or 4. The badges are an indicator of whether there is significant hydrogen sulfide present in the ambient air. They are simple to use, but can be a problem for disposal since the lead acetate used in the sampler is classified as a hazardous waste. They are easy to deploy and can be attached to a fence, tree, shed or the like. MPCA has required some feedlots, through permit requirements, to use badges to conduct self-monitoring.

C. Staffing and Training

1. Staffing

In August and September 1997, two new full time staff were hired by the MPCA. One position in the Water Quality Division and the other is in the Air Quality Division. Moving from a nuisance odor complaint response program to a hydrogen sulfide ambient air quality monitoring program has resulted in a shift in program goals with a steady overall increase in staff involvement since 1995. To assure this initiative's effectiveness, the MPCA created a multifaceted team with experience in a broad range of disciplines. This team includes individuals experienced in field monitoring, chemical and agricultural engineering, agricultural practices, compliance and enforcement, and working with issues of public health. In a span of about six to eight weeks, this team developed the basis for the 1997 work plan (first half of fiscal 1998),

to begin air sampling and monitoring, established the basic field monitoring protocol, and began conducting ambient air screening using the Jerome meter.

There has been some criticism of MPCA for not doing more monitoring in the summer of 1997 and not having new staff hired and ready to do monitoring until August and September 1997. Initially it was very important that existing staff develop sound field monitoring and follow-up enforcement protocol that would assure that the data collected would not be in question during an enforcement proceeding. This required considerable time and coordination of the team's activities. To this end, existing MPCA staff focused their efforts on these protocols and conducted monitoring on a complaint basis until routine compliance monitoring staff were hired. It was also very important that the new individuals be capable of doing more than routine compliance monitoring. Experience in enforcement activities and strategies was essential so that the team could be effective in its overall approach and assure compliance with the hydrogen sulfide standards. Finding the the people with the necessary skills and following prescribed Department of Employee Relations hiring practices was important. The MPCA believes the additional time spent obtaining these new staff, along with the foundational work on the program done by existing personnel, has resulted in a well balanced team approach that will be effective in any enforcement proceedings that may develop. Thus, the 1997 work effort has resulted in a solid foundation for the 1998 routine and compliance monitoring season.

The following table illustrates estimates of the staffing effort in man years that has evolved over the last several fiscal years and the relative emphasis of those efforts.

Staffing Estimates in "Work" Years for Specified Fiscal Year

Fiscal Year	1995	1996	1997	1998
Hydrogen Sulfide	0.0	0.5	1	2.5
Odor Complaint	0.5	0.8	0.8	0.8
General Management	0.2	0.3	0.6	0.7
Total	**0.7**	**1.6**	**2.4**	**4.0**

Two program areas not reflected in this table include public information and environmental review. The MPCA expects increases to continue in these areas. In conclusion, the increase in "work" years which are devoted to the feedlot hydrogen sulfide initiative and odor control has allowed the MPCA to develop a coordinated effort which MPCA staff believe will lead to appropriate controls based on sound scientific evidence.

2. Training

Many of the hydrogen sulfide initiative team members have significant experience in other programs and did not require the level of training often necessary with personnel associated with new and emerging programs. As pointed out above, this experience level allowed for the team to begin work immediately. For the most part training was achieved by acquainting staff with individuals in the field of research and the environment relating to hydrogen sulfide and odor control.

In August 1997, the American Society for Engineering in Agriculture, Food and Biological Systems (ASAE) held its annual conference in Minneapolis, Minnesota. Hydrogen sulfide and odor were the subject of many of the papers. Staff involved with odor complaint response and the emerging feedlot hydrogen sulfide initiative attended this conference. Attendees visited several sites where technologies have been implemented to reduce feedlot odors. This meeting was valuable because it allowed MPCA staff to network with the scientific community operating in this field.

In the fall of 1997, several MPCA staff met in Kansas City with Central States Air Resource Agencies (CENSARA). CENSARA is an association of midwestern state environmental agencies that meet to discuss and exchange information on various topics. This particular meeting was entitled "Confined Farm Animals and Air Quality Conference". Many of the discussions focused on hydrogen sulfide and odor. Through this effort many worthwhile contacts were made and it is clear that odor and hydrogen sulfide are emerging environmental issues on the national level.

MPCA staff also attended the University of Minnesota Program for Odor Research Update/Summit. The meeting included discussions of the following:

1. Developments in a University of Minnesota odor monitoring and rating system.
2. Discussion of latest health guidelines and concerns regarding hydrogen sulfide and other gases present in odor.
3. Discussion of the technology for controlling odor.

It is anticipated that future training will be principally done on the job. New information will continue to be gathered by working with individuals in the research community, the environmental community, and other state and federal government bodies familiar with hydrogen sulfide and odor monitoring and control.

Training in the operation of the monitoring equipment has been managed by the Air Quality Division - Ambient Air Quality Monitoring Unit of the MPCA.

D. Citizen Complaint Response

The MPCA investigation into hydrogen sulfide emission violations is primarily complaint driven. Citizens are able to telephone the MPCA or the Minnesota Duty Officer and report a feedlot odor complaint twenty four hours a day at 612-282-9880 or 1-800-657-3864. When calling these numbers, they should ask for Jim Sullivan in the Air Quality Division. The MPCA complaint line allows complainants to leave a detailed message of the odor situation they have encountered. The following discussion is focused on citizen complaint response protocol and protection of complainant anonymity.

1. Citizen Complaint Response Protocol

The following protocol has been established by the feedlot hydrogen sulfide initiative development team to address feedlot odor complaints as they are received. Virtually all complaints are received via the telephone. Most of the feedlot telephone complaints are taken by MPCA staff. Some feedlot odor complaint calls have been taken by the Minnesota Duty Officer or the MPCA telephone voice messaging system. MPCA staff routinely check their telephone messages to determine if a feedlot complaint has been lodged with the MPCA. It is desirable to obtain the name and possibly the telephone number of each complainant. However, this is not always possible as many individuals do not feel comfortable revealing their identities.

After the information is collected from the complainant, the data is recorded on the feedlot odor complaint log (Appendix B). After recording the complaint, MPCA staff will further respond to the complaint by meeting with the complainant where possible. The meeting between the complainant and the MPCA is important as it allows the MPCA to understand: 1) the effects feedlot odor emissions have on the complainants' lives; 2) technical aspects of the incident such as time of day and climatological conditions; 3) any practices that might be occurring when the incident occurs; and 4) when an odor incident is most prevalent. This complaint process is what leads the beginning of compliance level screening at the complainant's site.

Under the adopted protocol, the MPCA notifies the facility owners or operators that a feedlot odor complaint has been received and that their feedlot has been identified as a potential source of the emissions. The MPCA staff informs the owner or operator that the MPCA will be conducting compliance screening to determine whether the facility complies with the ambient air quality standards for hydrogen sulfide. The MPCA conducts the compliance screening at or beyond the property boundary of the feedlot facility. Sampling data is recorded and logged into the MPCA hydrogen sulfide database. Once the data has been collected, it is analyzed by MPCA staff to determine potential non-compliance with state ambient air quality hydrogen sulfide standards.

2. Anonymity of Complainant

One of the issues facing the MPCA feedlot odor complaint response protocol is the ability to obtain and conceal the identity of the complainant. As stated above, many complainants are reticent to divulge their identities or location for fear of retribution by the feedlot operators or owners. However, by knowing the identity of the complainant, the MPCA is better able to supply a response to the complaint. The MPCA staff can monitor both at the facility where the emissions occur and at the complainant's residence. Additionally MPCA staff can keep the complainant informed of monitoring results and any other relevant developments. Communication between the MPCA and the complainant also fosters a better working relationship that may help in resolving the hydrogen sulfide emission issue in their area.

The identity of the complainant is protected under Minn. Stat. § 13.44 (1996). Under the statute, the identity of individuals who register complaints with state agencies or political subdivisions concerning violations of state laws or local ordinances concerning the use of property is classified as confidential data unless otherwise ordered by a court of law. Within the confines of the law, this statute provides protection for individuals registering feedlot odor complaints from any act of retribution as a result of the complaint.

E. Monitoring and Screening

Minn. Stat. §116.0713 (Supp. 1997) requires that the MPCA "monitor and identify potential livestock facility violations of the state ambient air quality standards for hydrogen sulfide...". The following is a discussion on the purpose and types of screening and monitoring that will be conducted by the MPCA. Also included in this discussion is the topic of citizen monitoring and data analysis.

1. The State of Minnesota's Ambient Air Standards for Hydrogen Sulfide

The State of Minnesota's ambient air quality standards are contained in Minn. R. 7009.0080. The hydrogen sulfide ambient standards are as follows:

Pollutant/AirContaminant	Primary Standard	Remarks
Hydrogen sulfide	0.05 ppm* (50 ppb)	one half hour average
		not to be exceeded
		over two times per year.
	0.03 ppm*(30 ppb)	one half hour average
		not to be exceeded
		over two times for
		any five day period

Note: ppm means parts per million and ppb means parts per billion

2. Purpose of Screening and Monitoring

The purpose of conducting air monitoring around feedlot facilities is to determine whether the feedlot complies with the state ambient air quality standards for hydrogen sulfide. This compliance screening process at a specific facility is initiated by using the Jerome meter. Because the Jerome meter is not a true continuous monitor it is primarily used to determine if the potential for non-compliance exists: i.e., to determine if the facility exceeds the 30 ppb threshold for a thirty minute period of monitoring. If it

does, this information will be considered in determining whether further compliance monitoring should be conducted using either the TRS gas analyzer or the MDA "Chemcassette"®. This increased level of compliance monitoring may be conducted by the facility as part of a compliance agreement or by the MPCA staff.

A secondary function of the program is to sample air quality around feedlot facilities for research purposes. This data is used to evaluate the effectiveness of the various new and existing odor abatement techniques. In these circumstances either the Jerome meter or the MDA "Chemcassette"® will be employed.

The MPCA staff has recently completed a season of air monitoring using the screening methodology (See Appendix C). This monitoring was conducted with the primary purpose of investigating the effectiveness of the field protocol for air monitoring, recording and collecting data in the field, and responding to complaints. A copy of the 1997 sampling protocol is included in Appendix D.

The 1997 air quality screening has proven to be worthwhile. Most importantly the sampling season allowed MPCA staff to use the monitoring equipment under a variety of situations. These situations included both monitoring on and off the property of feedlot operators; during cool, cold and warm weather; during changing seasonal conditions; during a variety of wind conditions; and during the daytime, nighttime and on weekends. These efforts have led to the important distinction between compliance level screening, compliance monitoring, and research sampling. Furthermore, in accordance with Minn. R. 7009.0060, the Commissioner has approved two compliance methods: the Hydrogen Sulfide TRS monitor and the MDA "Chemcassette"® (see further discussion in Appendix E). Compliance screening has also led to a better understanding of biosecurity issues. The following discussion illustrates the three distinctions in monitoring.

a. Compliance Screening

The purpose of compliance screening is to gather information in the field that will be used to determine whether a facility has the potential for non-compliance with state ambient air quality standards. Screening takes place at the property boundary and beyond. The screening process employs a Jerome meter and involves taking a series of two 30 second samples every two minutes for one half hour at a fixed location down wind of the feedlot facility. For a more detailed description of these procedures see Appendix F.

The MPCA conducted compliance level screening in the latter part of 1997. None of the monitored facilities were determined to be out of compliance with state standards. Some research monitoring indicated elevated levels on the property of several facilities. Verification of non-compliance potential at these sites will include additional compliance screening at the property line. MPCA staff intend to conduct additional compliance screening at these facilities during the spring and summer of 1998.

b. Compliance Monitoring

Compliance monitoring is the next level of monitoring that can occur when compliance screening indicates there is the potential for noncompliance. It will be done using either or both the Hydrogen Sulfide TRS monitor or the MDA "Chemcassette"®. Additional discussion on each of these methodologies is contained in Appendix G. The duration of

testing for non-compliance may be for as little as a few days to as long as a year or more, because the 50 ppb threshold is an annual hydrogen sulfide standard. monitoring to demonstrate compliance will need to occur ideally for a minimum of one year.

c. Air Sampling for Research Purposes

Research sampling is conducted on the property of the feedlot operator. Typically it is conducted when a new technology is introduced or to characterize emissions from an existing facility. This sampling is conducted with notification of the landowner or operator.

The MPCA has collected hydrogen sulfide samples for the purposes of research during the 1997 season. This data has been useful in helping to prepare for the 1998 season by allowing MPCA field staff to use the monitoring equipment and further evaluate its performance. It was particularly helpful in understanding how the equipment performs closer to the facility when hydrogen sulfide gas can be expected to be more concentrated.

3. The Role of Citizen Monitoring

Citizens throughout the state have collected hydrogen sulfide emission data from various feedlot facilities. This data collection effort began approximately two years ago and reportedly will continue throughout 1998. This data collection has ranged from the use of a Jerome meter to a recording of general air quality conditions. In some cases badges were used to obtain qualitative estimates of hydrogen sulfide emissions. This information is found in Appendix H.

This data has been useful to the MPCA staff in characterizing the location and magnitude of feedlot odor and hydrogen sulfide emissions. Citizen input has been greatly appreciated in developing the screening and monitoring techniques outlined in the Air Sampling Strategy of Hydrogen Sulfide Around Animal Feedlots in Minnesota. As with all data, it is important that the equipment used be calibrated to known standards. In addition, the location for determining compliance with the hydrogen sulfide ambient standard must be at the property boundary or beyond. It is not evident whether some of the citizen data has met these conditions. The MPCA staff will continue to review and analyze the data collected by all available sources and consider this information as it reevaluates its sampling strategy and the need for further compliance level monitoring or enforcement.

4. Data Analysis

The hydrogen sulfide emission data collected in the field by the MPCA staff will be used for various types of analysis. Data collected at the property boundary and beyond shall be used for the purposes of determining whether the MPCA needs to contact the facility and inform them of potential noncompliance. The data collected on the site is used for multiple research purposes such as hydrogen sulfide technology performance evaluation, hydrogen sulfide emission source evaluation, hydrogen sulfide dispersion and other scientific and health related investigations. In keeping with the Data Practices Act, and the MPCA's desire to communicate with all interested parties, the data will be made available to the public.

F. Development of Compliance Strategy

1. Compliance and Enforcement Flow Chart

Appendix I of this report, is the MPCA Animal Feedlot Hydrogen Sulfide Enforcement Response Plan Flowchart (Flowchart). This flowchart is an amendment to the Air Quality Division's overall Enforcement Response Plan (ERP). The hydrogen sulfide flowchart is an important step in the development phase of the MPCA compliance and enforcement strategy. As shown in the flowchart, the MPCA will proceed by conducting an initial hydrogen sulfide screening of the feedlot with a hand held Jerome meter. If there is an indication of a potential violation of the state standard, the MPCA will require the feedlot owner to begin implementing a compliance plan. The compliance plan may include such elements as increased monitoring, evaluation of best management practices and implementation of a community action plan for controlling hydrogen sulfide emissions. The MPCA may deploy a Continuous Ambient Monitor (CAM) in the event that a facility owner or operator does not work toward a solution in a timely fashion. In the event a CAM records hydrogen sulfide over the state standard, the MPCA will commence enforcement proceedings.

It must be understood that as a guidance document the ERP establishes a frame of reference from which the MPCA staff works to develop compliance strategies and enforcement responses. Each situation will likely be very different and the MPCA's approach may change and evolve as new information becomes available. Some violations perhaps are more egregious than others. Prior knowledge of a problem, environmental damage, and failing to take action on a known violation are the clearest and most persuasive factors for determining whether monetary penalties should be imposed. For example, a facility that has been working diligently to develop and test a technology to deal with occasional excursions above the standard could be treated less harshly. Obviously there are many different possibilities. Each situation will be considered in light of all the available facts and the ERP will be the frame of reference from which MPCA will decide the appropriate enforcement response.

MPCA staff believes it is most desirable and to the benefit of producers and citizens to work positively to resolve a violation. The MPCA staff will always endeavor to do this by communicating with producers and clearly stating what it believes to be the severity of the problem. The MPCA staff will also consider the previous and continuing efforts of others, such as local units of government and citizens, to reach a resolution at a specific facility, facilitating constructive dialogue between the parties in MPCA's effort to arrive at a solution. Ultimately, the MPCA staff will be looking to the producers to develop and implement a solution to this problem.

2. Discussion of Existing Technology

To be an effective program, the MPCA not only needs the ability to document violations, but also to ensure that those violations are corrected. A knowledge of the technology which can be employed as a corrective action is very important. The MPCA has had the opportunity to view research, technology, presentations and seminars regarding manure storage and feedlot hydrogen sulfide emission abatement that may offer some potential solutions to control feedlot hydrogen sulfide emissions. The following discusses some of these technologies.

a. Known Technology

There are a variety of means that have been used to control hydrogen sulfide emissions from industrial and municipal wastewater treatment facilities. These include chemical addition; aeration; covering, collecting and flaring (burning) the gas; and biofiltration. In general, these technologies treat either the gas after it forms to reduce hydrogen sulfide; or the wastewater to prevent hydrogen sulfide formation. Some of these technologies if applied to animal agriculture in the manner used by industry would likely be very costly. Nevertheless, as in most emerging fields, there are a number of entrepreneurs proposing some variation of these basic technologies that may be part or all of the solution. The livestock industry is also considering diet modification and feedstock management techniques to lower sulfur content in the manure and wastewater. It will be up to the livestock industry to ultimately develop a solution. There may not be a "one size fits all solution". Individual facilities may choose different, or multiple, solutions to obtain the necessary reduction in emissions. The following is a brief discussion of some of the technologies being researched and evaluated.

1. Chemical Addition: As a short term solution

Chemical amendments exist which could be used either as a precipitant or chemical modifier to change the character of the manure/wastewater to reduce hydrogen sulfide emissions. Like pH adjustment, which is a form of chemical addition, most forms of chemical addition become more expensive as the frequency of application is increased. If chemical addition could be limited to perhaps certain times of the year when storage facility chemistry is at an optimum for emitting hydrogen sulfide, a cost effective management approach using chemical addition may be possible. Ferrous chloride is an example of a chemical that has been examined by the animal livestock industry. Its use has resulted in significant reductions in hydrogen sulfide emissions, but these reductions have only lasted for a short period of time. In addition, ferrous chloride is expensive, difficult to handle and highly reactive. This reactivity makes it an excellent chemical for reducing hydrogen sulfide, but it also means it may be corrosive to concrete and other structural materials which are part of the manure collection system. It is unlikely, by itself, that ferrous chloride will become a solution to control hydrogen sulfide emissions. However, it is possible that ferrous chloride could be a part of the solution by providing temporary abatement from excessive hydrogen sulfide and other related feedlot emissions.

Several producers have indicated that they are being contacted by chemical sales representatives wanting to try a new or existing product. As MPCA staff understands it, the animal livestock industry and scientific community believe more study is needed before it can be determined what role chemical amendments will have in a solution to control hydrogen sulfide emissions.

2. Aeration: Using modified air delivery systems

Aeration is a common method of biological waste treatment. In most cases the goal of municipal or industrial wastewater treatment is to create a clarified, essentially purified, wastewater that is capable of being discharged directly into a river or stream. The common measure of wastewater strength, or need for treatment, is the five day biochemical oxygen demand (BOD_5). Untreated municipal wastewater is typically 200 to

250 milligrams per liter (mg/l) BOD_5. Untreated industrial wastewater can be somewhat higher and usually ranges between 250 to 1000 mg/l BOD_5. Agricultural wastes in manure pits typically range from 2500 to 50,000 mg/l of BOD_5. These high levels of BOD_5 for agricultural waste make it difficult and expensive to treat by conventional aeration techniques, but also make it an excellent fertilizer if applied at agronomic rates.

The animal agriculture industry has observed that some treatment or stabilization of animal waste is necessary. An example of an animal waste treatment or stabilization system is the earthen lagoon system. With high strength wastes, like feedlot manure an anaerobic treatment technology is often employed. These systems are generally deep lagoons that make use of bacteria that can live in oxygen deficient environments. Creating a stabilized anaerobic lagoon can be difficult, but an advantage is the stabilized waste can be treated to a desired quality relatively inexpensively. In the case of agricultural wastes, the goal is to stabilize the waste so that it is still valuable as a fertilizer.

It is possible for anaerobic treatment systems to become upset and in some cases, where high sulfur levels are present in the waste, significant hydrogen sulfide can be emitted. Some anaerobic treatment units include aeration as a follow-up step to provide additional stabilization. Aerators can provide valuable stabilization but they can also agitate the lagoons upsetting the delicate anaerobic balance.

The wastewater being treated in a typical anaerobic lagoon may benefit in a reduction of hydrogen sulfide through the use of aeration at the surface of a lagoon. The increased oxygen levels from the aeration process would cause the conversion of free sulfur rising to the lagoon surface back into sulfate. This conversion is expected to reduce hydrogen sulfide emissions from the lagoon. Some experimental aeration of agricultural waste lagoons has occurred in the state. The results of these investigations have indicated limited success. and in some cases have increased emissions. I It is believed that many of the present aerator air delivery systems will cause excessive mixing freeing hydrogen sulfide. A recent investigation has indicated that the excessive mixing of the wastewater might be avoided by using a very thin layer of air at the surface of the lagoon. To accomplish this process, the livestock industry needs to develop an alternative air delivery system.

3. Covering lagoons and Incineration of gas

The use of a cover to collect gaseous emissions like those emitted from waste sludge digestion is a practice employed at both municipal and industrial treatment facilities. Historically, impermeable covers are economically feasible when substantial quantities of methane gas are generated. The recovered methane can be used for energy generation at a net savings in energy consumption. The economics driving these gas collection systems allows for the construction of a more sophisticated, rigid, dome-like structure, which can be expensive.

Covers which have been tried with earthen lagoons are generally flat, pliable and lie on the surface of the lagoons. Because they lack rigidity, they must be anchored using guy-wires and stakes. One swine production facility in the state installed an impermeable cover to capture methane and hydrogen sulfide gas being emitted from their manure storage lagoons. Initially the system was not vented and the gas which accumulated under the membrane would sometimes cause the cover to swell (like a balloon) and pull free of its anchor. With pliable covers, collecting the gas for incineration can be difficult as it can seep around the edges of the cover. These types of covers can be made more effective at capturing the gas, but at a much greater cost. Even without incineration of the captured gases, covers may help to disperse emissions into the environment.

Finally, the use of a straw cover may be a "low tech" solution that can be deployed for anaerobic lagoons. Usually a wheat or barley straw is placed on the surface of the lagoon in a floating mat approximately six inches to one foot thick. Unlike the pliable cover which is intended to retain gases at the lagoon surface for collection or dispersion, there is good evidence that some of the hydrogen sulfide gas moving through the straw cover may actually be adsorbed by the straw cover. A disadvantage of a straw cover is that ultimately it sinks to the bottom of the lagoon and fills some of space that would otherwise be available for manure storage. At the end of the season when the lagoon is drained and the manure is applied to the land as a fertilizer, the straw would also have to be disposed of. The straw could be managed separately from the other manure, but it would most likely be land applied with the manure.

4. Biofiltration

Biofiltration has been applied to "pit barns" with some apparent success in controlling odor and hydrogen sulfide. The gas generated from the manure storage area under the barn is forced through an earthen filtration system. These systems were first evaluated in Minnesota on agricultural emissions by Richard Nicoli, a swine producer and University of Minnesota engineering professor. They have also successfully been used by the Metropolitan Waste Control Commission to reduce odor from a large forcemain in St. Paul, Minnesota. Mr. Nicoli constructed his filter inexpensively using materials he obtained on his farmstead consisting generally of pallets for structural support and a mixture of earth, compost and straw. Although these systems may offer an inexpensive alternative for point sources like concrete pit barns, they would not be useful for nonpoint sources like manure storage lagoons without the use of a gas cover and collection system.

5. Miscellaneous Technology

There are an assortment of other technologies that have either been tried in other industries or not demonstrated in the agricultural industry. In most cases, limited or no research is available on these technologies for the feedlot industry. These include chemical stripping of gases, the use of biological additives to alter the wastewater, electrical plasma generation to change gas emissions, and low voltage high current electricity to enhance wastewater treatment.

Finding effective technical solutions to control hydrogen sulfide is a major step towards permanently solving this problem. Research continues on both a state and national level. Here in Minnesota, scientific and research organizations like the University of Minnesota are evaluating a number of different ways which these emissions may be controlled.

G. Miscellaneous

1. Outreach and Informational Meetings

One of the most important aspects of developing a successful emerging regulatory program is "getting the word out" and maintaining open lines of communication with the regulated community and general public. The MPCA Board monthly meetings provide a regular forum for discussing topics of interest. MPCA staff used these meetings to allow interested parties and the regulated community an opportunity to provide input to the program development. The following informational items have been discussed at MPCA Board meetings since July 1, 1997:

a. August 1997: A discussion of the MPCA operated continuous TRS monitoring site.
b. October 1997: A discussion of the Hydrogen Sulfide Initiative Workplan and Routine and Complaint Monitoring Plan proposal
c. November 1997: Further discussion including timing of hydrogen sulfide monitoring, what constitutes a violation, hydrogen sulfide treatment technology, plans for monitoring in 1998, and health related concerns.
d. December 1997: Discussion of the draft outline for this legislative report, copies of Jerome meter monitoring data, and program intentions of having additional informational meetings with producers, environmental groups and interested parties.

At each of these meetings, a number of groups and organizations were represented including Citizens for a Better Environment, Clean Water Action, Earth Protectors, Land Stewardship, Mankato Area Environmentalists, Minnesota Center for Environmental Advocacy, and various livestock producers. The Board meetings have been useful for clearing up misconceptions about the program; for learning the concerns of residents about hydrogen sulfide emissions; and for learning what the public believes should be considered in the development of the feedlot hydrogen sulfide program.

In September, 1997 MPCA staff participated in the "On Farm Assessment Training Session" initiated by the National Pork Producers Council (NPPC). The session was designed to inform and motivate producers, consultants etc. concerning the NPPC efforts to do an evaluation of the pork industry. Although designed as an industry self-evaluation program, MPCA staff made numerous contacts and was encouraged to actively participate in the three days of discussion. As part of the self-evaluation effort, NPPC used Jerome meters to do hydrogen sulfide analysis at some Minnesota producers.

Several meetings with county officials have been held by MPCA staff. These have included meetings with the Renville County Commissioners to discuss how the MPCA's

program might interface with their regulatory efforts. In December 1997, MPCA staff held a conference in Saint Cloud with county feedlot officers. The hydrogen sulfide initiative was among the topics of discussion.

Several conferences have proven to be a great means of exchanging ideas and learning who are conducting research and program development on this topic. The aforementioned annual ASAE meeting, in August, 1997 is an example. During this conference there was some valuable practical opportunities to observe what has been done in Minnesota to control odors and hydrogen sulfide. The University of Minnesota conducted a tour of various feedlots where odor control technologies were being employed. This proved to be an excellent means to speak with the agricultural community and the staff of the University of Minnesota. In February 1998, the Soil and Water Conservation Service's annual conference will be focused on manure management. Several MPCA staff members will be attending this conference and presenting papers on relevant topics.

From the public forum of the MPCA Board meetings it has been made clear that additional outreach and information exchanges will be useful. MPCA staff are planning to have meetings with environmental groups, agricultural groups, consulting firms, governmental organizations and producers. Public information meetings at locations around the state are also being considered. These efforts will provide discussion on the hydrogen sulfide initiative workplan and development of an effective information exchange. These meetings will also provide people with the knowledge of who to contact with their concerns and what is being done about their concerns. MPCA staff will also discuss the broader programmatic goals and compliance efforts.

a. Public Information Requests

Public information requests include requests for hydrogen sulfide emission data collected in the field and general information about the hydrogen sulfide initiative. The MPCA has received several requests in the last six months. All information requests concerning data are referred to Jim Sullivan of the Air Quality Division of the MPCA. Programmatic information requests are referred to Robert Criswell of the Water Quality Division nonpoint source section feedlot unit of the MPCA. For copies of this report or its appendices contact Stacy Grotberg at (612) 297-5367. There will be a charge for each image that you request a copy of.

2. Biosecurity

The animal livestock industry has expressed concerns that ambient air monitoring may compromise biosecurity at feedlots when MPCA staff move on and off their property. Organisms such as bacteria, viruses, fungus, and parasites can seriously damage or destroy the health of livestock and poultry. These organisms can be transmitted to a feedlot facility by means of clothing, equipment, vehicles and exposed skin. Some of the research monitoring the MPCA staff will do requires them to be on feedlot property. The MPCA has agreed to request entry when such access is needed. If a facility does not have a biosecurity program, the MPCA field staff shall conduct the following procedure:

1. Prior to entry into a farm animal facility or farmstead, MPCA staff

shall prepare a solution of an approved sanitizer mixed with water according to label instructions in a clean 5 gallon plastic bucket. Mix 2 to 4 gallons of the solution. Approved sanitizers include Lysol, Laro, Environ, Cresl-400, Tek-Trol, Discan, Synphenol-3, and Nolvasan.

2. Clean coveralls and rubber boots must be worn. The boots must have been scrubbed with the sanitizing solution, scrubbing off all manure and dirt before and after entering a farm facility.

It should be noted, the primary purpose of the hydrogen sulfide initiative is to monitor and screen facilities for compliance with the state ambient air quality standards. Monitoring occurring at the property boundary and beyond will not require the observance of a biosecurity plan.

III. Hydrogen Sulfide Program Goals

The Minnesota Pollution Control Agency feedlot hydrogen sulfide initiative workplan includes a monitoring strategy, compliance strategy, and public outreach. The foundation of the workplan is based on 1) the preexisting feedlot program, 2) knowledge gained during program development, 3) compliance screening and monitoring, and 4) the outreach done during the late summer and fall of 1997. As specified by Minn. Stat. § 116.0713, the primary focus of the hydrogen sulfide program is to:

1. monitor and identify potential feedlot violations of the state ambient air quality standards for hydrogen sulfide, and;
2. take appropriate actions necessary to ensure compliance when violations are found.

In 1998, the work plan will continue to be jointly administered by both the Air Quality and Water Quality Divisions. The two divisions will formulate environmental response designed to assure compliance with applicable standards through implementation of viable management practices and treatment technologies. Outreach efforts will be expanded in 1998 with the intent of developing partnerships to further compliance and implementation of control measures.

Appendix K is the MPCA workplan for period July 1, 1997, to July 1, 1998. The remainder of the work plan for 1998 will evolve as data collection proceeds, as violations are documented, and the need for facility specific compliance strategies is determined. The MPCA expects an effective partnership effort to result in the development of hydrogen sulfide compliance demonstration projects. Each of the following subsections will briefly illustrate how the program will be implemented and administered throughout 1998.

A. MPCA Response to Citizen Complaints

The MPCA staff programmatic goal is to respond to all citizen feedlot odor complaints. It is presumed that most complaints will be based on the occurrence of an odor incident although individuals may have access to badge, Jerome meters or other monitoring equipment. Complaints will be prioritized and receive attention based on several considerations, including the following:

1. The location where the complainant believes the odor event is occurring;
2. The frequency of the events;
3. The severity of the situation including what previous compliance screening has indicated;
4. How often MPCA staff have visited the site in the past and what any previous compliance screening data indicates; and
5. Whether there are known effects on human health or the environment.

Biosecurity issues will be followed as indicated in this report in Section II. F. 2. Biosecurity. As new complaints are received, they will be added to the odor complaint log and receive compliance screening.

B. Feedlot Hydrogen Sulfide Sampling

The MPCA will continue to conduct hydrogen sulfide air sampling on and around feedlot facilities throughout 1998 and into 1999. In each case where a complaint is received, MPCA staff will follow-up with a response based on the priority evaluation described above. New complaints about facilities may displace the attention currently being given to other facilities if data obtained during repeated compliance screening efforts does not reveal a hydrogen sulfide emission problem. In situations where compliance screening indicates the ambient thresholds are being approached or exceeded, the MPCA staff will consider the need for additional compliance monitoring or discuss with the facility owners the need for additional controls at the site. As time and resources permit, the MPCA will also collect research data on the feedlot premise.

1. Compliance Level Air Quality Screening

The MPCA continues to screen facilities for compliance with the state ambient air quality standards for hydrogen sulfide as complaints are received. Field staff will begin routine screening for compliance in March, 1998. This process shall be conducted at the property boundary and beyond. The data collected in the field will be evaluated for a determination of compliance by MPCA staff. Monitoring this season shall focus on the spring and fall turnover of the manure storage basins and on a variety of meteorological conditions. MPCA staff will respond to complaints and gather data for at least one full year so as to assure it develops a data base and establishes compliance strategies that are representative of variety of conditions occurring during all seasons. MPCA staff will collect data during a variety of meteorological conditions including hot and cold weather, daytime and nighttime, during windy and calm conditions, etc.

2. Research Sampling

As time and resources permit, the MPCA shall conduct air sampling on various feedlot sites. This data is collected on the property for the purposes of evaluating the effectiveness of manure storage systems and hydrogen sulfide abatement technology. This level of sampling shall be conducted after notifying the owner of the facility. Biosecurity measures shall be observed while on site. Data collected for this purpose shall also be used to evaluate spring and fall turnover of manure storage basins and seasonal variation.

C. Compliance, Enforcement and Penalties

The foundation for compliance and enforcement strategies for the feedlot hydrogen sulfide program is illustrated in the Air Quality Division's Enforcement Response Plan (ERP) with the addition of the Hydrogen Sulfide Enforcement Response Plan Flowchart as discussed in Part II, Program Development of the Hydrogen Sulfide Initiative. The MPCA's compliance approach is to enforce the hydrogen sulfide standard and to work with feedlot owners toward compliance. In implementing this compliance approach, the MPCA will also consider the effects of the noncompliance and various solutions on the surrounding environment and stakeholders. Prior knowledge of a violation, environmental damage, and failing to take action, are some of the factors that will be considered when determining whether monetary penalties should be imposed.

The development of a compliance approach traditionally considers several factors which include:

1. the potential to cause harm to human health or the environment;
2. the willingness of the party to comply with requirements;
3. whether the party receives a financial benefit because of the noncompliance; and,
4. the available technology to correct the problem.

The MPCA understands the source of feedlot hydrogen sulfide emissions is related to the decomposition of manure and the chemical and biological conditions existing in the manure storage facilities. As discussed below in Section III. D. 1, Technology and Demonstration Projects, these chemical and biological conditions are variable. They are dependent on multiple factors including quality of wastewater, type and genetics of livestock, livestock diet, facility operation, the type of storage employed, and climatological conditions. Although a variety of technologies exist that could reduce hydrogen sulfide emissions, some of them have not been demonstrated to be technologically feasible for this industry. Until hydrogen sulfide emission abatement technology emerges in this industry, the limiting factor for assuring compliance is the availability of a clear and ready solution to correct the hydrogen sulfide problem.

Even without a clearly demonstrated technology, the effect on the local environment and stakeholders must be considered. Presently some facilities are implementing varied levels of feedlot hydrogen sulfide emission control technologies. The MPCA will continue to work with these and other facilities to reduce emissions. To this end, facilities will be encouraged to try different emission control methods and evaluate their effectiveness. In situations where there are violations of the ambient air quality standards for hydrogen sulfide, MPCA will pursue enforcement action.

D. Partnerships

The MPCA is developing partnerships with the regulated communities, local units of government and interest groups. The MPCA is continuing our partnership with CENSARA in an effort to obtain regional and national input concerning this issue. The MPCA has had several discussions with Renville County to determine how each of us can cooperate in sharing the implementation of nuisance odor and hydrogen sulfide emission regulations as it pertains to feedlots. MPCA staff are in regular communication with the University of Minnesota and others researchers. MPCA staff have participated in a National Pork Producers Council (NPPC) to discuss their national environmental audit program for swine producers. Program staff are in regular communication with several environmental organizations and have shared information about hydrogen sulfide emissions. Staff have also communicated with the news media and have shared information for numerous newspaper articles and a piece on Minnesota Public Radio concerning the hydrogen sulfide compliance screening. As these and other partnerships mature the credibility, understanding, development and implementation of the feedlot hydrogen sulfide program should improve. MPCA anticipates that these efforts will increase as the program proceeds and that by working together we will be able to foster dialogue at various stages of new product research and development. MPCA will continue to improve this process by facilitating public meetings and, when possible, participating in state and local conferences and facility demonstration projects.

1. Technology and Management Demonstration Projects

In 1998, some facilities will be trying various technologies to determine their effectiveness. Under consideration are biochemical additives, modified aeration, the use of low voltage high current wastewater modification, and covers. The MPCA desires to work with these feedlot operators to evaluate these methods' effectiveness at complying with ambient standards. Our efforts may include some hydrogen sulfide compliance screening and research sampling of the emissions around the treated lagoons or barns to determine their effectiveness. This monitoring will be incorporated into the routine Jerome meter monitoring the MPCA staff will be conducting in 1998. In addition some longer term evaluations may be necessary using either the TRS monitor or the MDA "Chemcassettes"®.

The Renville County Economic Development Corporation has applied for a U. S. Environmental Protection Agency grant to conduct a full-scale demonstration project using a facultative lagoon specifically designed to control the emissions of hazardous and odorous gases from outdoor hog manure. The process employs thin layer aeration, a technique which creates a thin aerobic layer of wastewater and dissolved oxygen at the surface of the lagoon. The bacteria found in the upper aerobic water layer of a facultative lagoon preferentially biodegrade hazardous and odorous gases. The demonstration will consist of installing air lift aerators into an existing manure basin. If this grant is awarded to the county, this will be a valuable evaluation of a new and interesting use of aeration technology which will be followed closely by the MPCA and others.

A Strategy for Addressing Livestock Odor Issues

A report from the

Livestock Odor Task Force

to the

Feedlot & Manure Management Advisory Committee

February 5, 1997

Strategy for Addressing Livestock Odor Issues

Livestock Odor Task Force
Report & Recommendations

Table of Contents

Foreword	2
Task Force Membership	3
Introduction	4
Recommendations of the Livestock Odor Task Force-Overview	8
Recommendations for Odor Policy	9
Recommendations for Implementation	12
Recommendations for the Interim	15
Conclusion	17
Appendix A - Issues & Options Considered by LOTF	18
Appendix B - LOTF Protocols	51
Appendix C - LOTF Member Biographies	53
Appendix D - Feedlot & Manure Management Advisory Committee (FMMAC)	57
Appendix E - Bibliography	60

FOREWORD

The Livestock Odor Task Force considered it important that any livestock odor policy be fair to farms of all sizes, protect the public from undue odors, and not place an excessive burden on regulators or producers. Although it would be far easier to say that there is not enough information available to develop such a policy, this was not the choice made by the Task Force. Instead, the Task Force has made recommendations that it hopes will move the state forward in resolving some of the controversy surrounding livestock odors.

TASK FORCE MEMBERSHIP

Feedlot and Manure Management Advisory Committee's (FMMAC) LIVESTOCK ODOR TASK FORCE

Represents	Name	Organization	Address	Phone #
FMMAC	Marlin Pankratz	FMMAC	Mountain Lake	507-427-2152
Research	David Schmidt	University of Minnesota	St. Paul	612-625-4262
Environmental	Ginny Yingling	Clean Water Action	Minneapolis	612-623-3666
Producer	Dick Nicolai	MN Pork Producers Assn	Hector	612-848-2382
Local Gov't	Tina Rosenstein	Nicollet Co. Env. Svc.	St. Peter	800-247-5044
Consultant	Robert Mensch	Mensch Engineering	Fairmont	507-235-9151
Rural Non-farm	Charles Beatty Sr.		Faribault	507-332-2266
County Commissioner	Bob Peterson	Assn of MN Counties - Waseca Co. Commissioner	New Richland	507-465-8073
At-large	Heather Robins	Rice Co. Board of Commissioners	Northfield	507-663-7950
MN Pollution Control Agency	Dave Nelson	MPCA	St. Paul	612-296-9274
MN Department of Agriculture	Steven Olson	MDA	St. Paul	612-297-3217
MN Department of Health	Marian Marbury	MN Dept. of Health	Minneapolis	612-623-5629

The task force Co-Chairs are:
Steve Olson, MN Dept. of Agriculture (MDA), 90 W Plato Blvd., St. Paul, MN 55107;
Phone: 612/297-3217 E-mail: Steven.H.Olson@state.mn.us
Dave Nelson, MN Pollution Control Agency (MPCA) 520 LaFayette Rd, St. Paul, MN 55155;
Phone: 612/296-9274; E-mail: David.R.Nelson@pca.state.mn.us

Special thank you to Bob Patton of the Minnesota Department of Agriculture for his facilitation of the discussion and assistance in drafting the report.

INTRODUCTION

What is the Livestock Odor Task Force?

The Feedlot and Manure Management Advisory Committee (FMMAC) was created during the 1994 legislative session (Minnesota Statutes 17.136) to, among other tasks, "identify needs, goals, and suggest policies for research, monitoring, and regulatory activities regarding feedlot and manure management." Odor is an issue that in recent years has become a source of contention in many areas of Minnesota as well as across the country. In some instances, the issue has created conflict between neighbors. Because the conflict adversely affects farms, their neighbors (both farm and non-farm), and local communities, the FMMAC created the Livestock Odor Task Force (LOTF) to advise FMMAC on odor control issues. FMMAC's charge to the LOTF was to "develop workable solutions to address the odor issue."

LOTF consists of 12 members (see Task Force Membership on page 3) representing the following constituencies involved in the odor issue: FMMAC, research, environmental, producer, local government, industry/consultant, rural non-farm, Association of Minnesota Counties, MN Department of Health, MN Pollution Control Agency, MN Department of Agriculture, and an at-large position. LOTF was co-chaired by Steve Olson of the Minnesota Department of Agriculture (MDA) and Dave Nelson of the Minnesota Pollution Control Agency (MPCA). LOTF members were selected jointly by FMMAC, MPCA and MDA.

In its recommendations, the LOTF has tried to meet the legislature's goals for FMMAC and FMMAC's goal for the LOTF. The LOTF believes that it may be tempting to mandate policy of zero odor, but this is impractical, as livestock production, or any other industry, could not exist with such a policy. Likewise, having no regulation of odors will only result in increased conflict in rural areas. In its odor policy recommendation the LOTF strove for middle ground of protecting the public interest along with the livestock industry. To do this there will be a need for reductions in odor emissions from some facilities and a tolerance of some odors from the public.

What is the Odor Issue?

In livestock production, odor is a product of microbial degradation of organic matter. The major source of odor on livestock farms is manure. As biological activity occurs gases are released. Over 168 compounds such as hydrogen sulfide and ammonia have been identified which contribute to odor from livestock manure.

Odors have always been associated with livestock. The question is "why is livestock odor an issue now compared with 20 to 30 years ago?" In the past two decades farms have increased in size. The frequency and intensity of odors from the small farms of the past were possibly different and more than likely less intense and less frequent than the odors generated by current facilities. Two factors might help explain the controversy: the increase in density of livestock (more animals per site); and in some areas an increase in numbers of people -- both farm and non-farm living near livestock farms. Odor has been a contentious issue in areas where human populations are stable or decreasing.

Hydrogen Sulfide

Most of the odorous compounds are created during anaerobic decomposition of organic matter. Of these compounds, hydrogen sulfide (H_2S) has received the most attention and has been the center of recent monitoring efforts in Renville County, Minnesota.

In addition to contributing to odor, H_2S can be a health concern. H_2S is a compound that, at certain levels, can affect human health. Portions of the following discussion are segments taken from a Minnesota Department of Health (MDH) analysis of ambient air monitoring done by citizens in Renville County. The concerns regard the potential level of hydrogen sulfide from livestock operations.

> The Department of Health is currently developing "Health Risk Value" (HRV) for several compounds including hydrogen sulfide. The proposed HRVs will be applied to several industries, not just agriculture. MDH is calculating the HRV "very conservatively, to be highly protective of the public. As long as the HRV is not exceeded, exposure to H_2S should not pose any health concern - even for children, people with chronic diseases, or other vulnerable individuals." The Department of Health will use the H_2S HRV as a "yardstick" in determining when H_2S "may potentially be a health concern. When an HRV is exceeded, further evaluation may be necessary to determine whether there is an actual public health risk."
>
> "MDH has concluded that the levels of H_2S detected at certain sites by the citizen monitoring effort do not constitute an immediate crisis or public health emergency - but they do represent a potential health concern." "Exposure to hydrogen sulfide is not associated with any increased risk of cancer. No lasting health effects have been linked with short term exposure to H_2S at the levels measured during the citizens monitoring effort. This level of exposure may sometimes be associated with problems like nausea, headaches, and irritation of the eyes, throat or respiratory system - especially in children and people with underlying health problems. It could also aggravate the symptoms of asthma, but it would most likely not cause anyone to develop asthma." "Based on the results of the citizen monitoring effort - as well as earlier testing done by MDH and the MN Pollution Control Agency (MPCA) - MDH is recommending that steps be taken to reduce H_2S emissions at sites where levels have exceeded the proposed HRV."

The LOTF discussed these findings at several of its meetings. It considered linking odor control policy to existing hydrogen sulfide regulations, i.e. if the MPCA is planning to reduce hydrogen sulfide emissions would odor be reduced as well? However, the correlation between hydrogen sulfide and odor is not sufficient to warrant only one standard. There can often be high odorous emissions and low hydrogen sulfide emissions from the same facility. Therefore, odor emissions must be considered a separate problem. The LOTF reached consensus early in its discussions that regardless of how the livestock odor issue is resolved, the health of all citizens must be equally protected. Therefore, the health and air quality standards related to hydrogen sulfide should be enforced. While the evidence of direct health effects related to odor is still open to debate, this is not the case for hydrogen sulfide. The discussion with respect to differing standards based on different zoning or population density which the LOTF considered with respect to odor do not apply with regard to hydrogen sulfide.

LOTF Discussion and Methodology

The LOTF started a twelve month process of facilitated discussions with the identification of four issue areas :

1. How should government policy motivate development and use of design and management techniques to prevent or control odor?
2. What is the relationship of land use policies to odor control? Parts of this question are:
   - What could each level of government do to reduce conflict?
   - Can the odor problem be reduced through land use planning?
   - If the odor problem were solved would land use conflict evaporate?
3. How do we measure odor to achieve the goals of policy regarding community/industry exposure to odors?
4. What should the government policy be on how much odor a community or individual should have to tolerate?

Assumptions

The LOTF discussion was guided by the following assumptions:

1. Both animal agriculture and the public good are important to the state of Minnesota; therefore, the state should invest time and resources toward resolving the odor issue.
2. The state is responsible for establishing health-based criteria for specific components of emissions and developing appropriate standards.
3. Government policy should not inhibit the creation of effective and economical odor control technologies.
4. The state should promote low emission and low energy use systems.

Methodology

The LOTF divided into working teams to develop through a brainstorming process options/alternatives to address each of the problem statements. Afterward, as a whole, the LOTF reviewed, commented on and revised the options and alternatives. They then developed pros and cons for each of the alternatives. Next, each group was responsible for drafting a discussion on the options. The intent was to present a balanced discussion on the issue that would assist the LOTF in developing recommendations. The options/alternatives are described in Appendix A. Finally the LOTF as a whole evaluated elements of recommendations. These were subsequently written up in draft, revised and adopted by consensus.

Overview of Recommendations

The most effective odor policy is one that is based on total odor emissions from a farm site. An odor policy based on total emissions allows farms of any size and manure handling system to be compared and regulated on a uniform basis. However, since actual monitoring of odor emissions from individual farm sites is both difficult and expensive, odor emissions from an individual farm site must be estimated. To be reliable, these estimates must be based on on-farm odor measurements of typical odor sources. On-farm odor sources include livestock housing and manure storage. (Note: odors from land application are intermittent and are not currently included in the discussion of on-farm odors; however, different land application methods could also be evaluated similarly). Once total emissions from an individual farm site are estimated, acceptable and standardized separation distances can be determined.

The recommended odor policy is based on two key elements: the development of an odor rating system; and a method to relate odor emissions to separation distances. Recommendations also address implementation and interim issues.

The Livestock Odor Task Force is recommending that the State of Minnesota take the following actions:

I. Recommendation for Odor Policy

- **Total Odor Emissions Rating System.** Research, development, and implementation of a system for rating the total odor emissions from livestock facilities based upon evaluation of new and existing manure management odor control technologies, practices and size of facility.
- **Emission/Separation Curves.** Development of a line graph for use by county governments in determining separation distances between livestock facilities and other land uses, based on the total odor emissions rating system.
- **Best Management Practices for Peak Odor Events.** Development of best management practices (BMPs) to address seasonal or periodic peak levels of odor that are not adequately addressed by the total odor emissions rating system, emission/separation curves, and resulting separation distances

II. Recommendations for Implementation

- **Funding.** Identification of funding mechanisms for rating emissions from both common, and patentable production practices.
- **Users Manual.** Development of a users manual to assist county government and producers in use of the total odor emissions ratings system and emission/separation curves.
- **County Implementation.** Facilitation and encouragement of county implementation of the total odor emissions rating system, emission/separation curves, and best management practices for peak odor events, through funding and technical assistance.
- **Mediation Services.** Development and provision of mediation services to local governments to assist in resolving conflicts of livestock odor.
- **Evaluation**. Assessing the effectiveness of the rating system, emission/separation distance curves, and best management practices for peak odor events; and the level of implementation by county governments.

III. Recommendations for the Interim

- **Promotion of Best Management Practices (BMPs)** Develop fact sheets on current odor control practices to assist producers in reducing odors and county government in addressing complaints.
- **Hydrogen Sulfide (H_2S)** Support MPCA's efforts in determining extent of H_2S emissions from livestock operations.

RECOMMENDATIONS OF THE LIVESTOCK ODOR TASK FORCE

I. Recommendations for Odor Policy

Total Odor Emission Rating System

Several types of livestock farming systems are currently in use throughout the state of Minnesota. These farming systems range from low density pasture systems to high density confinement systems. The number of animals raised on individual farms also ranges from a few animals to several thousand animals. Because of these variations each individual farm will generate a different amount of odor. Trying to monitor or measure the amount of odors being emitted from each farm would be a nearly impossible task. Some system therefore must be developed to estimate the amount of odors generated on these farms. Having a reliable estimate of the total odors generated allows farms to be compared based on odors emitted rather than on the number of animals.

An odor rating system needs to be developed as a means to predict and compare odor emissions from farms. By taking odor measurements from a variety of odor sources, a rating of these sources can be established. Odors can be measured using an olfactometer (see Appendix A). Olfactometery is a method that uses the human nose to evaluate the strength of an odor. It is a systematic method that records the amount of clean dilution air needed to make a sample of odorous air undetectable. This number is recorded as odor units (ou). Although the olfactometer does not give an actual measure of odor emissions (mass per time), it does indicate a relative rating of the strength of an odor from a particular source. Once a system is given an odor rating it can be compared to other systems. Although a particular protocol has not been established, it is thought that the sample of odorous air from a particular source would be measured directly from the source, e.g., directly off the surface of a manure storage basin, rather than somewhere downwind from the source.

An odor rating for any particular type of system could be generated by taking actual air samples from several existing systems, evaluating the sample using an olfactometer, and averaging the results. (Note, these odor ratings would be based on average odor measurements from these systems. Considerations would not be made for the multitude of variables that impact gas emissions. The rating system would be based on a standard testing protocol and would only indicate average odor emissions). These odor ratings would be published in a table. As new technologies become available they would be evaluated and given an odor rating.

The development of an odor rating system makes it possible to compare relative odor emissions from different types of systems, or to evaluate the percent odor reduction that could be anticipated by implementing an odor control technology. However, an odor rating can only compare the relative odor emissions from different types of systems. What is also needed is a method to compare the total emissions from different types of systems that are in use on various farm sizes. Therefore, a method to relate the odor rating to the estimated total odor emissions from a farm is needed. Although no such method currently exists, it is

anticipated that such a method can be developed. This method would factor in variables such as the surface area of the odor source or the amount of odorous air being ventilated from a building. With this type of information the total odor emissions from a farm site could be estimated.

Example

A farm is looking at some expansions and modifications. Currently they are finishing 1000 pigs per year in cargill units (open front barns). Manure is currently being scraped from these units into an earthen basin. The farmers are proposing a new facility on the same site which will finish 2500 pigs per year in a deep pitted, mechanically ventilated barn. The existing facilities, including the earthen basin, will be abandoned. Does the potential for off-site odors increase or decrease with this change?

Currently this question can not be answered. With the proposed system the cargill units, the earthen storage, and the deep pitted barns will have an odor rating; some number that indicates the average amount of odors generated. Using the odor rating number for each system and the sizes of the facilities estimated odor impact from the existing and proposed could be compared.

Will the system promote or stifle innovation?

The proposed recommendations will most likely stimulate the creation of economical odor control technologies. Currently any odor control technology is seen as suspect. One key factor in stimulating the creation of new technology is the ability for new products and technologies to be evaluated. It is the hope of this task force that the rating of new technologies will be very economical and timely. Provisions may also be made to accept test results from other testing facilities.

What will the odor rating include?

The evaluation of systems will be primarily based on average odor generation from a given system or technology. However, other information could be attained at the same time with little additional effort. Other information may include the emissions of hydrogen sulfide or ammonia or the cost of implementing the technology.

Challenges

Although the Task Force has agreed that the proposed system would be the best policy option, some difficulties still exist.

Rating manure handling systems based on odor emissions can be a simple process once the protocol has been determined. However, there are a multitude of manure handling systems and system variations that need to be evaluated. For instance, there are three or four different methods for storing liquid manure. These few systems could easily be given a rating, given the same type of manure was in the storage. However, odors from these storage may vary by type of livestock manure, solids concentration, initial sulfate content in the water, animal diet, management practices, odor reducing additives, etc.. Preliminary investigations indicate that some of these factors may contribute significantly to odor while others may not. Therefore, the sheer number of options or variations to evaluate may make the rating system very difficult to create and maintain.

Another potential problem with the rating system is the lack of methodology for estimating total emissions from a system based on individual odor measurements. An odor measurement from the surface of a manure storage will give a ratio of dilution to threshold or odor unit. This odor must then be related to the total emissions from that storage. It is logical that the total emissions is related to the total area of the odor emitting surface or the amount of odorous air exhausted from a building, however, these relationships have not fully been established.

The primary goal of the rating system is to determine the total emissions from a farm site. Most farms will have a combination of odor sources, some emitting surfaces and some ventilation fans. These two very different types of emissions must be combined in determining a total odor emissions for the farm. No current method exists that can compare or combine these two odor sources.

Recommendation for Odor Policy 1: Total Odor Emission Rating System

The State, through research and development by the University of Minnesota, should develop and implement a system for rating the total odor emissions from livestock facilities. Odor emissions from each typical livestock production practice (each typical housing, manure handling, and storage practice), for each species, utilizing each typical odor control technology would be measured and standardized. The odor measurements would be taken directly from on-farm odor sources using an olfactometer. Measurements would also be made of hydrogen sulfide, ammonia, and other potential indicators of odor (e.g., total solids content of manure).

Each typical practice, utilizing each typical odor control technology, would then be given a rating along a numerical scale (e.g., 1 to 10) based on the odor measurement.

For any given livestock site, a total odor emissions rating would be calculated by adding together ratings of all practices, modified by factors to account for the size of the livestock facility.

Emission/Separation Distances

Another key to the odor impact on a community is separation distance, the distance between an odor source and the property line, nearest neighbor, or residential area. Once an odor rating system is developed it is possible to develop separation distances that are based specifically on odor. Current separation distances are based on the assumption that larger facilities generate more odor and therefore require greater separations. This theory would

hold true if all operations were identical. However, with the diversity of manure handling systems and facility designs and the new odor control technologies currently being developed, farm size is not the only variable in odor emissions. With the odor ratings system, it will be possible to develop separation distances based on the actual odor impact from a facility. Therefore, the second key element of the recommendations is a method to compare the odor impact of various existing and proposed farm sites on a community. One method to determine this impact is with a dispersion model. A dispersion model is a mathematical method of estimating how a gas, emitted into the atmosphere, is dispersed in the ambient air. Although many factors exist in determining how a gas is dispersed, the model could be used with a standard set of input variables. In this way, the only variable would be the odor emissions as estimated by the odor rating. The separation distances generated by a dispersion model could be verified by reviewing existing livestock and poultry operations that are acceptable to the community.

A line graph would be developed showing several curves, with each curve representing a different frequency or intensity of odor. The line graph would allow the user to determine a separation distance between a livestock site and a receiving site, based on the odor sensitivity of the receiving site and the odor rating of the livestock site.

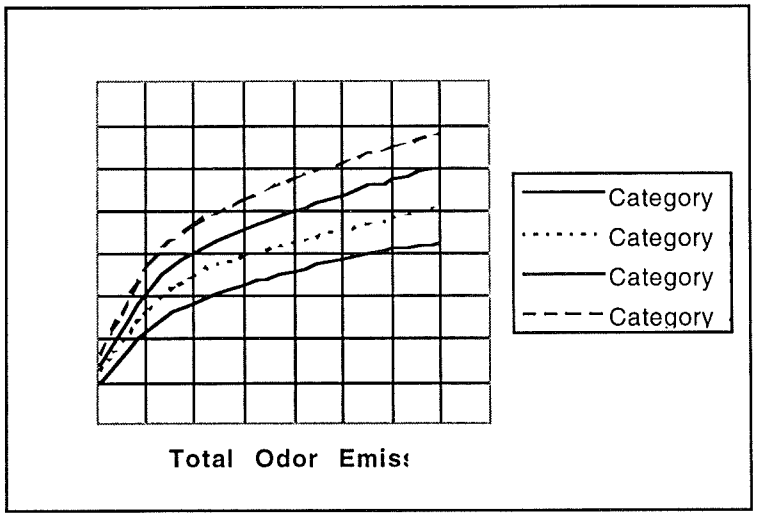


Figure 1. Odor emission vs. separation distance curves (theoretical).

A set of separation distance curves might look similar to what is shown in figure 1. In figure 1 the different categories represent some indication of the acceptable limits of odor impact. These categories could represent various odor intensities and frequencies. For instance category 1 may be a land use classification where more intense or more frequent odors could be expected. Category 4 may represent a land use classification with a fairly low tolerance to intense or frequent odors. The total odor emission represented on the horizontal axis would be the total odor emissions as estimated by the odor rating system. The separation distances would be calculated values based on odor dispersion modeling and verified by field measurements or experience with existing facilities.

Recommendation for Odor Policy 2: Emission/Separation Distance Curves

The State, through research and development by the University of Minnesota, should develop a line graph for use by county governments in determining separation distances between livestock facilities and other land uses, based on the total odor emissions rating system.

Best Management Practices for Peak Odor Events

An odor rating system would most likely rate systems at average odor emissions. Outdoor manure storage facilities may emit more odor during periods of transition between cold and warm weather (spring and fall turnover). Also, odor emissions are much greater when manure storage facilities are being agitated during emptying. Because the recommended odor policy is based on average odor emissions, these periods of high odors will impact surrounding neighbors and communities. The actual impact of these periods of high odor is dependent on wind speed and direction during those periods.

The proposed odor rating system deals with typical odor in a quantitative way. Because of the transitory nature of peaks, it would be impractical to address them in the same manner. Peaks need to be addressed in a prescriptive fashion (BMPs). There are some management practices and technologies that are currently available to address these periods of high intermittent odors. Technologies currently being developed will also be available to address those periods.

Recommendation for Odor Policy 3: Best Management Practices for Peak Odor Events

The State should develop best management practices (BMPs) to address seasonal or periodic peak levels of odor that are not adequately addressed by the total odor emissions rating system, emission/separation curves, and resulting separation distances.

II. Recommendations for Implementation

Implementation of Odor Rating System and Emission/Separation Distance Curves

Current rules and regulations involving the operation and construction of livestock facilities differ across the state. This inconsistency is especially obvious in the regulation of livestock odors. Counties throughout Minnesota are developing methods of regulating livestock facility with regard to odor. These systems typically do little to control odor problems or put an excessive burden on producers. In counties where no odor regulations are implemented the public may not be protected from undue or excessive odors. One method to standardize these odor regulations would be for the state to set minimum separation distance based on odor rating and emission/separation curves. The LOTF determined that implementation of such statewide standard would not be appropriate because such a standard may be too permissive for some counties and too restrictive for other counties. Therefore, it was determined that the use of the total odor emissions ratings and emission/separation curves should be at the option and discretion of county government. However, it is important to both producers and the public that most or all counties in Minnesota adopt this system. Therefore the adoption of this system should be strongly supported and encouraged by the state.

Setting up and maintaining an efficient method to rate systems will cost money. Most elements of a manure handling systems are very common. However some elements of manure handling systems are specific technologies that are patented by the manufacturer. This difference in systems must be accounted for when funding the odor rating test. LOTF recommends that odor ratings for standard systems be funded by public funding sources while ratings for patentable systems be funded through the private firm developing the odor control technology.

What about existing facilities?

The odor rating system is intended primarily for use in evaluating and regulating proposed livestock facilities. However, the system could also be applied to existing facilities. In enforcement of any new zoning provision, a local government must decide how to address "nonconforming lots, buildings, or uses"; land, structures, or uses of the land that complied with local laws before adoption of new zoning provisions, but that are in violation of the provisions after adoption. A lawfully-existing livestock facility that does not comply with new odor-related separation distance provisions could be considered a nonconforming building or structure. Possible options to address nonconformities range from allowing their continued existence, to requiring termination after a specified period of time (a concept known as "amortization"), to immediate termination. A number of legal issues are associated with addressing nonconformities in zoning regulations, and local governments should obtain sound legal advice before developing and implementing such regulations.

The following two recommendations are critical to the success of the odor rating system and emission/separation curves.

Recommendation for Implementation 1: Funding of Development & Operation of Total Odor Emissions Rating System and Emission/Separation Curves

The state should fund the research and development of the total odor emissions rating system and emission/separation curves, and the odor emissions ratings for commonly used livestock production practices. Odor emissions ratings for patentable livestock production practices and odor control technologies should be funded through fees from the firms or institutions developing the patentable practices or technologies.

Recommendation for Implementation 2: User's Manual

Use of the total odor emissions ratings and emission/separation distance curves should be at the option and discretion of county government. The State should develop a users manual to assist county government in use of the total odor emissions ratings and emission/separation distance curves.

County Implementation

Both state and county governments have an interest in solving the issues related to odors from livestock facilities. Odor policy recommendations include the state and county governments in policy implementation. Under the recommendation, state government would be responsible for developing and maintaining an odor rating system along with setting guidelines for determining separation distances. County governments would be responsible for implementing the odor rating system through their zoning authority. County governments could make separation distances more or less restrictive than the state guidelines.

Recommendation for Implementation 3: County Implementation

The state should facilitate and encourage county implementation of the total odor emissions rating system, emission/separation distance curves, and best management practices for peak odor events, through funding and technical

assistance.

Mediation Process

The LOTF envisions county governments handling odor complaints by first inspecting the livestock facility, followed by referral of mediation services, where appropriate. Upon a livestock odor complaint, inspection would be conducted by trained county personnel to determine whether the facility meets odor rating criteria, and whether odor levels being generated are above those that would be expected from the plan. Inspection personnel would also provide complainants information on what odors would be expected from proper implementation of the odor management plan. Results of the inspection would be provided to both the complainant and the producer. Subsequent to the inspection, if the facility was found to be in noncompliance, then the county government would require the facility to be brought into compliance.

If the facility was found to be in compliance with the county provisions, and an odor issue still exists between the parties, mediation between the complainant and producer would be offered to resolve the odor issues. Initiating mediation would be at the option of the complainant and the producer.

Recommendation for Implementation 4: Mediation Services

The LOTF recognizes that, even after application of separation distances established according to the total odor emissions rating system and emission/separation distance curves, some persons affected by livestock odors will seek recourse from county government or the courts. The state should develop and provide mediation services to counties in such cases.

Evaluation

This use of an odor rating system and separation distance curves is a new approach to addressing this issue. As a new approach the effectiveness and implementation will need to be evaluated and adjusted as necessary. After development of odor ratings, implementation by counties will probably occur over a couple of years. The LOTF realizes that after a period of time the rating system will need to be evaluated for its effectiveness in addressing the odor issue. The effectiveness should examine the level of implementation by counties, and the usefulness to counties and livestock producers.

Recommendation for Implementation 5: Policy Evaluation

The State should evaluate the practicality and effectiveness of the odor rating system at the earliest point in time after the system is developed. If the odor rating system is found to be impractical or ineffective, the State should reassess it options for addressing the issue of livestock odors and take prompt action.

If the odor rating system is found to be practical and effective, and two years after the system is developed and available for county use, the State should evaluate the rate at which county agencies are adopting and using the odor rating system. The State should also evaluate the how the system fits in with feedlot regulation by the State.

III. Recommendation for Interim

The projected timeline for developing the odor rating system, separation curves, and BMPs for peak odor events is estimated to be 2-3 years. The LOTF recognizes that in the interim efforts will need to be made to address the issue. The LOTF recommends promotion of current odor control BMPs, and continued analysis by MPCA & Minnesota Department of Health of the prevalence of hydrogen sulfide emissions from livestock operations.

The Minnesota Pollution Control Agency currently has regulations governing the concentrations of hydrogen sulfide in the ambient air. Hydrogen sulfide is one of the odorous gases emitted from livestock and poultry operations. The MPCA's control of hydrogen sulfide emissions will most likely reduce the amount of odor generated at many livestock facilities. However, reductions in hydrogen sulfide may not lead to sufficient reductions in odor. Therefore, the livestock odor task force recommends that an odor policy be implemented regardless of the MPCA's efforts on hydrogen sulfide. The recommended odor policy should not interfere with any hydrogen sulfide regulations.

Recommendation for Interim 1: Interim Promotion of BMPs

The Minnesota Extension Service should make a special effort to publicize whatever information is available on ways to control odor from livestock facilities. These techniques or systems could be considered best available

management practices. This information should be gathered from other sources throughout the state, nation, and world.

Recommendation for Interim 2: Hydrogen Sulfide Evaluation

Funding should be provided by the state to increase MPCA efforts to develop tools and strategies to address H2S problems.

CONCLUSION

The LOTF recognizes that development and implementation of an odor rating system and its other recommendations will be no simple task. However, the LOTF believes that development and implementation of such a system is the right course and direction for Minnesota.

Steps to Implement an Odor Rating System

The following are areas identified by the Livestock Odor Task Force for future work to further address the issue of odor from livestock. These areas include implementation of odor emissions based standards as well as other necessary research and education.

1. Develop a protocol for rating systems on odor emissions.
2. Designate an appropriate body to rate the systems.
3. Determine the relationship between relative odor measurements from systems and total odor emissions.
4. Determine an acceptable relationship between separation distances and total odor emissions.
5. Develop dispersion modeling.
6. Request funding from legislature for determining odor ratings for standard, non-patentable systems and dispersion modeling.

Issues & Options/Alternatives

This appendix is a compilation of the various issues and options identified and discussed by the Livestock Odor Task Force (LOTF). In order to make the issue of odor and the process of developing recommendations more manageable, the LOTF used a facilitated process to identify four issue areas. The issue areas were written in the form of problem statements. The LOTF then established "working teams" to develop possible options/alternatives to address the issue areas. The initial list of options was reviewed by the whole task force.

Pros and cons to each issue were brainstormed. The working teams then gathered information to support, and in some cases, illustrate, both the benefits and drawbacks of each option. The intent was to manage the workload while still giving each task force member the opportunity to give input into areas of discussion being developed by another working team. The final product is a balanced discussion of the issues and the various options available. The alternatives/options represent neither consensus nor disagreement among the LOTF members. Rather, this discussion was used as a springboard to developing recommendations from the LOTF to FMMAC on addressing the odor issue.

Problem Statement

How do we measure odors to achieve the goals of our policy regarding community and/or individual exposure to odors?

Background:

Measurement of odors has become a focal point in the debate surrounding livestock odor policies, because of the difficulty of quantifying odors in a meaningful way that allows for public policy to respond to citizen and producer concerns. In order to fully address the policy questions surrounding odors, we must not only quantify the odors, but we must also quantify or evaluate human response to those odors.

Quantification of livestock odor itself is difficult. At least 168 different compounds have been identified in livestock wastes or the surrounding air. At least 30 of these have very low olfactory detection limits and it is unclear for many of these compounds what contribution they make to the overall "smell" generated from a livestock operation. In addition, actual emissions are extremely variable and depend on a wide variety of factors, including the size of the herd, age of the livestock, the feed that is used, the genetic strain of the animals, whether animal waste is handled aerobically or anaerobically, the sulfur content of the water, and the season, temperature and humidity. As a result, developing one testing method that can account for all of the variables associated with livestock odor and that can quantify all of the odor causing elements in the emissions from livestock waste is extremely difficult. At best, quantifiable methods such as indicator gas measurement, can test for only a few compounds at a time, and those compounds may not be the main odor causers. "Human-based" methods, such as olfactometers and field monitors/trained sniffers measure the whole odor, but are expensive and do not provide producers with predictable levels that they can try to achieve.

Sampling is also a difficulty in developing an odor monitoring plan. Continuous monitoring of air quality requires permanent monitoring stations, but wind direction is variable. Thus, either an extremely expensive network of monitors is required or the monitoring system is less than adequate to measure odors continuously. Periodic sampling, either with an instrument or human "sniffers" may not occur at the appropriate times and so may either underestimate or overestimate the level of odor to which nearby residents are exposed.

In addition to the limitations of the methods themselves, there are additional aspects of the odor issue that simple quantification cannot address. For example, different people experience odors differently. What may be an offensive odor to one person may be merely annoying to another and unnoticeable to yet another. Beyond that, there is evidence that frequent exposure to an odor may cause sensitization of some people, so that subsequent exposures generate a greater response in sensitized individuals than in previously unexposed persons. Also, there is some concern on the part of producers that odor complaints may be generated by neighbors who have other issues that are not odor related.

All of this being said, there are numerous odor sampling or monitoring methods. These are detailed below, with discussion of the pros and cons of the various methods.

Olfactometer

The most accepted and most common means of measuring odor is with a dynamic olfactometer. Several types of dynamic olfactometers have been developed and are being used world-wide. The instruments are primarily a system of delivering odorous gases at different dilutions to a panelist. This method of odor measurement has been used to quantify odors from waste water treatment facilities and other industrial sources for many years. The procedure has been accepted and standardized by the American Society of Testing and Measurement (Standard # E679-91).

In this procedure, odorous air is collected in a sample bag made of material that does not absorb odors. Odorous air from the bag is then drawn through a mixing chamber where it is diluted with clean air. A panelist is then presented with three samples of air; one of diluted odorous air and two of odor free air. The panelist is forced to make a choice as to which air sample has the odor. Initially the odorous air is very dilute. This process of delivering three samples of air, two clean air and one diluted odorous air, is repeated with decreasing dilutions of odorous air. The dilution where the panelist consistently and correctly detects the sample containing the odorous air is labeled the detection threshold.

Typically the odor sample / dilutions are presented to several panelists (six to twelve). The dilution threshold is the dilution where 50% of the panelists indicate detection. The results are reported as a dilution to threshold (DT) for the particular odorous air sample. This number is often reported as an odor unit (ou),. A high dilution to threshold indicates a high odor concentration.

The major advantage of this system is that it relates well to the actual problem -- odor and human response to it -- rather than measuring a specific compound

that may or may not be the actual source of the odor. This is one of the few measurement techniques which allows this comparison to be made. However, despite being "human based", it does not address the issue of varying response to odors by different individuals.

Although olfactometry seems somewhat subjective, in actuality the results are very repeatable. However, it is difficult to compare results between laboratories because of subtle differences in equipment or protocol. Therefore, the best use of an olfactometer is in doing odor comparisons. Currently the University of Minnesota and a few other universities are using olfactometers to monitor reductions in odors when various odor control technologies are used.

Olfactometers are not very effective at measuring ambient air odors downwind of an odor source. This type of measurement is difficult for two reasons. First, the sampling of odors (filling of the tedlar bag) takes a few minutes. During this time the plume may move which would reduce the amount of odorous air captured in the sample. Secondly, odors in an odor plume are very dilute compared with the odor source. Very dilute odors are typically only a few dilutions away from being undetectable. Because there is some degradation of the odor in the sample bag and some losses of odors in the equipment used to dilute the sample the final measurement will most likely be undetectable by the panelists.

Any ambient air sampling for odors is also difficult because it is often hard to separate and distinguish which odors are coming from which facilities. In agricultural areas typically there are many odor sources in a relatively small geographic area. Therefore determining the odor contribution from one source using ambient measurements is problematic. To solve the problems of ambient air sampling and analysis, air samples are typically collected directly from the odor emitting surface. These measurements must then be related to actual ambient air concentrations at distances from the odor source. See odor modeling section in Appendix A. Because odor generation is extremely variable from livestock odor sources it usually requires several air samples to be analyzed before any conclusions about odor emissions can be drawn. As with any air sampling or odor measurement additional sampling is good but also will increase the cost. Typical costs for using an olfactometer are between 125 and 150 per sample (not including sample collection).

Electronic Nose

Several researchers are currently evaluating the use of an electronic sensor for measuring livestock odor. The technology is currently being used in the food and perfume industry to monitor manufacturing processes. This technology has the potential to take the subjective nature out of odor quantification. Using an array of electronic sensors, the electronic nose can determine the concentrations of several classes of compounds. Through a process of calibration of these concentrations to the results of an odor panel (i.e.,. sniffers), the numerical results are correlated to odor offensiveness. However, the correlation of the electronic nose responses to actual odor offensiveness is poor, at best.

Moreover, this method again does not account for the variability in human perception and response to odors, nor does it give a good measure of odor intensity. However, it does provide a "quantifiable" measurement of odor, which could provide targets for producers to aim for in odor reduction.

Measurement using Trained Odor Monitors

One of the ways that people have measured odors is to use "field monitors"- people, who go through training to be able to reliably distinguish specific odors and to rate their intensity. Training for field odor monitors consist of two to four days of training plus an additional day per year for updating. The cost per odor sample with a trained sniffer is the labor cost associated with the sniffer traveling out on site and spending approximately one hour making measurements.

When evaluating a odor event, the sniffers are assigned a predetermined sampling strategy that outlines where and how often they will stop to "take samples". For example, a person may be told to stand in a specific location and sniff once per minute for 10 minutes and then document the odor intensity at each interval. This method is currently being used in Ramsey County as a means of monitoring the odor from the municipal composting facility.

The advantages of this approach is that it is the most direct measure of the basic problem - human perception of odors. In addition, it has been shown to be fairly reliable. That is, after training, people can identify odors and rate their intensity in a repeatable fashion. Typically the field monitors would be chosen from the community and would represent a cross section of citizens.

There are also apparent disadvantages to this approach. The first is that it has usually been used to assess the odors from one specific facility, and with a fairly consistent odor emission. Odor generated from livestock facilities vary substantially over the seasons and vary between facilities. Also the close proximity of facilities may make it difficult to determine background odors from the odors generated at a particular facility.

Another disadvantage, which is a disadvantage to most odor quantifying techniques, is cost. One method of odor monitoring that can reduce this cost is to use community volunteers. These volunteers could be trained to take measurements at their residents or at designated locations. These measurements may be less "detailed" than a field monitors but would provide some very valuable information. While using local residents provides a means for communities to have an active role in the regulatory process, it may also raise the question of impartiality. Experience with similar situations suggests that if properly managed, the community field monitors could be fairly accurate and impartial.

Indicator gas concentrations ("marker compound")

One of the potential ways to measure odors is to choose an indicator gas, such as hydrogen sulfide or ammonia, as a surrogate, rather than to focus on odors per se. If an indicator gas could be identified that was closely correlated with odors, this approach would have several obvious major advantages: cost, repeatability, objectivity, an established regulatory framework, connection to health impact, and the facilitation of better management practices.

Ambient air monitoring is not necessarily inexpensive. While "grab samples" can be quite cheap, their lower limit of detection may not be adequate and the sampling timeframe may not match the sampling timeframe required by regulations. Establishment of a fixed air monitoring site may be necessary to acquire the requisite data. In addition to adding substantially to the cost of monitoring, adequate siting of the monitor may be difficult because of the variability of the plume direction depending on meteorological conditions. Nonetheless, assuming the latter problem can be addressed, monitoring for a specific indicator gas will still be less expensive than the other methods of monitoring odor.

Two major advantages of monitoring an indicator gas are repeatability and objectivity. By repeatability we mean that, assuming the monitoring instrument is adequately calibrated and correctly used, results from repeat samples taken under identical conditions will closely agree. By objectivity we mean that, while interpretation of the significance of the results in terms of health concern may vary, the actual results themselves are not influenced by individual factors. In contrast, the perception of odor by individuals as "offensive" is highly individual and influenced by many personal factors, and therefore is neither repeatable or objective.

A further advantage of monitoring an indicator gas is that a regulatory framework for monitoring emissions is widely practiced and accepted. While there has been some history of dealing with odors under nuisance statutes, the history is limited and variable. Further, the MPCA has already abandoned efforts in the Air Quality Division to develop odor rules and has indicated that it is unlikely to continue to address feedlot odors through rules. In contrast the control of emissions through monitoring and regulation is firmly established.

Monitoring an indicator gas also has the advantage of a direct connection to health concern, presumably one of the endpoints of concern. Again, the relation of odor to health impact is poorly understood. While it is clear that some people respond to odors with nonspecific symptoms such as headaches and nausea, the response appears to be highly individual and the basis for the response, whether primarily toxicological or psychological, has not been determined. In contrast, the health impacts of a specific emission can be determined, at least in theory, through toxicological and/or epidemiological studies. For example, there is a fair amount of scientific literature on the health effects of hydrogen sulfide and this literature can form the basis for establishing safe levels of exposure.

Lastly, monitoring an indicator compound could provide immediate feedback regarding the adequacy of existing controls or the efficacy of new controls. This would provide producers with a clear goal to shoot for, and relevant information on whether the goal has been achieved.

Unfortunately, despite all the obvious advantages of monitoring an indicator compound, no consistently adequate indicator compound has been identified. As noted in the background section for this problem statement, there are numerous factors that affect the quality and intensity of livestock odor and the generation of emissions from livestock waste. Thus a specific gas such as hydrogen sulfide may be closely related to odor offensiveness at one facility but be an unimportant contributor at another. Therefore, focusing on monitoring and control of one specific compound might lead to the expenditure of large

sums of money and effort without resulting in appreciable resolution of the odor problem.

Performance standard for specific compounds

Hydrogen Sulfide Issues and Implications:

One option for addressing odor emissions would be to chose a particular reference compound of concern and measure that compound for compliance. A limitation with this method is that no one compound has been shown to correlate well with odor levels. However, hydrogen sulfide is emerging as a compound of concern from certain livestock facilities.

Ambient air quality monitoring that was done in the vicinity of large swine facilities in 1995 and 1996, by both concerned citizens as well as by Renville County and the MPCA, found levels of hydrogen sulfide that, at times, appeared to exceed state standards and which have been characterized as a human health concern by the Minnesota Department of Health. MPCA efforts in response to this problem have included the installation of a continuous monitoring station for reduced sulfur in the vicinity of two of the swine facilities. There has also been a significant amount of field work to determine if hydrogen sulfide is likely the only compound of significant concern, to see how the reduced sulfur levels at the swine facilities compare with other emission sources in the area, and to test less costly methods for measuring sulfur compounds at these facilities.

Data thus far indicates that hydrogen sulfide is the key compound of concern. The data also seems to indicate that higher hydrogen sulfide levels are found at swine facilities than at cattle or poultry facilities.

The discovery of hydrogen sulfide near swine facilities at levels that appear to exceed state ambient air quality standards and which have been characterized as a human health concern, has major implications for the industry and for the MPCA Feedlot Program. The state ambient air quality standards for hydrogen sulfide read as follows:

CHAPTER 7009, MINNESOTA POLLUTION CONTROL AGENCY, AIR QUALITY DIVISION, AMBIENT AIR QUALITY STANDARDS

7009.0010 DEFINITIONS.

Subpart 1. **Scope**. For the purpose of parts 7009.0010 to 7009.0080, the following terms have the meanings given them.

Subp. 2. **Primary ambient air quality standards; primary standards.** "Primary ambient air quality standards" or "primary standards" mean levels established to protect the public health from adverse effects. The adverse effects that the standards should protect against include acute or chronic subjective symptoms and physiological changes that are likely to interfere with normal activity in healthy or sensitive individuals or to interfere unreasonably with the enjoyment of life or property.

Subp. 3. **Secondary ambient air quality standards; secondary standards.** "Secondary ambient air quality standards" or "secondary standards" mean levels established to protect the public welfare from any known or anticipated adverse effects, such as injury to agricultural crops and livestock, damage to or deterioration of property, annoyance and nuisance of persons, or hazards to air and ground transportation.

The ambient air quality standards for hydrogen sulfide are as follows:

Pollutant/ Air Contaminant	Primary Standard	Secondary Standard	Remarks
Hydrogen Sulfide	0.05 ppm by volume (70.0 micrograms per cubic meter)		1/2 hour average not to be exceeded over 2 times per year
	.03 ppm by volume (42.0 micrograms per cubic meter)		1/2 hour average not to be exceeded over 2 times in any 5 consecutive days.

This same standard contains requirements for measurement methodology.

7009.0060 MEASUREMENT METHODOLOGY FOR HYDROGEN SULFIDE.
For hydrogen sulfide, measurements made to determine compliance with the standards shall be performed in accordance with any measurement method approved by the commissioner. The commissioner shall approve a measurement method where the sensitivity, precision, accuracy, response time, and interference levels of the method are comparable to that of the measurement methods for the other pollutants described in part 7009.0050; and when the person seeking to take the measurement has developed and submitted to the agency a quality assurance plan that provides operational procedures for each of the activities described in Code of Federal Regulations, as amended, title 40, part 58, appendix A.2.2, Quality Assurance Requirements for State and Local Air Monitoring Stations.

There are a variety of test methods available for measuring hydrogen sulfide. There is a significant range in the cost as well as in the accuracy and precision of these test methods.. It appears that the lower cost methods of testing for hydrogen sulfide do not meet the above rule requirements.

The rule governing the issuance of permits by the MPCA is MN Rule 7001. Specifically, MN Rule 7001.0140 contains justification for the denial of a permit application.

Subp. 2. **Agency findings.** The following findings by the agency constitute justification for the agency to refuse to issue a new or modified permit, to refuse permit reissuance, or to revoke a permit without reissuance:

A. that with respect to the facility or activity to be permitted, the proposed permittee or permittees will not comply with all applicable state and federal pollution control statutes and rules administered by the agency, or conditions of the permit; ...

D. that the permitted facility or activity endangers human health and the environment and that the danger cannot be removed by a modification of the conditions of the permit;

As discussed earlier, it appears that some feedlots, though likely a small percentage of sites, have exceeded the state ambient air quality standard for hydrogen sulfide. Due to a lack of information on which facilities have hydrogen sulfide emission problems, and which ones do not, it is difficult to predict which facilities may exceed the above standards. Therefore to address item A as well as item D above, hydrogen sulfide monitoring will likely be necessary in permits for certain large feedlots, particularly those for swine, at least until this problem is better understood.

It seems both possible and reasonable to use a lower cost test method in such monitoring to screen for possible problems. Where a possible problem is discovered, additional monitoring as well as efforts to reduce emissions would be required in these permits.

Reducing hydrogen sulfide levels can be expected to reduce odors, since hydrogen sulfide is an odorous compound. However, it is very possible to have strong odors and low hydrogen sulfide levels. Therefore hydrogen sulfide efforts will not likely eliminate odor issues at livestock facilities.

Modeling

Another method to determine a facility's odor impact on the surrounding community is through the use of computer modeling. Computer modeling of odor movement and dispersion is a useful tool to be used with odor emission measurements to compare expected ambient air concentrations of odor and gases. Dispersion modeling is currently used as a tool to regulate gas emissions from industrial facilities. Computer models use local weather and topographic data, combined with expected headspace concentrations from various sources at the site, to determine potential gas concentrations at various locations around a facility. This method can also be used to predict odor concentrations from facilities, improving siting of new facilities in order to prevent odor complaints (when combined with adequate land-use planning to prevent nearby, downwind development). Both Netherlands and Germany and currently use some form of odor modeling in the process of siting new livestock facilities.

Dispersion modeling can be used as a first step in evaluating the odor impact of proposed sites. However, in order to predict the impact of odors on a surrounding community the actual odor emissions from a facility must be quantified. This is difficult because odor emissions from livestock facilities vary significantly by management practice, season, and system design. Initial research is being done to try to quantify the actual emissions, using headspace measurements, from various types of livestock facilities, but more research is needed.

References:

Sweeten, J.M., 1995 Odor Measurement Technology and Applications: A State-Of-The-Art Review. In Seventh International Symposium on Agricultural and Food Processing Wastes. pp. 214-229. ASAE, St. Joseph Michigan

O'Neill, D.H. and V.R. Phillips J., Agricultural Engineering Research 1992 53, 23-50A review of the control of nuisance odors from livestock buildings: Part 3, Properties of the odorous substances which have been identified in Livestock Wastes or in the air around them.

Klarenbeek, J.V. and T.A. van Harreveld, 1988 "On the regulations, measurement and abatement of odours emanating from livestock housing in the Netherlands. International Odor Conference '95 Iowa State University.

Paduch, M., "Present State of VDI-Guidelines on Odour Assessment; In Volatile emissions from livestock farming and sewage operations; pg. 38-42. Elsivier Applied Science

Problem Statement

How should government policy motivate development and use of design and management techniques to prevent or control odor?

Alternatives and Pros/Cons

Prescriptive Methods

Prescriptive Methods

One possible approach to controlling odor is to prescribe methods that are acceptable. This differs from a performance standard which simply sets out the goal to be achieved or a voluntary best management practice . The intent is to identify technologies, and practices that are found, through some means, to reduce odors from livestock operations. This is similar to a best management practice except that the latter is voluntary. From the producer perspective, a list of preapproved odor control methods may make the planning and, possibly, the permitting process easier. The drawback is that prescriptive practices will not be as effective for each farm. Technology X may work for Farmer A but not as well for Farmer B. Similarly, prescribing certain technologies does not allow for contingencies

Another downside to prescriptive methods is that identifying a list of practices has the potential to possibly inhibit or even prevent the incentive for new, more effective and affordable technologies. Most people close to this issue have the view that odor control technology will continue to evolve. It is important that as new technologies are developed, a system for evaluating them exists.

The theory behind prescriptive standards is that if an activity is designed or managed in a certain manner, the negative effects of the use can be softened or eliminated. Typical prescriptive standards used in the past have been limits on hours of operation, screening of the activity from neighboring properties or districts, dust control measures as well as various other industry specific standards.

In the case of odor control from livestock confinement areas, prescriptive standards that are effective are still being investigated. Some of the prescriptive standards that are being considered for use in this arena are requiring covers on manure storage facilities and using manure application methods that incorporate the manure into the soil instead of laying it on the surface. Research is being conducted on different management techniques such as manure storage loading rates and frequency to reduce odor, additives to manure to change the odor, adding oxygen to the manure to change the odor, feed manipulation, and a

wealth of other methods currently being investigated, covered in more detail in other sections of this report.

The difficulty of using prescriptive standards is that they can raise expectations that if the standard is carried out, the problem will be solved. In the case of odor management, the level of odor and how many people will be subjected to it may dictate the standard that will be required as in the case of a large facility near a population center (city or subdivision). However, if the standard is to reduce, but not eliminate the odor, conflicts may still arise.

Prescriptive standards may also become problematic in determining how much and under what circumstances. A feedlot in a low population area that is impacting a few people not involved in the feedlot may be expected to perform at an odor control level similar to a feedlot in close proximity to a population center.

Production System Components

Odor control at livestock facilities is an integral part of the entire livestock manure system. Obviously, odors will be generated at livestock facilities regardless of odor prevention precaution. This being the case, the next step is management of odor. Significant attention has been directed towards methods of controlling odor from livestock facilities."

"It is very important to consider the overall operation when you are planning a manure management system. The amount of labor and your present equipment should be major factors. The type of system will be based on manure characteristics, equipment used, site conditions and individual management preference."

There are six components in a manure management system:

1. **Production** is the amount, type, origin and consistency of manure;
2. **Collection** refers to gathering and initial storage;
3. **Storage** involves the areas used to hold manure until utilization;
4. **Treatment** refers to changing the manure characteristics, e.g., aerobic or anaerobic treatment or additives to reduce odor;
5. **Transfer** refers to the movement of the manure from collection to storage treatment or from storage to utilization; and
6. **Utilization** is the final use of manure such as land application or energy generation." (2).

When designing a manure handling system, the above functions will have quite different priorities and requirements depending upon the species of poultry and livestock. If a goal of government policy is to motivate the development and use of design and management techniques to prevent or control odor; a method must be established to evaluate each of the components of livestock production systems for each species of livestock. The components of livestock production systems are: production, collection, storage, treatment, transfer and utilization.

Production varies from solid to liquid depending upon species of animals and housing systems. The characteristics of manure as produced by the animal can be influenced by the feed ration and feed additives. Some feed additives tie up or bind odor generating compounds in the waste while others improve feed

digestibility, thus the animals put out less waste. Size of the operation will affect the amount or volume of odors generated.

Collection of waste with pull--plug and flushing systems generally reduce the odors in the barns, however the storage and treatment (or lack of treatment) associated with such systems often generate more odors.

Storage facilities depend upon the storage period and consistency of manure (solid or liquid). Short term storage may take place in the bedded pack pen or shallow pit under slatted floors. Long term storage in deep pits under slatted floors, concrete tanks, earthen basins or lagoons.

Treatment methods include: Manure additives include bacteria, enzymes, nutrients, biological inhibitors (chlorine, line), pH control chemicals (hydrated lime); oxidizing agents (hydrogen peroxide) and activated carbon (an absorbent). Research projects at Agricultural Utilization Research Institute (AURI) and land grant universities are evaluating some of the 150 or more manure additive products that are now on the market.

Feed additives may also play a role in controlling the odor which comes directly from the top of slotted floors in hog barns .

Aerobic treatment methods (aerated storage, oxidation ditches, aerobic lagoons) are generally quite effective in minimizing odor, but are rather costly operations.

Anaerobic Digestion occurring in open top containers (tanks and lagoons) will give off quite offensive odors. Covered digesters used for methane generation require considerable management and utilize a large part of the gas generated just to keep the system warm in the Minnesota climate. The gas from covered tanks and lagoons may be flared off or treated to further reduce odors.

Separation of the solids and liquids by mechanical means or settling often will reduce the odors generated during storage of the liquid fraction. The solid fractions may be composted to minimize odors. Composting of the solid fraction will reduce the volume and odors.

Transfer from collection to storage and storage to utilization may take many forms. The drag-hose system with chisel plow injection in the soil which has become widely accepted in the last five years will greatly reduce odors during field application of liquid manure.

Utilization will primarily be land application for fertilizer for some time to come. Other uses of manure by-products such as compost will use only a small fraction of the total poultry and livestock manure generated in the state.

Pros

The prescriptive method(s) of controlling odors has some advantages over performance standards.

The ability to measure and compare odors for a livestock facility:

a. Would take some of the guess work out of comparing one system vs. another;

b. Should not require a specialist;
c. May be used in land use zoning;

The system which is below a given odor rating would be:
a. A tool of defense in lawsuits
b. Eligible for grants/other financial assistance.

Prescriptive methods would be less costly to the producer because it would:
a. not require design by environmental specialists;
b. not be subject to expensive monitoring;
c. deter lawsuits; and/or
d. not be charged high insurance premiums.

Cons

1. Who will evaluate and rate the various alternatives: a citizens committee, MPCA, University of Minnesota (which college), AURI or a private consulting firm?
2. Will the rating scheme allow or provide for use of new methods and products, so as not to stifle innovation and development?
3. Is there currently enough scientific research data to make a fair rating?
4. The system does not consider management skills of owner/operator?

The establishment of an odor rating for each alternative is beyond the time frame of the LOTF. And the number of possible system combinations soon becomes overwhelming.

References

1. Manure Management Alternatives: A Supplemental Manual, MN Dept. of Agriculture, 1995.
2. Manure Management Planning Guide for Livestock, MN Dept. of Agriculture, 1995.

Other

The appendix: Separation of Feedlots From Neighbors is based on a simple odor rating (K value).

Odor Management Plan

Another option for addressing odors from livestock facilities would be to require an odor management plan as part of the MPCA permit program. This has been done on certain large facilities. Staff have considered making this a broader requirement. Proponents of this approach say that it forces the facility owner/operator to think about odor management issues, which might not otherwise occur. In a sense, requiring a plan becomes an educational requirement for the producer.

MPCA staff have developed the following list of items that should be considered in such a plan.

Air Emissions Management Components

The following manure storage design and management components can affect air emissions, odor production, and neighbor perceptions:

Lagoons

1. Initial design parameters
   a. Volatile solids (or volatile fatty acids) loading rate to lagoon (maximum recommended concentration)
   b. Drinking water sulfur content
   c. Drinking water pH
   d. Depth of lagoon
   e. Surface area of lagoon
   f. Predominant wind directions during summer
   g. Landscape setting (e.g. in valley vs. on top of hill, or adjacent to odor corridor)
   h. Lagoon berm height and effects on local air movement
   I. Feed ration
      - $CuSO_4$, crude protein, etc.
      - deodorants, binding agents, etc.
      - increase fiber content?
   j. Windbreaks
   k. Concrete primary cell, clay-lined secondary cell
   l. Public relations - inform neighbors of the project

2. Start-up practices
   a. Water temperature at start of loading (affects metabolic and reproductive rate of microorganisms)
   b. Time of year at start-up (e.g. July & August vs. November or December)
   c. Amount of manure loaded (i.e. concentration)
   d. Inoculants

3. Operational issues
   a. Manure loading frequency or schedule (frequent vs. "slug" loading)
   b. Monitoring of lagoon contents - set acceptable ranges for operation
      - pH, temperature, volatile solids or fatty acids, sulfur

4. Odor suppression techniques
   a. Covers
      - floating plastic mats
      - floating organic mats (straw, peat, etc.)
   b. Aeration
   c. Deodorants or odor suppresser sprays (e.g. Odorguard)
   d. Trees around lagoon perimeter
   e. Modify wind patterns across lagoon surface
   f. Odor counteractants

5. Remediation (requires assessment of reason(s) for upset of system)
   a. Adjust lagoon "habitat"
      - pH
      - manure or volatile solids concentration (e.g. remove solids or add dilution water)
      - temperature (if modification feasible)
      - aerate
   b. Cover lagoon
   c. Empty lagoon and start over
   d. Treat with ferric or ferrous chloride (watch pH, though)

6. Miscellaneous
   a. Manure solids separation
   b. Anaerobic digestion

c. aeration

This is simply a "laundry list" of things to consider. The list is designed for lagoons, but might be modified for other types of facilities. In its current version, only topics are listed. No guidance is given regarding the importance or use of any of these factors in reducing odors. That information is available from other sources, but in scattered pieces in a variety of publications.

Draw backs to this approach include the question of whether requiring a plan does in fact lead to changes in facility design and operation. A predictable outcome of such a requirement would be for consultants to develop standard plans that are submitted for each type of facility. This would lead to higher costs for the producer, but may not result in the education that was hoped for. Also, lacking criteria for the approval or review of these plans, it seems that this would be a weak requirement.

A factor that will likely lead to the MPCA not making this a requirement is that staff efforts will be needed to focus on the hydrogen sulfide issue. Hydrogen sulfide reduction plans may be required at facilities with documented problems. However, there is no discretionary staff time available to work on odor requirements which are not part of current rules.

Incentives

Managing a livestock farm to control odor is a new approach. While livestock manure has always generated odor, it is only within the past few years that it has become an issue. In those instances where the potential exists for odor to be a concern, a change in the management approach is important. However, change can be cost prohibitive. This section will look at private and public incentives as methods to assist in adjusting management systems to control odor.

Private Incentives

Narrative

Examples of private incentives are Minnesota Pork Producers Association (MPPA) Environmental Assurance Program (EAP); and SCAN (Sweden). The EAP program provides information for producers on the environmental aspects of the raising pork. SCAN is producer driven program in Sweden with the goal of reducing the use of antibiotics in livestock production.

Environmental Assurance Program (EAP)

(Information provided by the Minnesota Pork Producers Association)

The goal of this educational program is to provide pork producers practical, proactive information which will enable them to identify and economically address the key management issues affecting the environmental quality of their operations and their communities.

Key elements of the program include: environmental assurance workshops sponsored by state pork producers associations; on-farm assessments to be used as a basis for a voluntary farm environmental management plan to be completed by the producer following the workshop; and a review of the environmental management plan every two to three years at future Environmental Assurance Program events.

The curriculum for the workshop is tailored to incorporate specific needs for the local county pork producers. Extension educators selected by the Minnesota Pork Producers Association conduct the Environmental Assurance Workshops.

The workshop is co-sponsored by the county producers association.

An overview of the curriculum includes:

1. Introduction to the Environment - the importance of a sound environment to the pork industry and how improvement in environmental practices can help consumers view the pork industry in a more positive way.
2. On-farm inventory-this quick review allows producers to focus on key management areas.
3. Key Environmental Management Plan - how to use the on-farm assessment and local expertise to develop a management plan.
4. Developing Environmental Management Plan - how to use the on-farm assessment and local expertise to develop a management plan.
5. State and Local Regulations - highlights what is required for compliance and how to reduce environmental liability.

Following completion of the program, producers will better understand the cause-effect relationship between everyday management practices and long-term environmental quality. And they will have the tools to objectively assess their operation.

At the Environmental Assurance Workshop, pork producers review their operation and learn practical tips they can take back to their farm. It's a way for pork producers to learn new environmental practices that will help them to continue producing pork responsibly. Most producers are doing a good job with their operation from an environmental viewpoint. This program helps them assess their current practices and then do some fine-tuning. This program is another way for pork producers to show their dedication to conserving the environment.

SCAN

Although the Scan program is not an odor program, for the purposes of this discussion, it serves as an example of a program that was developed by the private sector in a attempt to alleviate a problem at a critical control point. Scan, the problem is antibiotic resistant salmonella and coli bacillus. The critical control point is the farm.

Scan is a Swedish farmers' association that has developed a program to reduce the use of antibiotics in animal production due to the evolution of antibiotic resistant strains of salmonella. The program created a new organizational structure consisting of an animal welfare council, a centrally-placed program coordinator, animal care advisors, regional animal care groups, and animal protection advisors at all animal processing facilities. Scan carries out a number of measures: control and rearing programs; education of processing personnel, transporters, and others; a development program in the area of animal handling and transport; and an evaluation and development program of new rearing systems.

Benefits

A major benefit to the public, of private sector incentives, is that the cost is borne by the producer, not the general population. For the producer, these type of programs are a way to deal with an issue without involving government. Most people are more willing to do something if they are not forced through a

mandate or regulation. However if encouragement is necessary, peer pressure from other producers can be effective in improving odor control practices.

Cons

A drawback of private sector incentives is that the industry policing of itself may not be effective. A voluntary system allows for "bad actors" to not improve practices. The incentives can stimulate adoption of better practices but the recourse is limited.

Public Incentives

Narrative

As stated at the beginning of the Incentives section, changing management practices can be cost prohibitive. Public incentive programs can be useful to producers implementing odor control practices. This discussion of public incentives will center on financial assistance and a "Green Label" program.

Financial Assistance

Narrative

The cost of implementing a manure management system varies depending on the type of system. In many cases, the cost is significant ranging from a few thousand dollars to over $100,000, the Natural Resources Conservation Service (NRCS) estimates the average cost to be approximately $40,000. Such a management practice is important, but difficult for operators to absorb. The cost of this type of environmental practice does not add anything directly to the producer's short-term bottom line. For this reason both the state and federal governments have established financial assistance programs to serve as both incentive and aid in implementing management practices that provide a benefit to the state's residents. Three primary assistance programs are available. However, each focus on providing water quality protection. Whether odor reduction/control measures would be included is currently being investigated.

A brief description of each of the programs is given below:

State Cost-Share Program:
(from information provided by the Board of Water & Soil Resources (BWSR))
The Erosion, Sediment Control, and Water Quality Cost-Share Program (C-S Program) provides funds to soil and water conservation districts (SWCDs) to cost-share on priority projects. One of the Minnesota Board of Water and Soil Resources' (BWSRs') first implementation programs, it began in 1977 and usually receives an annual appropriation of approximately $2 million. The C-S Program provides technical and financial assistance to landowners who install permanent, nonproduction-oriented practices designed to protect and improve soil and water resources.

The C-S Program's funding is appropriated from the state's general fund. Public tax dollars are made available to individual landowners through the BWSR and SWCDs to share the costs associated with reducing soil erosion or improving or protecting a water resource. Enabling Minnesota Statutes guide the administration of the program to ensure program funds are used to effectively treat problems having a significant environmental consequence, on-site and off-site.

Generally, this funding is provided to SWCDs in grant amounts ranging from $5,000 to $50,000 per district. A portion of the program funds are allocated

via a competitive process for special projects. The money funds anywhere from one to ten projects annually in each district. Projects eligible for the C-S Program include erosion control structures, stripcropping, terraces, grassed waterways, diversions, storm water control systems, field windbreaks, animal waste control systems, and critical area stabilization. The district board of supervisors is given the authority to decide which resource problems within their jurisdiction are most deserving of financial assistance, as well as the amount of assistance (not to exceed 75 percent of the eligible costs for high priority practices and not to exceed 50 percent for secondary priority practices). Cultural or management systems, like conservation tillage or rotational grazing systems, are not considered to be permanent practices; therefore, they are not eligible for the C-S Program.

As part of the C-S Program, districts can utilize up to 20 percent of their allocation for technical assistance costs such as salaries, travel, communications, and equipment.

The BWSR administers this program at the state level; locally, it is administered by the districts. Authorization and administrative guidelines for the C-S Program are found in Minnesota Statutes (M.S.) 103.501 and Chapter 8400.

Local people identifying and solving local resource problems is the key ingredient to the success of the state C-S Program. Practices installed with funding from the program often stem from a cooperative effort put forth by the land occupiers, local government units (LGUs), and state and federal agencies. These partnerships, combined with comprehensive natural resource planning to identify high priority problems to target cost-share assistance, result in treating resource problems that are having a negative impact on society.

Environmental Quality Incentive Program (EQIP) (which includes the former Agricultural Conservation Program (ACP) federal cost-share program):
This new program was included in the conservation provisions in the 1996 Farm Bill. The specific program rules are still evolving. The program consolidates the functions of four existing conservation programs into one and focuses assistance to locally-identified conservation priority areas or areas where agricultural improvement will help meet water quality goals. The program will be funded nationally, at the level of $200 million annually. EQIP will fund incentive payments for management practices and cost-sharing on conservation practices. Fifty percent of the funds are dedicated to conservation associated with livestock operations.

Although program implementation is still sketchy, it appears Natural Resource Conservation Service (NRCS) will have overall administration of the program with Farm Service Agency (FSA) responsible for county sign-ups. A state technical committee will make recommendations on implementation. H.R. CONF. REP. NO. 2854, 104th Cong., 2d Sess. (1996).

Agriculture Best Management Practices(BMP) Loan Program (a.k.a. State Revolving Fund):
The program is administered by the Minnesota Department of Agriculture and local units of government with technical assistance provided by regional Board of Water and Soil Resources (BWSR) and Soil and Water Conservation District (SWCD) staff. Funding is from the federal Environmental Protection Agency (EPA). The Loan Program is a response to needs expressed by local

governments, agricultural producers and natural resources agencies for financial incentives for water quality practices. The program provides low interest financing to farmers, agriculture supply businesses and rural landowners to encourage agriculture best management practices that prevent or mitigate nonpoint source pollution. Local governments apply for an allocation from MDA. Local governments work through local lenders to deliver the loan program.

An example of one eligible activity is improvements of animal waste control facilities. At this time, it is uncertain whether odor control practices will be eligible outside of nonpoint source pollution prevention or mitigation. Eligibility is currently being investigated.

References

H.R. Conf. Rep. No. 2854 104th Congress, 2d Session (1996) pp. 114-120.

Questions yet to answer

1. Should odor control practices be included as an eligible cost for financial assistance programs?
2. Will odor reduction methods alone be admissible for inclusion in each of the financial assistance programs?
3. Will odor reduction methods in combination with water quality objectives be admissible for inclusion in each of the financial assistance programs, i.e. if putting in an earthen pond with a cover is the cost of the cover included by the funds?
4. Who will determine what is to be covered?
5. If not included, what needs to be done to include?

(combined green label section from team 3)

Best Management Practice-based Odor Control

Green Label Another system which serves to regulate odor emissions is either mandating or approving types of manure management practices are acceptable. Although this process does nothing to define "how much is too much", it is a way to definitively reduce total odor emissions. This type of regulatory approach could be based on the Netherlands policy for reducing ammonia emissions.

In the Netherlands, the national government has set a goal for 2005 of reducing total ammonia emissions by 70% of the ammonia emissions in 1980. To do this, several systems of manure management are being developed and tested. If these systems reduce ammonia emissions by 40 to 60% (depending on category of animal), they are classified as "Green Label" systems (GL). If producers adopt such a system or practice, apply for the program by providing a technical description of the total farm system (i.e., farm layout, manure management, and operating procedures), and document the required ammonia emissions, they are GL certified. The plan adopted for the farm evaluates the amount of ammonia emitted by each component of the farm and the total emission reduction is calculated for the various technologies which will be used on that farm. Certification entitles farmers to a special depreciation rate for income taxes and the guarantee that they will not have to rebuild their facility in the next 15 years as a result of new government regulations. Approximately 22 different livestock housing systems are being marketed as GL systems.

In the case of odors, the certification of certain management practices or system designs that reduce odor emissions does not guarantee the area surrounding the facility will be odor free. Also, in the Dutch system ammonia reductions are on a per pig basis; therefore, a larger facility will still emit a large amount of ammonia. Similarly, a large swine facility that has reduced odors on a per pig basis may be emitting a significant amount of odors. To solve this problem, there could be limits placed on the total amount of odors produced by individual facilities. Facilities could be rewarded if they meet these odor emission criteria.

A modification of the Dutch system would be for farmers to prepare an odor reduction plan as part of the application for a conditional use permit. The plan would detail those technologies and management practices for reducing odors which are best suited to that particular operation. Once approved by the local zoning board, the plan would become law by its inclusion in the conditional use permit.

The advantages to these systems are that the producer can chose the most economical and appropriate solutions for his operation and the producer gains some predictability in what will be expected of him/her. It also allows for less restrictive standards and less expensive technologies for those facilities which are unlikely to cause problems, either due to lower surrounding population densities or other factors.

The disadvantages are that the local zoning board, or another regulatory agency, must evaluate each proposal and each technology proposed. If handled poorly (i.e., government inflexibility, long/complex approval process, or public resistance to new technologies), this may result in stifling innovations in technologies. On the other hand, if handled correctly, such a system may actually stimulate innovations as researchers and companies compete to create more efficient and cost effective technologies.

Another disadvantage is that someone must select an "enforceable" odor level or determine how much odor reduction is to be achieved. Selecting such a level is hard enough when basing it on human health effects, it is infinitely more difficult when it is based on odor offensiveness.

Education

A award systems can serve as the incentive for producers to seek information on the latest management practices.

References

"New Housing System for Pigs: Dutch Policy Ammonia Emission and Costs., N. Verdoes, J.A.M., Voermans and C.E.P. van Brake; Research Institute for Pig Husbandry, Rosmalen, Netherlands.

No Response/Do Nothing

Narrative:

Not responding or doing nothing regarding this issue, although controversial, is an option for the state to take. Under this scenario, the state would not follow-up on complaints about odor from livestock operations.

Benefits

The benefits of such an approach is the savings in dollars and time on both the front and tail ends. A policy of no regulations for odor from livestock operations will reduce the amount of "red tape" producers have to go through in becoming permitted as well as meeting other environmental standards for their operation. The reduction, (and/or avoidance, if other options presented in this report were to be adopted), of red tape and regulators time as well as a cost savings in expenses, personnel, and legal fees. Regulators would not have to divert time from other responsibilities such as permitting, and inspecting feedlots for compliance with water quality regulations.

Cons

Despite the savings in time and dollars to the state, the cost of no regulations would be born to the system overall, meaning that the courts would probably be used more heavily to reduce conflict between neighbors and define how much odor is too much.

Another drawback of the state not responding to odor from livestock operations is that a segment of the population will probably not accept that as a viable option. The MPCA is in the process of revising the rules regulating feedlots within the state. During a comment period to identify areas for consideration in the feedlot rule revision, approximately 80 percent of the comments the Feedlot Program received were regarding odor..

Certification/Testing

Narrative

This alternative would require a certification/testing program for producers and/or others working with manure. Odor management could be included as a component in an overall manure management certification program. In the case of odor, the certification/training would be for the producer/operator, not the system. Minnesota's Pesticide Applicators program is one example of an existing certification program that possibly could serve as a model.

As a result of a mandate contained in the 1972 Federal Environmental Pesticide Control Act (FEPCA), Minnesota developed a statewide program that provides for the training and certification of pesticide applicators. Responsibility for training lies with the Minnesota Extension Service and certification is the responsibility of the Minnesota Department of Agriculture. You must be certified before you can purchase or apply a restricted use pesticide. Training provides information on proper application procedures and safety precautions for handling pesticides.

M.S. Chapt. 18B.30 contains Pesticide Use License Requirements. The statute delineates five license categories:

- pesticide dealers - sells restricted use or bulk pesticide to the pesticide end user;
- structural or aquatic pest control;
- commercial applicator - applies pesticide for hire;
- noncommercial applicator - applies pesticide for employer in performance of official duties; and
- private applicator - required for use to produce an agricultural commodity.

The private applicator category applies to farmers. Certification is good for three years; and requires the passing of an examination. Statute sets a nonrefundable application fee of $10. Statute does not state that records be kept by private applicators.

MPCA is considering certification of land application for water quality, if the program progresses odor control certification could be incorporate into the training. However, for a certification/training program to be successful it would be necessary to identify the producers. In the case of crop protection applicators, dealers are required to verify proof of farmer license before selling pesticide products to a farmer. Manure/odor certification is more difficult because there is not as clear of a point of contact as in the case of crop protection chemicals. As a result, a manure/odor management certification would be dependent upon identifying livestock producers. The challenge is how to identify the estimated 35,000 livestock producers.

The state of Illinois passed an act in the 1995-96 session defining setbacks for feedlots, based on size of feedlot and residence or population center. They established a training program for livestock operators requiring that they become certified livestock managers trained in various environmental factors including odor

control techniques. Any operator having 300 animal units or more must become certified.

Benefits

A 1993 report from the Minnesota Department of Agriculture identifies that the level of understanding among producers of regulations and practices of manure management varies. The use of a certification program, will enhance the likelihood of a consistent level of knowledge of management practices among producers.

Cons

Currently, MPCA estimates Minnesota to have 35,000 feedlots. Two obstacles must be overcome for a certification program to work. First, no inventory of feedlots exists. A comprehensive effort to identify the locations of the state's feedlots would be necessary. The second obstacle is the manageability of such a program and its cost. Identifying the location of feedlots could be expensive. Likewise the mechanics of running a program could increase the bureaucracy. Another challenge is enforcement. For enforcement to be effective, MPCA must know "who is out there".

Education

In the case of pesticides, certification (and recertification) provides an opportunity for producers to become familiar with the latest information on products, regulations, technology, and research. A similar opportunity would exist with a manure management certification program.

References

- Minnesota Statutes Chapter 18B (extract from 1994 MN Statutes including amendments from 1995 Legislative Session) pp. 21-33.
- "Feedlot Waste Management Study" by Angus Reid Group for the Minnesota Department of Agriculture (February, 1994)

Problem Statement

What is the relationship of land use to odor? Parts of this question are:

- What activities could each level of government do to reduce conflict?
- Can the odor problem be reduced through land use planning?
- Is odor itself the land use conflict? If solved, would the land use problem evaporate?

In any discussion of reducing the impact of livestock odor on a population, the subject of land use invariably arises. The concept of separating different land uses in order to reduce the conflicts between the uses is inherent in zoning. Setbacks and buffer zones have commonly been a tool used in zoning to ameliorate the effects of a land use that has impact beyond the boundaries of the district in which the use is located, such as noise, light, vibrations, electrical interference or odor. The other tools available in land use controls are specific performance standards focused on controlling the possible negative aspects of a land use.

SEPARATION

In the case of agricultural land uses, the buffering and setback issue is not as clear cut as in urban land uses. Livestock have typically been a part of agriculture, but as specialization occurs in the ag sector, and the numbers of livestock on a particular site have increased, the assumption that all agricultural land uses are compatible within the same district comes into question. The problems inherent in separation distances to deal with odor from livestock are:

1. How far is enough to satisfy the problem?
2. Does the separation deny the right of the land owner from using his land as zoned?
3. What should the separation be from; i.e., other farm sites, non-farm residential homes or clusters, other zoning districts?

A proposal developed by Robert Mensch, an agricultural engineer, suggests a varying separation distance based upon multiplying factors of number of animal units, type of housing and manure handling system and character of neighboring land use. The basic distance based on animal units ranges from 450' for 100 a.u. to 2,000' for 10,000 a.u.. Using this system, a 3,000 head hog total confinement deep pit barn would be set back 1/2 mile from 12 housing units, down to 1/4 mile from 1 housing unit.

Reference: (Separation of Feedlots from Neighbors. Robert Mensch, 9 Feb. 1996)

Existing Standards

A study of selected Minnesota livestock production counties zoning and land use (so) ordinances reveals the following with regard to setbacks for construction or expansion of livestock facilities:

Setback feature	distance range
From neighboring residences	500' - 3/4 miles
Property lines	50' - 200'
Parks	100' - 1 mile
Subdivisions	1/4 mile - 1 mile
Municipal Boundaries	1/2 mile - 1 mile
Other feedlots if > 300 a.u.	1/4 mile

Reference: Draft matrix of So. MN County Feedlot Ordinance provisions. MCEA, 1996

The State of Iowa has, set in statute, separation distances for livestock facilities from residences not owned by the owner of the feedlot, commercial uses, religious institutions or educational institutions. The distances are based on the number of animals in the facility, type of animal (bovine and others) and type of storage. The setbacks range from 750' to 2500'.
Reference: Iowa Statutes Section 455B

A telephone survey done in January 1995 of setback standards for feedlots in counties in California, Colorado, Delaware, Indiana, Iowa, Kansas, Michigan, Missouri, Nebraska, North Carolina, North Dakota, Ohio, Pennsylvania and Wisconsin showed that of the 46 counties surveyed, 17 have setbacks ranging from 100' to 1 mile for feedlots from residences or other types of populated areas. Some listed setbacks from water bodies, but the setbacks were generally of a lesser distance than from populations.

Of States regulating setbacks, the following distances are required for the listed uses:

State	Use	Setback
Indiana	earthen manure basins from:	
	residences	1000'
	public buildings	1500'
	built up areas	2000'
	other	500'-1300'
Kansas	feedlots, incl. manure storage:	
	property lines, water supplies	100'
	(40 acre minimum)	
Nebraska	manure storage:	
	domestic wells	100'
	public water supply wells	100'
North Carolina	feedlot:	
	property line	2500'
	Manure storage from:	
	highway	1000'
US waters		250'

Reference: Feedlot regulations phone survey, Scott Allen, Rice Co. 1995

Another setback method currently being considered for use in some counties has been to increase or reduce setback distances depending on the prevailing wind directions.

An issue that arises with regard to using setbacks is the fact that a 1/4 mile setback impacts a 125 acre radius around the feedlot, and a 1/2 mile setback impacts in excess of 500 acres around the feedlot. This can lead to allegations that the

setbacks are preventing landowners from using their land for a reasonable use generally allowed in the district.

Should Minnesota, like the other states listed above, establish a separation distance for feedlots from other uses? Part of this question would need to address if the state standard would be a setback that counties could individually make more or less restrictive, or if it would preempt counties from setting other standards.

The separation distance would need to take into account the factors of the type of animal at the facility, the manure handling system in place, the number of animals on the site and any odor control technology being utilized.

At issue is the effectiveness of using separation distance for odor control. Distance alone may not be an adequate solution. At the same time, preventing other uses from encroaching into feedlot setback areas would be an important part of any effort to control odor.

As discussed above, the basic premise of land use planning is to provide zoning districts where like uses may be grouped together to facilitate the compatibility of the uses. Within the zoning district, there may be separation distances for various uses based on the impact of the specific use to neighboring uses.

Within the agricultural zoning districts in counties, houses as well as feedlots are usually allowed uses. This has been the case because of the nature of farming in this region. The operator of the farm lived on or near the land they farmed. The house was there because the farming activity was there. Where there has been extensive housing development intermixed in agricultural districts, the conflicts arising from changes in agriculture have been very magnified.

With the changes in agriculture over the years, and particularly with livestock confinement odors, the incompatibility of housing with this type of agriculture has become apparent. A possible solution to this may be to treat livestock confinement differently than other agricultural activities. An agricultural district that would allow only crop production and perhaps limited livestock production, and another that would permit confinement units may be a solution similar to what urban areas have done with light and heavy industrial districts. This approach has been adopted by 1 County in Minnesota at this time, with the variation that smal (under 300 animal units) may be allowed in the crop agricultural district.

In summary, the land use controls trend has been to attempt to reduce the effect of odor from livestock facilities though putting space between the livestock and the people. The more animals and/ or the more people, the greater the distance. This has not always worked to solve the odor problem, since odor can travel for long distances under certain topographic and atmospheric conditions. For this reason, other measures have been employed at the local level to resolve the conflict.

Where local controls have not been effective in preserving prime agricultural land, it may be a role of the state to mandate a loss control program for this resources. The Sustainable Development Task force is currently looking at the growth patterns of the state, and this effort may well lead to some such mandate.

MITIGATION/MIXING

Inherent in land use regulation is the concept of performance standards to mitigate problems for different activities. This is a method whereby a use that could have negative impacts on neighboring land uses within a district is subject to certain standards that will reduce the conflict.

Since a basic precept in zoning is to allow similar land uses in different zones that will be compatible with each other, determining the level of odor that is acceptable from a facility would be very important for setting performance standards on odor control as a base. A key issue with performance standards is that if they are incorporated into a land use ordinance, they must be effective in obtaining the desired results. Another factor to consider would be the ability of the governing unit to enforce compliance with any performance standards.

An area that has confinement livestock facilities in close proximity to high density residential uses may require extensive mitigation measures to reduce the conflict from odor. Where an activity that creates a lot of odor is located sufficiently far away from other uses that the odor is not detectable, then the activity would be exempt from the mitigation measures.

LEVELS OF RESPONSIBILITY

Minnesota State Statutes provide that controls of land use and zoning be done at a local level through the use of comprehensive planning and zoning ordinances. The power to zone rests with Cities, Counties and Townships.

As discussed above, zoning may address odor control measures through setbacks, performance standards, zoning district use restrictions and the permitting process. Counties and Townships have attempted to deal with odor by regulating the location and size of feedlots and attaching conditions to the operations through either the conditional use permit process or performance standards.

A survey of 17 South Minnesota County zoning ordinances reveal that 6 of them require a conditional use permit for feedlots over 300 animal units, 2 for over 1,000 animal units, 1 for over 100 animal units, one for over 600 animal units. 8 of them require conditional use permits for earthen manure storage basins. There are various other provisions within ordinances which address odor such as manure application methods, setbacks on residences for manure application and development of odor control measures. Townships who have adopted land use controls have used similar measures to address odors.

There are pros and cons relating to having the control of feedlot locations at different levels of government. They are summarized below.

STATE ROLE

The advantage to the state taking a strong position with regard to where feedlots may be located is that it creates uniformity throughout the state. This can serve to reduce conflict at the local level, since the local politicians may be preempted from doing more restrictive standards. This would also serve to carry out a policy of protecting the feedlot industry from being zoned out of large areas of the state. The disadvantage is that the state cannot be aware of the local conditions that would impact the proper siting of a feedlot. Additionally, the public may resent a strong role by the state in dictating land use.

COUNTY ROLE

The advantage of county implemented land use controls, are the flexibility for local land use conditions. There may also be a strong perception by the public that local control will be more responsive to their needs. The cons are that local control is subject to the local pressures and personal agendas and that is leads to a lack of statewide uniformity.

TOWNSHIP ROLE

Townships have increasingly taken over the feedlot siting issue where the citizens may have felt that their concerns were not addressed at the county level. The downside is that Townships generally do not have a sufficient tax base or experience to perform the functions efficiently. It also creates conflicts between the townships within a county, and may conflict with the county comprehensive plan. The neighbor conflicts at the township level can make controversial issues turn arbitrary and capricious.

Recently, there have been court cases that have muddied the areas of responsibility between the 3 levels of government. It may be necessary to have a legislative clarification of the different roles of each level with regard to feedlots and land use.

Problem Statement

What should the government policy be on how much odor a community or individual should have to tolerate:

Background

One of the primary questions that must be addressed with any odor policy or regulation is the question how much odor should be tolerated by individuals or the community, or in other words: "how much odor is too much?". This question is the core of the current odor controversy.

Everyone agrees that there have always been odors generated from livestock production. Apparently the odors generated in the past were not considered to be "too much", although historical documents indicate that at times even small farms generated too much odor. The frequency and intensity of odors from the small farms of the past were possibly different and more than likely less intense and less frequent than the current odors generated by current facilities. Somewhere in the transition, the odors being generated have gone from tolerable to extremely controversial. Two factors contribute to this phenomenon: the increasing density of livestock operations which leads to a high density of manure, and the increasing numbers of people -- both farm and non-farm residents -- living in rural areas.

This also raises a further question in the odor debate: is odor a problem if nobody is exposed to it? What if only one person, or only a few people, are exposed? Can the complaints of one or a few people be allowed to inhibit the economic development of rural areas and limit the ability of producers to expand their operations? Clearly, health standards must be enforced for all members of society, but what about odors that may simply be a nuisance, not a health threat? And if such a decision is made, that a few people must put up with what would not be acceptable to a larger population, how do we reconcile this with the concept of "equal protection under the law"? These are difficult questions with which local and state decision-makers continue to struggle.

One further aspect that may confound the issue of setting odor policy is the possibility that some of the odorous or non- odorous gasses emitted from livestock facilities may cause health problems either in the general population, or for certain hypersensitive people. Just as with "Sick Building Syndrome", the symptoms may be varied, and the actual cause and effect difficult to document. However, recent air quality sampling in Minnesota has detected exceedances of proposed health risk values for hydrogen sulfide. Additional research is needed to clarify the relation between human health and livestock odors/emissions. Until then, odor policies need to acknowledge the possibility of these relationships and protect the public from unacceptable exposures.

Most people will agree that the odors produced from some facilities is "too much". However, attempting to define exactly what "too much" is remains elusive. It may be tempting to mandate a zero odor policy, but this is impractical as livestock production, or any other industry, could not exist with such a policy. Likewise, having no regulation of odors will only result in increased conflict in our rural areas and leaves too many people in an intolerable situation. Therefore, these two extremes are not discussed in this section. Instead an odor policy must strive for some middle ground, protecting the public interest along with the livestock industry. To do this there will most likely be a need for reductions in odor emissions from some facilities and a tolerance of some odors from the public.

Complaint-based

One system of regulation that offers some compromise on odor control is one based on complaints from nearby residents. The Minnesota Pollution Control Agency recently proposed a complaint-based policy based on the number of legitimate independent complaints (10) during a given time period (90 days). By stipulating the number of complaints within a given time period, the question "how much odor is too much" was defined. (Current status of policy, at time of writing the proposed rule, was with the administrative law judge).

The advantage of this type of system is that it addresses the actual problem -- citizen exposure to odors which they find offensive. This avoids the problem of varying responses to odors by different people. This system also allows community members, not government, to decide how much odor is "too much". There are, however, several disadvantages. Some residents may not feel comfortable reporting odors, for a variety of reasons. Other neighbors may complain about odors because they have other, unrelated issues with the producer, leaving the producers "at the mercy" of their neighbors and with no fixed target for odor control or reduction.

Confirmation of an "odor event" requires rapid response from the appropriate agencies, which may or may not occur. Also, some residents have reported negative health responses without an accompanying offensive odor event. Finally, a uniform number of complaints required to trigger action may not be appropriate as population densities vary across the state -- it is not appropriate to inflict intolerable odors/emissions on residents simply because they are isolated.

Gas concentration(s) based on receptor

As described above, one of the problems faced by producers is having a fixed target for odor/emissions control and reduction. Also, it has been noted that some emissions may be potentially harmful to human health may or may not contribute to the odor problem at a feedlot operation. One option to address these problems is to base an odor policy, at least in part, on indicator gas concentrations, either through modeling or monitoring.

The advantages are those already discussed. If an appropriate indicator gas could be identified, one that correlated well with odor, this would provide an optimal solution. In addition, rather than dealing with the unknown relationship between odor and health effects, a risk assessment approach could derive an acceptable concentration which would be protective of the public health. However, there is disagreement over what are acceptable levels -- concentration, frequency and duration -- and what are the appropriate methods for measuring gases such as hydrogen sulfide.

Also, the lack of an appropriate indicator gas has already been described. In addition, this approach would not allow for individual situations. For example, there may be some farms that are sufficiently isolated that they have no impact on surrounding populations. With this approach they would be subject to the same regulatory requirements as farms in populated areas. Of course, depending on the desired outcome, this might not be an undesirable feature, as it would create a level playing field for all farms regardless of location.

The net result is that this option, alone, could result in expensive monitoring requirements and emission controls that are protective of human health, but do not address the issue of livestock odor.

Odor Detection Frequency and/or "Fenceline" Odor Limits

One approach to providing protection to neighbors while also providing some predictability to producers is to set some type of odor limit. This limit might specify fenceline concentrations and frequency of odors. This system is currently being used in the Netherlands. In 1991, the Dutch Ministry of Public Health and Environmental Hygiene began regulating odor emissions from industries by means of exposure limits in the form of iso-concentration lines. These iso-concentration lines are determined by a standard dispersion modeling.

This guideline states that around new sources, no residential buildings should be present within the odor contour representing 1 odor unit (ou) per cubic meter as a calculated hourly average occurring during 99.5% of the hours in a year with average meteorology of that site (Klarenbeek). This regulation then continues to place limits on existing facilities (<1 ou/m3, 98% of the time) and for scattered housing in industrial areas (<1 ou/m3, 95% of the time; 1 ou/m3 is the detection threshold for odor concentration). Because of the inaccuracies inherent in dispersion modeling, the actual emissions may be more or less than the policy limits.

The North Rhine-Westphalia region in Germany has an odor regulatory program that is comprised of several different regulatory tools. The primary tool places odor loading limits on both residential areas and industrial areas. Residential zoned areas should not exceed one odor unit 10 % of the time and industrial zoned areas will not exceed one odor unit 15 % of the time. (One odor unit is the detection threshold for 50% of the population).

In this system, new facilities are required to have odor control best management practices in place. Proposed facilities are evaluated using dispersion modeling. This is done to determine the additional "odor load" on the area surrounding the proposed facility. The modeled iso-concentration lines are then overlaid with current odor measurements in the area to determine the "total odor load". This total odor loading must not exceed the mandated guidelines for the area. The guidelines are very specific on how odor emissions are measured, how areas are evaluated, and certain types of exemptions.

The advantage of such systems is that they provide specific targets for producers to achieve, which are imposed only when nearby residents are exposed, and they treat all residents equally, regardless of population density. However, by using odor units, which are based on detection thresholds for the general population, these systems do not address sensitive individuals' responses to odors. This system has the advantage of addressing existing facilities and can take into account "odor loading", or the additive effect of odors from many sources. However, these systems are susceptible to failure if the modeling is done inaccurately.

References:

Verdoes, N., J.M. Voermans, , and C.P. Van Brakel. 1995. New housing systems for pigs: Dutch policy, ammonia emission and costs. In "International Livestock Odor Conference '95". Iowa State University

Department of the Environment, Regional Planning and Agriculture of the Land North Rhine-Westphalia.: 1993. Determination and Evaluation of Odour Emissions (Directive on Odour Emissions)

Klarenbeek., J.V., 1995. On the regulations, measurement and abatement of odours emanating from livestock housing in the Netherlands. In "International Livestock Odor Conference '95". Iowa State University

Organizational Protocols
Minnesota Livestock Odor Task Force
approved May 8, 1996

I. Objective

The mission of the Minnesota Livestock Odor Task Force (LOTF) is to recommend workable solutions to address the odor issue.

II Membership

- Members of the LOTF were selected by Agriculture Commissioner Gene Hugoson and Pollution Control Agency Commissioner Chuck Williams and represent the broad range of interests in this issue.
- LOTF members may not be represented by alternates.

III Open and Interactive Process

Open Meetings. All meetings of the LOTF are open to the public and the media. Meetings of the LOTF are subject to the open meeting law established by MS 471.705. Seven or more members may not meet to discuss LOTF business unless the meeting date and time has been publicized in accordance with the open meeting law.

IV. Decision Making and Internal Organization

A. Use of Consensus. The LOTF will operate by consensus. LOTF decisions will be made only with concurrence of all members represented at the meeting. No member can be out voted. Members will be polled individually to verify consensus.

> ***Consensus:*** *Consensus is based on the term "to Consent" or "to grant permission." The solution may not be "my first choice," but I will "live with" the decision. Consensus means there is some level of commitment to implement the agreement.*

B. Failure to Reach Consensus. If the LOTF fails to reach consensus on any portion of the recommendations, that portion of the recommendations shall be submitted with multiple recommended options along with supporting information for each option.

C. Meeting Times. Meeting times can only be changed with the full consent of all LOTF members.

D. Agenda. Draft meeting agendas will be developed by LOTF Co-Chairs Steve Olson and Dave Nelson with input from all LOTF members.

V. Ground Rules for Interaction

A. Ground Rules. Members of the LOTF shall seek to participate constructively in meetings. Ground rules for constructive interaction include:

*Listen Carefully
*One person speaks at a time
*Be committed to addressing the issues - focus on interests, not positions
*Focus on the Problem and the Solution - not on finding fault
*Share all relevant information
*Be brief and clear in you comments, be specific whenever possible
*It's OK to disagree—Disagree openly, but respectfully

*Observe meeting time limits
*Ground rules may be amended at any meeting by consensus

B. Enforcement of Ground Rules. Ground rules can be enforced by any member of the committee.

VI Responsibility of LOTF members

A. Attendance LOTF members shall attempt to attend all meetings of the LOTF. Failure to attend two meeting in succession shall be sufficient cause for removal of the member.

B. Preparation. Members of the LOTF shall come to all meetings prepared to work.

David Nelson, PE
Minnesota Pollution Control Agency

I supervise program development efforts in the Feedlot Program at the Minnesota Pollution Control Agency. I have worked for the Agency since 1982, over half that time with the feedlot program, with additional experience in the on-site sewage treatment program and with industrial wastewater treatment facilities. Prior to working for the state, I farmed with my brother for a number of years. I have been active in both national and regional work groups that are attempting to address feedlot issues across the country. I have both Bachelor of Science and a Master of Science degrees in Agricultural Engineering from the University of Minnesota.

Steve Olson
Minnesota Department of Agriculture

Biography: I have been with the Minnesota Department of Agriculture for the past 5 years. My involvement in feedlot and manure management issue began with the development of a proposal to increase the number of animal waste control facility designs completed in specific regions of the state, thereby accessing under utilized federal cost-share funds. One component of this project was focus group interviews with livestock producers and support persons to identify needs and attitudes toward manure management issues. In addition, I coordinated the production of three feedlot and manure management publications. Currently, I am providing staff support to the Feedlot and Manure Management Advisory Committee (FMMAC) as well as working with the University of Minnesota on various odor research projects. I am also project manager for the Composting Animal Mortalities (CAM) on-farm demonstration project. This project is working with swine and sheep producers to increase awareness of composting as an alternative method. I have a Bachelor of Science degree in Agriculture Education and Agricultural Economics from the University of Minnesota. I am currently working on a Masters program at the University of St. Thomas.

David Schmidt
Research

Education: MS Agricultural Engineering, University of Minnesota
Biography: My position with the Minnesota Extension Service, as an Assistant Extension Engineer - Manure Management Systems in the Department of Biosystems and Agricultural Engineering focuses on providing information to livestock producers and the public on environmentally sound and economically viable manure management systems. One aspect of these systems is their ability to control odor. I have done an extensive review of current odor reduction technologies and the tools available to quantify the odors. Our department is currently planning several research projects that attempt to quantify odor reduction of different manure handling systems. We built a dynamic olfactometer to assist us in these evaluations. I am currently serving as an alternate on FMMAC as co-representative for the Department of Biosystems and Agricultural Engineering.

Robert L. Mensch, PE
Consultant/Industry

Biography: I am a registered professional engineer with BS and MS degrees in agricultural engineering. I spent six years teaching and research in the area of farm structures before starting consulting work in design of livestock facilities. I worked six years on a United Nations Development Program/Food & Agriculture Organization (UNDP/FAO) pig farm pollution control and redevelopment project in Singapore. Since 1991 my main work has been preparation of construction plans and feedlot permit applications for livestock facilities in Minnesota. I organized AD-HOC (A Determined Hog Odor Control) committee for the on-farm testing of manure additives. AURI is now carrying out the testing of these products.

Marlin Pankratz
Feedlot & Manure Management Advisory Committee (FMMAC)

I have been involved in a family farm corporation in Cottonwood County since 1970. We have finishing capacity for 7500 head and part interest in a 5500 head farrowing operation. We also farm 360 acres. I am the current Chair of the Feedlot and Manure Management Advisory Committee (FMMAC). I have served on this committee and its predecessor (the Feedlot Advisory Group) since 1990 and been part of the Land Application Task Force for three years. I am a member of AD-HOC Committee. I received the National Pork Producers Environmental Stewardship award in 1995. I am a member of the Worker Health and Safety Committee for the National Pork Producers. I am also the current co-chair for MN Ag2010, which is dedicated to promoting the image of agriculture. In 1995 I was the President of the Minnesota Pork Producers Association. I have spent time talking to fellow producers and other groups on pork issues including odor and environment.

Tina Rosenstein
Local Government

Biography: I have worked as Zoning Administrator and Senior Planner for Nicollet County since January of 1992. Nicollet County is primarily an agricultural county, and has policies in place since 1981 preventing urban residential growth out in the ag land. I have handled the feedlot permits for feedlots in excess of 300 animal units (which require a conditional use permit and hearing). Our county has acknowledged that odor is a part of livestock production, but out operators have recognized that they can do things to control the intensity of the odor through certain practices. I have worked on an individual basis with many of our operators to deal with odor both during the planning process of their facilities (location of the barns and manure storage with a sensitivity of down wind neighbor proximity) and also when there is a particularly malodorous condition, determining what the cause and handling is. I would say that Nicollet County Commissioners have directed me to take a common sense approach to livestock odor which has worked to keep the livestock industry expanding in our county.

Heather Robins
At-Large

Biography: I am a County Commissioner from Rice County, Minnesota. I have been studying the topic of manure management and odor for over a year and a half. I undertook this study because Rice County is creating a new feedlot ordinance. The odor of liquid manure has been a frequent complaint from property owners in Rice County.

In the last year and a half, I have read thousands of pages of material on the subject, attended several conferences and met with agricultural and scientific faculty from Iowa State University, the University of Minnesota, Duke University and the University of North Carolina. I have also met with Agricultural experts from Sweden and Germany.

Last summer I traveled to North Carolina where several counties have been overrun by intensive livestock farms with liquid manure systems. What I saw there and smelled there increased my determination that Minnesotans will not suffer the same abuse.

I represent a constituency that is within the limits of the city of Northfield and the town of Dundas. In my urban neighborhood I am sometimes troubled by a nauseous stench from agricultural establishments. The problem of odor is not just a rural one.

Richard Nicolai PE
Producer

Biography: From 1975 until present, we have farmed in Renville County. The farm consists of 400 acres tillable and a 220 sow farrow to finish operation. All hogs are in total confinement with deep pits under each barn.

Since July 1994, I have been employed half time as an extension engineer at the Biosystems and agriculture engineering Department of the University of Minnesota. Much of that time has been dealing the with the odor issue in swine facilities. I have author several news releases and one Engineer Update on the topic of swine odors as well as spoken to various producer groups.

I also operate Nicolai Engineering Services, which provides technical services to swine producers in the area of swine odor control.

I am a member of the AD-HOC (A Determined Hog Odor Control) committee which is evaluating various additives to manure pits to control odors and build-up.

Charles Beatty Sr.
Rural Non-farm

High School Graduate
AMA Certified
Misc. College Credits and CEO
Corporate Market Management Course, University of Wisconsin

1953-1971	Wilson & Co Inc. Dairy and Poultry Division	Faribault, MN
1971-1980	New Richmand Farms, Division of DOBOY	Faribault, MN
1981-1985	Loyal Order of Moose	Faribault, MN
1985-1990	Land O Lakes Sales Manager, Turkey Division	Arden Hills, MN
1990-Present	Met Con Companies, Construction Services	Faribault, MN

Ginny Yingling
Environmental

I am the Minnesota State Director of Clean Water Action Alliance, an environmental group with over 50,000 members in Minnesota and over 600,000 members nationwide. Our mission is to promote policies and behaviors that protect the environment and create a sustainable economy and a just society. We work with diverse coalitions of people and organizations on a variety of issues that relate to the protection of our water resources. Among these issues, in Minnesota we are working with rural residents and local officials to address the environmental and social problems associated with large-scale, high-density livestock operations. I am participating on this task force because many of the citizens with whom we are working have experienced significant impacts to their health and quality of life as a result of intense odors from such livestock operations.

My background is in geology. I received a bachelors degree from Penn State and a masters degree from the University of Wyoming in this field. Prior to working for Clean Water Action, I was employed as an environmental consultant and then as a pollution control specialist and finally as a hydrogeologist at the Minnesota Pollution Control Agency, where I worked in both the Superfund and Leaking Underground Storage Tanks programs.

Marian Marbury
Minnesota Department of Health

I have been an Environmental Epidemiologist in the Section of Chronic Disease and Environmental Epidemiology at the Minnesota Department of Health for the past ten years. In that position my research has focused on the respiratory health effects, particularly asthma, of both indoor and outdoor air pollution. I have an MS in Occupational Health and an Sc.D. in Occupational Health and Epidemiology from the Harvard School of Public Health.

APPENDIX D
FEEDLOT AND MANURE MANAGEMENT ADVISORY COMMITTEE (FMMAC)

MISSION STATEMENT & OBJECTIVES

MISSION STATEMENT

FMMAC's mission is to assist and advise state agencies in providing leadership and direction on the environmental and economic issues surrounding feedlot and manure management; to prioritize feedlot and manure management research, educational, and regulatory needs and goals; and to suggest related policies.

The objectives of FMMAC are to:

- develop and propose solutions to environmental & economic problems facing the livestock industry and, environmental and regulating communities;
- identify and prioritize research, educational, and regulatory needs to focus resources for improving the environment;
- foster communications and cooperation between interested parties to improve the development and acceptance of recommendations;
- facilitate the exchange of information on manure management, regulatory issues, and educational material;
- identify regulatory and enforcement needs, and consequences;
- review existing and revised rules and policies and procedures, recommend revisions and provide recommendations on draft revised rules;
- serve as a forum to identify and prioritize concerns; and
- identify educational needs of producers, technical support staff and the general public.

Minnesota Statutes 17.136 - Animal Feedlots. "The commissioner of agriculture and the commissioner of the pollution control agency shall establish a feedlot and manure management advisory committee to identify needs, goals, and suggest policies for research, monitoring, and regulatory activities regarding feedlot and manure management."

For more information contact:

Steve Olson, MN Dept. of Agriculture, Phone: 612/297-3217; E-mail: Steven.H.Olson@state.mn.us
Dave Nelson, MN Pollution Control Agency, Phone: 612/296-9274; E-mail: David.R.Nelson@pca.state.mn.us

FEEDLOT AND MANURE MANAGEMENT ADVISORY COMMITTEE (FMMAC)
APPOINTMENT LIST 1996

Voting Members

NAME	ORGANIZATION	CITY	CATEGORY
Mr. Duane Bakke	MN Pork Producers	Lanesboro	Producer
Mr. Dave Frederickson	MN Farmers Union	St. Paul	Producer
Mr. Troy Gilchrist	MN Assn of Townships	St. Michael	Local Government
Mr. Roger Gilland	MN Cattlemen's Assn	Morgan	Producer
Mr. Palmer Norling	MN Turkey Growers Assn	Blomkest	Producer
Dr. Larry Jacobson	University of Minnesota	St. Paul	Expert
Mr. Leroy Koppendrayer	House of Representatives	Princeton	State Representative
Mr. Gary Martens	MN Farm Bureau	Mora	Producer
Mr. Jerry Miller	Dairy Herd Improvement Assn	Eden Valley	Producer
Mr. Greg Murch	Sparboe Companies	Litchfield	Producer
Dr. Sally Noll	University of Minnesota	St. Paul	Expert
Mr. Marlin Pankratz	MN Pork Producers	Mountain Lake	Producer
Dr. Gyles Randall	University of Minnesota	Waseca	Expert
Mr. Chuck Schwartau	MN Ext. Service Wabasha Co.	Wabasha	Expert
Ms. Kris Sigford	MN Center for Environmental Advocacy	St. Paul	Environmental
Mr. Scott Sparlin	Izaak Walton League	New Ulm	Environmental
Ms. Sam Sunderlin	MN Lakes Assn	Faribault	Environmental
Mr. Jim Vickerman	State Senate	Tracy	State Senator

FEEDLOT AND MANURE MANAGEMENT ADVISORY COMMITTEE (FMMAC)
APPOINTMENT LIST 1996

Ex-Officio

Mr. Greg Anderson	Farm Services Administration	St. Paul	Ex-Officio
Mr. John Brach	Natural Resource Conservation Service	St. Paul	Ex-Officio
Mr. Wayne Edgerton	MN Department of Natural Resources	St. Paul	Ex-Officio
Ms. Tina Rosenstein	Assn of MN Counties	St. Peter	Ex-Officio
Commissioner Gene Hugoson	MN Department of Agriculture	St. Paul	Ex-Officio
Mr. Danny Potter	MN Assn of Soil & Water Conservation Districts	Redwood Falls	Ex-Officio
Mr. Jim Rossman	Board of Water and Soil Resources	Oronoco	Ex-Officio
Commissioner Peder Larson	MN Pollution Control Agency	St. Paul	Ex-Officio

Staff

Dave Nelson	*MN Pollution Control Agency*	*520 LaFayette Rd. St. Paul, MN 55155*	*Staff*
Steve Olson	*MN Department of Agriculture*	*90 W. Plato Blvd. St. Paul, MN 55107*	*Staff*

Bibliography

Below are resources that members of the task force used in gathering information on the various options discussed in Appendix A. This bibliography is not intended to be a comprehensive listing of all resources available on livestock odor. The National Pork Producers Council recently commissioned an extensive review of available literature. To obtain their literature review, executive summary, and/or bibliography contact them at 515/223-2600.

Chapter 7009, Minnesota Pollution Control Agency, Air Quality Division, Ambient Air Quality Standards

Manure Management Alternatives: A Supplemental Manual, MN Dept. of Agriculture, 1995.

Manure Management Planning Guide for Livestock, MN Dept. of Agriculture, 1995.

The appendix: Separation of Feedlots From Neighbors is based on a simple odor rating (K value).

H.R. Conf. Rep. No. 2854 104th Congress, 2d Session (1996) pp. 114-120.

"New Housing System for Pigs: Dutch Policy Ammonia Emission and Costs., N. Verdoes, J.A.M., Voermans and C.E.P. van Brake; Research Institute for Pig Husbandry, Rosmalen, Netherlands.

Minnesota Statutes Chapter 18B (extract from 1994 MN Statutes including amendments from 1995 Legislative Session) pp. 21-33.

"Feedlot Waste Management Study" by Angus Reid Group for the Minnesota Department of Agriculture (February, 1994)

Feedlot regulations phone survey, Scott Allen, Rice Co. 1995

Draft matrix of So. MN County feedlot Ordinance provisions. MCEA, 1996

Iowa Statutes Section 455B

Separation of Feedlots from Neighbors. Robert Mensch, 9 Feb. 1996

Sweeten, J.M., 1995 Odor Measurement Technology and Applications: A State-Of-The-Art Review. In Seventh International Symposium on Agricultural and Food Processing Wastes. pp. 214-229. ASAE, St. Joseph Michigan

Verdoes, N., J.M. Voermans, , and C.P. Van Brakel. 1995. New housing systems for pigs: Dutch policy, ammonia emission and costs. In "International Livestock Odor Conference '95". Iowa State University

Department of the Environment, Regional Planning and Agriculture of the Land North Rhine-Westphalia. 1993. Determination and Evaluation of Odour Emissions (Directive on Odour Emissions)

Bibliography

Below are resources that members of the task force used in gathering information on the various options discussed in Appendix A. This bibliography is not intended to be a comprehensive listing of all resources available on livestock odor. The National Pork Producers Council recently commissioned an extensive review of available literature. To obtain their literature review, executive summary, and/or bibliography contact them at 515/223-2600.

Chapter 7009, Minnesota Pollution Control Agency, Air Quality Division, Ambient Air Quality Standards

Manure Management Alternatives: A Supplemental Manual, MN Dept. of Agriculture, 1995.

Manure Management Planning Guide for Livestock, MN Dept. of Agriculture, 1995.

The appendix: Separation of Feedlots From Neighbors is based on a simple odor rating (K value).

H.R. Conf. Rep. No. 2854 104th Congress, 2d Session (1996) pp. 114-120.

"New Housing System for Pigs: Dutch Policy Ammonia Emission and Costs., N. Verdoes, J.A.M., Voermans and C.E.P. van Brake; Research Institute for Pig Husbandry, Rosmalen, Netherlands.

Minnesota Statutes Chapter 18B (extract from 1994 MN Statutes including amendments from 1995 Legislative Session) pp. 21-33.

"Feedlot Waste Management Study" by Angus Reid Group for the Minnesota Department of Agriculture (February, 1994)

Feedlot regulations phone survey, Scott Allen, Rice Co. 1995

Draft matrix of So. MN County feedlot Ordinance provisions. MCEA, 1996

Iowa Statutes Section 455B

Separation of Feedlots from Neighbors. Robert Mensch, 9 Feb. 1996

Sweeten, J.M., 1995 Odor Measurement Technology and Applications: A State-Of-The-Art Review. In Seventh International Symposium on Agricultural and Food Processing Wastes. pp. 214-229. ASAE, St. Joseph Michigan

Verdoes, N., J.M. Voermans, , and C.P. Van Brakel. 1995. New housing systems for pigs: Dutch policy, ammonia emission and costs. In "International Livestock Odor Conference '95". Iowa State University

Department of the Environment, Regional Planning and Agriculture of the Land North Rhine-Westphalia. 1993. Determination and Evaluation of Odour Emissions (Directive on Odour Emissions)

Klarenbeek., J.V., 1995. On the regulations, measurement and abatement of odours emanating from livestock housing in the Netherlands. In "International Livestock Odor Conference '95". Iowa State University

MPCA Odor Log

Complaint No.	Date Call Received (m/d/y)	Time call received	Staff receiving call	Details	Name of suspected facility?	Address	County	Township	Section	Q/Quarter section	Type of animals at suspected facility?		Time of day odor noticed? (am/pm)	Were the odors? continuous, intermittent, or fleeting
1	5/15/96	2:15pm	H. Siddens		Exetare		Yellow Medicine	Tyro	34 & 35		hogs			
2	8/1/96	3:00	H. Siddens		Waldo Petersen- Sale barn located in city limits.		Yellow Medicine				hogs & cattle			continuous
3	8/1/96		H. Siddens		Dennis Engels and Wallace Engels		Lyon	Westerheim	35		hogs		Evenings and when the weather is changing	
4	9/4/96	4:00	H. Siddens		Farm 1 mile North of Vesta		Redwood				hogs			
5	9/4/96	6:13pm	DO8		?	1 mile north of Vesta	Redwood				hogs		4:00pm	
6	9/25/96	9:27	Paul; forwarded from Dave Nelson		VALADCO (Lipert site)		Renville	Norfolk	27		hogs		Sep 16, 1996; first thing in the morning, 6-7:00	intermittent
7	10/18/96	approx 1:00 pm	R. Leaf		Roger Kingstrom (sp?) did not track down file		Renville				10 - 12 hog barns		Calendar of three monthsof odors, was unbearable today.	
8	10/29/96	1:00	D. Nelson		ValAdCo (lippert site)		Renville	Norfolk					Odors started at 6:00	hasn't left
9	12/6/96	10:25	K. Brynildson		Roger Kingstrom MPCA-I 1157(A)R		Renville	Winfield	36	SE/NW	Hogs - Lagoon system			
10	12/20/96	3:05	D. Nelson		ValAdCo Lippert site		Renville	Norfolk	27	SE	Hogs, lagoon system		odors are bad in house even with charcoal filters	since 6:00 AM
11	1/2/97		D. Nelson		ValAdCo Tisdale site		Renville	Norfolk	29		Hogs			
12	1/2/97		D. Nelson		ValAdCo Lippert site		Renville	Norfolk	27		hogs			
13	1/21/97		Paul: referred from Pat Mader		ValAdCo - "both sites"		Renville	Norfolk	27 & 29		hogs		evening of 1/20/97; worst at 11 am on 1/21/97	N/A
14	3/5/97	2:00	David Nelson		ValAdCo		Renville	Norfolk	27 & 29		hogs			
15	3/26/97	9:30	Pete S.		Paul Maney		Mower	Windom	15		hogs		all day	continuous

MPCA Odor Log

Complaint No.	How long did odors continue?	Intensity of the odors?	Prevailing wind direction?	Wind speed?	Air temperature during occurrence?	Relative Humidity?	Barometric pressure? (rising or falling)	Any unusual activity? (e.g. land appl)	Monitoring results if taken?	Have you reported this problem before?	Comments
1											
2	all day										horrible odors, fly problems, and dead animals
3			from SE								
4			from South					cleaning pits			
5	9/4/96	unlivable	so.								apparently hog farm is cleaning hog pit, wind from the south is making the smell unliveable.
6	contiued all day Monday and onto Tuesday; got worst on Wed, Thurs the same, Friday off and on in am, pm wind changed then cattle odors	Mon & Tue - bad, Wed & Thur the worst, Fri - bad (not home over the weekend)	Mon & Tue - E wind, Wed & Thur - SE wind, Fri - S wind in am, N wind in pm	5 - 10 mph (estimate)	65, 31.5 baro, hum 49%, wind speed 5 10mph	49%	31.5 (N/A)	none noted	no	yes	blacked out at 2:00, first time this season, for approx a minute, could not see, after ~10 min back to 'normal', headaches, shakey, nauseated, sinuses blocked, diaerreha, all kids at daycare affected
7	Refer to calendar (available upon request)								(60 ppb outside fr door)	No	Husband too upset to call, but very bad for him too.
8	All day	Very bad	From SE	est 10 - 15	45					yes	Kids removed from house.
9	December 3 and Dec. 6 - Thought odors would decrease with winter months, but they have not.				20 -30 F					yes	
10	All day	Very bad, a major problem when shoveling snow.		10 - 15 mph	4 - 7 F	44 % in the house				yes	Daughter Kimberly does not feel good, says tummy hurts and is sleeping. Very unlike her. No one else there due to snow conditions. Back of legs hurt, hard to breathe, nose burns and face and hands are itchy. Headaches. Sinus blocked. Sewer smell.
11	26-Dec	Feels better when leaves the home for a while								yes	terrible headache, daughter has been sick, encouraged to call Rita Messing of MDH
12	12/27 - 12/31	Feel better when wind shifts								yes	" "
13	1/20 - 1/21	Very bad at 11 am	no wind (1/21/97)	no wind (1/21/970	40 F outside;68 F inside	22% inside	29.3 inside	none given	N/A	yes	kids/adults headache-stomach upset
14										yes	Also passed on complaints about Watonwan Feeder Pig, and the "Johnson facility in Renville County" She wants to ensure that her family has protectioin from nasal legions and mentioned evidence of health concerns at 2 ppb.
15	days	very bad								no	it stinks

MPCA Odor Log

Complaint No.	Staff lead	Action Taken:	Results of investigation:	Source contacted on:
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14		She specifically requested letters to facilities that had citizen monitoring to let them know that they have a problem. Also wanted liquid level measurements in lagoons		
15				

MPCA Odor Log

Complaint No.	Date Call Received (m/d/y)	Time call received	Staff receiving call	Details	Name of suspected facility?	Address	County	Township	Section	Q/Quarter section	Type of animals at suspected facility?		Time of day odor noticed? (am/pm)	Were the odors? continuous, intermittent, or fleeting
16	4/3/97	2:30	Jim Sullivan		Paul Meaney		Mower	Windham	15		hogs		all day	continuous
17	5/7/97	2:30	David Nelson		Jerome Forrest		Nicollet	N. Mankato ?			hogs		any time	intermittent
18	6/5/97		Ron Leaf- forwarded to Paul		Holden Farms	Not Falling Brook,Twin Oaks?	Rice	Northfield	either 21 or 17		hog		12:00pm	N/A
19	6/10/97	am	Ron Leaf		ValAdCo	Sect 27 &/or 29	Renville	Norfolk	27/29		hogs			
20	6/11/97	10:30	David Johnson		Beet Plant; ValAdCo	Crooks twp	Renville	Crooks			hogs, beet processing		evening hours	continuous
21	6/11/97		Paul - from Holly		ValAdCo		Renville	Crooks	30	Sw 1/4	hogs			
22	6/11/97		Paul - from Holly		Christianson Farms		Lincoln	Marble	22					continuous
23	6/14/97	9:18pm			ValAdCo		Renville	Norfolk	27		hogs		early am or late pm	
24	6/15/97	late night	ron leaf		Churchill	Section 22	Renville	Brookfield	22		hogs		west wind	
25	6/15/97	8:34pm			ValAdCo		Renville	Norfolk	27		hogs		noon	
26	6/16/97	am	Jim Sullivan		Neal Johnson	Section 15, 23,22	Renville	Hector	15,22,23		hogs		all the time	wind direction dependant
27	6/20/97	am	Ron Leaf		Holden, Pine Grove	21	Rice	Northfield	21		hogs		s-sw wind	
28	6/21/97	pm	Randy Ellingboe		Scherping - Metro Farms		Wright	Woodland			dairy cows			
29	6/24/97	am	Ron Leaf		?	near Hector	Renville							
30	6/24/97	am - 7/1	Randy Ellingboe		Churchill Co-op		Renville	Brookfield	22		hogs		pm	
31	6/25/97	am - 7/1	Randy Ellingboe		Churchill Co-op		Renville	Brookfield	22		hogs		pm	
32	6/25/97	am	Jim Sullivan		?	Waldorf	Waseca	?	?	?	hogs		all the time	wind direction dependant
33	6/26/97	am - 7/1	Randy Ellingboe		Churchill Co-op		Renville	Brookfield	22		hogs		all day	
34	6/30/97	am	David Johnson		ValAdCo		Renville	Norfolk	27		hogs		all the time	wind direction dependent
35	6/30/97	am	Ron Leaf		Flora Twp. site		Renville	Flora	6		hogs		all day	
36	6/30/97	am	Paul:forwarded from Beth Lockwood		Jerry Endeson	Fergus Falls	Otter Tail			N/A	900-1000 cattle		am	N/A
37	6/30/97	am	Paul:forwarded from Beth Lockwood		Pristine Pork	N/A	Roseau	N/A	24	N/A	hogs		am, every monring	N/A
38	6/30/97	am	Paul - from Beth Lockwood		Pristine Pork		Roseau		24		hogs		am every morning	continuous

MPCA Odor Log

Complaint No.	How long did odors continue?	Intensity of the odors?	Prevailing wind direction?	Wind speed?	Air temperature during occurrence?	Relative Humidity?	Barometric pressure? (rising or falling)	Any unusual activity? (e.g. land appl)	Monitoring results if taken?	Have you reported this problem before?	Comments
16	last few days	very bad	wind from S	n/a	around 60	n/a	n/a	Lots of flies	n/a	no	worst in 16 years; also concerned about MOPRO
17	every time wind is from that direction	terrible. Feels sick and hard to live with.						no		yes, many times	Terrible. Hard to live with. Head aches and feel sick.
18	odor stayed in car for a period of time after passing the site, windows down	overwhelming, different smell then normal	out of the North? south of lagoon when smelled odor	strong winds	approx. 70	n/a	n/a	no	n/a	no	drive by this site reasonably often, have smelled this site before, but this bad, thishas been the worst occurrence
19	It stinks as of 6/6 through 6/11 odors									yes	
20	4 days	very strong	ENE	light to strong winds	50 night ,75 day	n/a	n/a	no	n/a	many times have spoken with city of Renville	people not feeling well, says kids are getting sick from smell
21	since 6/7		SE								Husband is on oxygen. Spraying W/airplane. Irrigating.
22			SE								Constant smell. Headaches -nauseous sinus infections
23	past 2 weeks	terrible odor									Has talked to Ron Leaf . What is being done?
24	wind dependent	very bad at night, headaches	west	light						not to pca	also tried to call managers and consultant
25		terrible odor									Odor is so bad that the wife gets diarrhea. Called county Commissioner. When will something be done?
26	days	very strong	West and north	light	60 night 80 day	n/a	n/a	no	no	no	Migrant workers refuse to work in the fields and son had to sell house and move because of the odor
27											
28		high									
29			west to southwest								
30	afternoon	bad	easterly							yes	headaches, nose stuffed-up
31	all night	bad	easterly							yes	bad all next day, too
32		very bad Shuts down the house									This is from the Stroebel (FAST) farm
33	all day	bad	easterly							yes	
34	wind dependent	very strong	all directions	light	65night 85day	n/a	n/a	no	no	yes	this is 4th year, says nothing being done.
35	sat/sun 6/28 and 6/29 all day, 6/30 am	very strong									took report from phone message
36	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	yes - to Mark Steuart (DL)	There are 900-1000 head of cattle; has had cattle for 30 years and claimed manure has never been hauled away.
37	daily; June 27, 28, 29, 30	very intense, especially a problem when there are temp inversions	SE on Jun 27-29, SW on Jun 30.	N/A	70 deg, temp inversion on Jun 27, 28, 29; overcast on the 30th	high humidity	N/A	N/A	N/A	yes - to Mark Steuart (DL)	Has kept a log of odors, Jun 27-30; started marking problems on calendar since May; claims facility has not emptied their tanks, almost full only 4' to go in tank
38	since May	very intense	SE wind		70 degrees	high					Odor every am. Especially a problem when there are temp. inversions. Facility hasn't emptied tanks; almost full; only 4' to go in tank.

MPCA Odor Log

Complaint No.	Staff lead	Action Taken:	Results of investigation:	Source contacted on:
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28	RLE			
29				
30	RLE			
31	RLE			
32				
33	RLE			
34				
35				
36				
37				
38				

MPCA Odor Log

Complaint No.	Date Call Received (m/d/y)	Time call received	Staff receiving call	Details	Name of suspected facility?	Address	County	Township	Section	Q/Quarter section	Type of animals at suspected facility?		Time of day odor noticed? (am/pm)	Were the odors? continuous, intermittent, or fleeting
39	6/30/97	am	Paul - from Beth Lockwood		Jerry Endeson's Feedlot			Fergus Falls			900 - 1,000 cattle			
40	7/1/97	1:30 PM	Kim Brynildson		Jerome Forst		Nicollet				hogs		all the time	
41	7/1/97	p.m.	David K. Johnson		?	Waldorf	Waseca	?	?	?	hogs		all the time	?
42	7/1/97		Ron Leaf		ValAdCo		Renville	Norfolk	27 & 29		hogs		all day	wind depd.
43	7/1/97		Ron Leaf		ValAdCo		Renville	Norfolk	27/29		hogs		"	"
44	7/1/97		Ron Leaf		ValAdCO		Renville	Norfolk	?		hogs			
45	7/2/97	am	Ron Leaf		ValAdCo		Renville	Norfolk	27/29		hogs		wind depd	"
46	7/2/97	9:25am			Neil Johnson Farm	Rt 2 Box 184	Renville	Hector			hogs			intermittent
47	7/8/97	am	Ron Leaf		ValAdCo		Renville	Norfolk	27/29		hogs		all day	continuous
48	7/8/97	am	Ron Leaf		ValAdCo		Renville	Norfolk	27/29		hogs		all day	continuous
49	7/11/97	1:30pm	Paul - from Beth Lockwood		Gerhart Farm Hog Works	Rt. 1, Box 203AA	Martin	Welcome			hogs			
50	7/14/97	am	Jerry H. forwarded to Ron Leaf		Gerhart Farm Hog Works	Rt. 1, Box 203AA	Martin	Welcome			hogs			
51	7/16/97	9:05am	Paul - from Beth Lockwood		Pristine Pork		Roseau	Malung	24					
52	7/16/97	1:07pm	Paul - from Beth Lockwood		Pristine Pork		Roseau	Malung	24					
53	7/16/97	6:20am	DO7		Golden Oval	340 Dupont Ave.	Renville	Renville			chicken		5:30am	continous
54	7/17/97	8:55am	Paul - from Beth Lockwood		Jerome Forest Farm	RR 2	Nicollet	Gibbon			hogs			
55	7/17/97	9:00am	Paul - from Beth Lockwood		hogs?beet plant?chickens?		Renville				hogs			
56	7/18/97	2:30 PM	Kim Brynildson		Several sites located around Ceylon - Gerhart Farms north of town		Martin				hogs		all times of day	continuous
57	7/18/97	2:00pm	Holly		ValAdCo		Renville				hogs			
58	7/21/97	2:05pm	Ron L.		?									
59	7/22/97	9:00 AM	Paul - from Beth Lockwood		Shady Farm	7 mi. S. of Renville	Renville				hogs		7-20 & 7-22pm	

MPCA Odor Log

Complaint No.	How long did odors continue?	Intensity of the odors?	Prevailing wind direction?	Wind speed?	Air temperature during occurrence?	Relative Humidity?	Barometric pressure? (rising or falling)	Any unusual activity? (e.g. land appl)	Monitoring results if taken?	Have you reported this problem before?	Comments
39											Feedlot has had cattle for 30 years and has never hauled away any manure.
40		very strong, headaches						no		yes	Has enclosed deck with glass and changed duct work in house to keep odors out. Last fall he passed out. Is considering legal action against owner or county for permitting site. Has lived here 48 years and does not think he should be the one to move.
41	?	very bad seems to come thru walls	?	?	?	n/a	n/a	?	?	yes	took report from phone message
42	wind depd.	stinks								yes	"it still stinks here" phone message
43	"	very bad/horrible	from SE							yes	also bad on the 26th,27,28,29,30th of June
44										?	message on voice mail
45	"									yes	has calendar log of June and July
46			west wind							yes	Complaintant & neighbors have attended several meeting re: this odor. Has been reported several times over last 2 years.
47		very bad		light		rain				yes	very bad last sunday during the rain. Located down slope of facility; drains to home.
48			from SE	light						yes	it reeks
49											Has developed allergies & has gone to Rochester with her health problems. Waste is washing into lake and streams. Water from tap smells.
50											Concerns of odors affecting health
51											When wind is calm - odor is everywhere - when wind is blowing - odor follows the wind direction.
52											7/6 - 7/16 has dates and times of odor. Has been keeping track.
53		foul odor									foul odor from a chicken farm. Also, a fly problem
54		very bad	SE								When there is SE wind the hog smell is very bad.
55		strong odor									Strong odor - thins it comes from stinky water being sprayed on fields.
56		very bad	From NW	light	85 - 90 degrees	high					Odors are affecting health - alergies diagnosed in Rochester
57		worse than ever									Nauseating - worse than ever. Hope that something is being done. Also said that beet plant was horrible.
58	7/20/97										Location - mile marker 139 on I90
59											

MPCA Odor Log

Complaint No.	Staff lead	Action Taken:	Results of investigation:	Source contacted on:
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				

MPCA Odor Log

Complaint No.	Date Call Received (m/d/y)	Time call received	Staff receiving call	Details	Name of suspected facility?	Address	County	Township	Section	Q/Quarter section	Type of animals at suspected facility?		Time of day odor noticed? (am/pm)	Were the odors? continuous, intermittent, or fleeting
60	7/22/97		Paul T. - from Holly S.		Shady Farms	7 miles S. of Renville	Renville				hogs		evening 7/20 & morning 7/22	
61	7/23/97		Paul T. - from Rick Strassman		unknown	City of Renville	Renville				hogs		eveing	
62	7/24/97		Paul T. - from Rick Strassman		Jerome Forst		Nicollet	Weston			hogs			
63	7/27/97	4:20pm	Dave Nelson		ValAdCo		Renville	Norfolk	27/29		hogs		virtually every evening	continuous
64	7/30/97		Paul T. - form Ron L.		Jerome Forst		Nicollet	Weston			hogs			
65	8/4/97		Paul T.		Buffalo Run		Waseca	Otesco	13		hogs		all times	contiuous
66	9/5/97	2:45p.m.	Dave J.		Neil Johnson	Cty rd _2 N of 212 between sec 22 ,23 and 15	Renville	Hector	22,23,15		hogs		am/pm	continuous
67	9/18/97				Swine Complex, Inc		Rock	Springwater			hog			
68	10/1/97		Jim Sullivan		Robert Schemel		Renville				hogs			
69	10/6/97	830am	Ron L.		Robert Dahlheiner	Hwy 44 towards Farhaven?	Steams				Dairy		all day	all day
70	10/6/97	1100am	Ron L.		Scherping Farms/Metro Dairy		Wright	Woodland	15?		dairy		day	most days some nights
71	10/6/97	1140am	Ron L.		Scherping Farms/Metro Dairy		Wright	Woodland	15?		dairy		day	
72	10/6/97	130pm	Ron L.		Scherping Farms/Metro Dairy		Wright	Woodland	15?		dairy		day/night	worse in am and late pm
73	10/27/97		Randy E.		Watonwan Co. Fdr Pig Co-op	Lewisville	Watonwan	Fieldon	26	SW	Hogs		on 10/24/97	continuous
74	10/29/97		Jim Sullivan		Halquist dairy/Jim Kuhl		Carver	San Francisco			Dairy/Hogs			continuous
75	10/30/97		Jim Sullivan		Dennis Magnussen		Freeborn	Newry	35		Hogs			continuous
76	10/30/97		Jim Sullivan		Swine Complex, Inc		Lincoln	Marble	27		Hogs			
77	11/24/97		Jim Sullivan		Metro Dairy	Winstead	Wright				Dairy		late afternoon	
78	12/16/97		Jim Sullivan		Metro Dairy	Winstead	Wright				Dairy		late afternoon	
79	12/18/97		Jim Sullivan		Dennis Wilson	Cherry Grove	Fillmore	York	15		Hog		throughout the day	
80	12/18/97		Jim Sullivan		Robert Schmezing		Blue Earth	Vernon Center			Hog		continuous	
81	12/22/97		Jim Sullivan		Valadco - Lippert Site		Renville				Hog			
82	12/25/97		Jim Sullivan		FAST Development		Waseca				Hog			
83	7/21 & 30/97		Paul T.		Sherping Dairy		Wright	Woodland	15		dairy		late pm	

MPCA Odor Log

Complaint No.	How long did odors continue?	Intensity of the odors?	Prevailing wind direction?	Wind speed?	Air temperature during occurrence?	Relative Humidity?	Barometric pressure? (rising or falling)	Any unusual activity? (e.g. land appl)	Monitoring results if taken?	Have you reported this problem before?	Comments
60		bad									referred to Region 4 from AQCES by Schnick_S
61		heavy stench on town									
62			SE wind								
63	all evening	could cut it with a knive								yes	Generally disatified with our efforts
64		bad	SE wind								
65			calm					spreading manure, 500' aaway from property			using land not on permit, injecting but not all getting into ground
66	July 8, 20, 21, 22, 27, 28, 29 and 14 days in August	strong odor	No.	no wind / light wind	70's and up	humid	falling	no		no	When wind is from the north, particularly bad.
67											
68											
69	most of summer has been bad	unbearable								no	lives 2 miles from facility. Is not alwasy detecable at this location, but can smell it when the condiitons are right.
70	all summer, worse last couple weeks	have to keep windows closed	se	worse with more wind, very bad at calm nights	70					yes	very good to talk to live person instead of VMail, also wants us to look into the culvert at this site draining into/out of the ditch. The ditch is dry this year instead of full of water.
71	all summer									no	voice mail messsage
72	all summer, worse over 24-26 of Sept. and Sept 30. and this weekend 10/3-10/5									?	odor plume sits in a low area to the wwest of the basins
73								Lagoon reconstruction		yes	Jim Sullivan coincidentally out within 2 days of event
74											Will have to continue monitoring to determine a response.
75											may be some water quality issues associated with this facility
76											Responded to compliant - no odor present at time of visit
77											
78											
79											
80											
81											
82											
83		bad in the middle of the night, had to shut windows	west					emptying manure, semi trucks holding solids last week, diggers/equipment doing repair work		yes	14th really bad, ammonia smell,

MPCA Odor Log

Complaint No.	Staff lead	Action Taken:	Results of investigation:	Source contacted on:
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				

MPCA Odor Log

Complaint No.	Date Call Received (m/d/y)	Time call received	Staff receiving call	Details	Name of suspected facility?	Address	County	Township	Section	Q/Quarter section	Type of animals at suspected facility?		Time of day odor noticed? (am/pm)	Were the odors? continuous, intermittent, or fleeting
84	7/25/97-7/27/97	9:00 AM	David Johnson		Gerhardt Farms	Ceylon	Martin	Lake Belt	29		hogs		all day	continuous
85	8/7 & 8/1997		Paul T. - form Ron L.		Jerome Forst		Nicollet	Weston			hogs			
86														
87														
88														
89														
90														
91														
92														
93														
94														
95														
96														

MPCA Odor Log

Complaint No.	How long did odors continue?	Intensity of the odors?	Prevailing wind direction?	Wind speed?	Air temperature during occurrence?	Relative Humidity?	Barometric pressure? (rising or falling)	Any unusual activity? (e.g. land appl)	Monitoring results if taken?	Have you reported this problem before?	Comments
84	all weekend	very bad	from NW	breezy	85-90 degrees	high				yes	She and husband feel ill from fumes coming from hog farm
85		terrible	SE wind								"what is being done"
86											
87											
88											
89											
90											
91											
92											
93											
94											
95											
96											

Farm Name/Farmer	Street Address	City	State	Zip	Telephone Number	County	Permit Number	Unique Number	Type
ValAdCo - Lippert Site	P.O. Box 392	Renville	MN	56284	612-329-8415	Renville	NPDES MN 0062618	C-RENV-S-1	Swine
ValAdCo - Tisdale Site	P.O. Box 392	Renville	MN	56284	612-329-8416	Renville	NPDES	C-RENV-S-2	Swine
Robert Schemel	R.R. 2, Box 180	Renville	MN	56284	612-329-3716	Renville	MPCA-I 1298(A)R	C-RENV-S-3	Swine
Swine Complex, Inc.	101 W. Main, P.O. Box 381	Sleepy Eye	MN	56085	507-794-5310	Rock	MPCA-I 1997(A)R	C-ROCK-S-4	Swine
Churchill Co-op	R.R. 2, Box 200A	Hector	MN	55342		Renville	NPDES	C-RENV-S-5	Swine
Churchill Co-op	R.R. 2, Box 200A	Hector	MN	55342		Renville	NPDES	C-RENV-S-6	Swine
Rodney Johnson	621 Pacific Ave	Morris	MN	56267	612-589-1834	Roseau	MPCA-C 5955	C-ROSE-S-7	Swine
Rodney Johnson	621 Pacific Ave	Morris	MN	56267	612-589-1834	Roseau	MPCA-C 5955	C-ROSE-S-8	Swine
Neal Johnson	Route 2, Box 185	Hector	MN	55342		Renville	MPCA-I 1394(A)	C-RENV-S-9	Swine
Neal Johnson	Route 2, Box 185	Hector	MN	55342		Renville	MPCA-C 5772R	C-RENV-S-10	Swine
Neal Johnson	Route 2, Box 185	Hector	MN	55342		Renville	MPCA-C 4070R2	C-RENV-S-11	Swine
Virgil Scherping	P.O. Box 10	Winstead	MN	55395		Wright	(A)R2;MPCA-C 5920R;	C-WRIG-D-12	Dairy
MNDAK Dairy, Inc	R.R. 1	Cleveland	MN	56017	507-931-6303	Le Sueur	Pending NPDES	S-LESU-D-13	Dairy
Little Pine Dairy	Box 269 Industrial Blvd	Perham	MN	56573	218-346-4244	Otter Tail		S-OTTE-D-14	Dairy
Tilden Farms	R.R.1 Box 27	Mentor	MN	56736	218-637-8186	Polk	MPCA-C 1601	S-POLK-B-15	Beef
Bernard and David Their	Route 2, Box 228	Rushmore	MN	56168	507-478-4137	Nobles	MPCA-C 5596R	S-NOBL-B-16	Beef
Joe Neusch	RR 2, Box 245	Fairmont	MN	56031	507-235-3688	Martin	MPCA-I 1129(B)	S-MART-B-17	Beef
Jack Frost, Inc	309 Lincoln Avenue Southeast	St. Cloud	MN	56301		Sherburne	MPCA-C 3974	S-SHER-P-18	Poultry
Jerome Foods, Inc	1116 N.W. 4th Avenue	Faribault	MN	55021		Dodge	MPCA-C 2666	S-DODG-P-19	Poultry
Jerome Foods, Inc	1116 N.W. 4th Avenue	Faribault	MN	55021		Dodge	MPCA-C 2665	S-DODG-P-20	Poultry
Jerome Foods, Inc	1116 N.W. 4th Avenue	Faribault	MN	55021		Dodge	MPCA-C 2664	S-DODG-P-21	Poultry
Jerome Foods, Inc	1116 N.W. 4th Avenue	Faribault	MN	55021		Dodge	MPCA-C 2663	S-DODG-P-22	Poultry
Dennis Magnusen			MN			Freeborn		C-FREE-S-23	Swine
Halquist Dairy			MN			Carver		C-CARV-D-24	Dairy
F.A.S.T.		Waldorf	MN			Waseca		C-WASE-S-25	Swine
Watonwan Feeder Pigs	Route 1, Box 60	Lewisville	MN	56060	507-375-3810	Watonwan	MPCA-I 2213(A)	C-WATO-S-26	Swine
Watonwan Feeder Pigs	Route 1, Box 61	Lewisville	MN	56060	507-375-3811	Watonwan	MPCA-C 5452	C-WATO-S-27	Swine

Unique Number	Lot/Barn Type	Storage Type	Monitoring Date	Wind Direction	ind Speed (MP	Temperature (F)	Humidity (%)	Barometric Pressure	Jerome #	GPS#
C-WASE-S-25	Confined	Flush/lagoon	10/21/97	NW	15-20mph	51	68%		1539	
C-WATO-S-26	Confined	lagoon	10/21/97	NW	5-10mph	41	50%		1539	
C-WATO-S-27	Confined	Concrete Pit	10/21/97	NW	10-15mph	47	48%		1539	
C-WATO-S-27	Confined	Concrete Pit	10/21/97	NW	10-15mph	47	48%		1539	
C-RENV-S-10	Confined	Lagoon	10/22/97	SE	0-5mph	31	58%		1539	
Johnson 23	Confined	Lagoon	10/22/97	SE-ESE	0-5mph	36	60%		1539	
Johnson 15	Confined	Lagoon	10/22/97	SW	0-5mph	42	70%		1539	
Churchill Co-op 21	Confined	Lagoon	10/22/97	SW/S	0-5mph	44	45%		1539	
Churchill Co-op 10	Confined	Lagoon	10/22/97	S	0-5mph	42	55%		1539	
ValAdCo	Confined	Lagoon	10/22/97	S/SE	5-10mph	47	49%		1539	
ValAdCo-29	Confined	Lagoon	10/22/97	S/SE	5-10mph	44	59%		1539	
C-RENV-S-3	Confined	Concrete Pit	10/22/97	S/SE	5-10mph	47	55%		1539	
Unique Number	Lot/Barn Type	Storage Type	Monitoring Date	Wind Direction	ind Speed (MP	Temperature (F)	Humidity (%)	Barometric Pressure	Jerome #	GPS#
C-RENV-S-1	Confined	Lagoon	10/29/97	S/SE	10-25MPH	47			1531	
C-NICO-S-28	Confined	Lagoon	10/10/97	S/SE	15-25MPH	60-65			1531	
C-NICO-S-28	Confined	Lagoon	10/10/97	S/SE	15-25MPH	60-65			1531	
C-NICO-S-28	Confined	Lagoon	8/28/97	E	0-5MPH	70-75			1531	
C-RENV-S-3	Confined	Lagoon	9/3/97	E	0-5MPH	70-75			1531	
C-RENV-S-3	Confined	Lagoon	9/3/97	E	0-5MPH	70-75			1530	
C-RENV-S-3	Confined	Lagoon	9/3/97	E	0-5MPH	70-75			1530	

Latitude	Longitude	Start Time	0 minute	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	12 minutes	14 minutes	16 minutes	18 minutes	20 minutes	22 minutes	24 minutes	26 minutes
		11:10	0.001	0.002	0.004	0.002	0.003	0.003	0.002	0.003	0.003	0.004	0.004	0.003	0.003	0.003
		14:40	0.003	0.002	0.002	0.003	0.003	0.002	0.003	0.002	0.002	0.003	0.002	0.003	0.002	0.003
		15:44	0.004	0.004	0.005	0.007	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.003	0.003
		16:20	0.035	0.033	0.041	0.052	0.028	0.076	0.057	0.031	0.043	0.064	0.092	0.037	0.075	0.076
		9:16	0.016	0.013	0.008	0.008	0.011	0.019	0.024	0.017	0.037	0.021	0.031	0.028	0.016	0.02
		9:53	0.003	0.002	0.002	0.002	0.002	0.001	0.002	0.003	0.002	0.002	0.002	0.003	0.003	0.003
		10:55	0.001	0.002	0.001	0.001	0.001	0.003	0.011	0.006	0.003	0.004	0.004	0.003	0.003	0.005
		11:33	0.028	0.003	0.011	0.003	0.016	0.009	0.003	0.013	0.008	0.007	0.006	0.004	0.016	0.008
		12:16	0.03	0.015	0.019	0.012	0.011	0.009	0.012	0.025	0.006	0.029	0.03	0.014	0.02	0.022
		13:48	0.065	0.032	0.061	0.047	0.049	0.105	0.08	0.077	0.021	0.096	0.06	0.1	0.046	0.034
		14:25	0.008	0.004	0.003	0.008	0.006	0.004	0.005	0.006	0.005	0.004	0.008	0.005	0.004	0.004
		15:16	0.035	0.046	0.028	0.067	0.024	0.029	0.026	0.034	0.044	0.019	0.023	0.015	0.04	0.033
Latitude	Longitude	Start Time	0 minute	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	12 minutes	14 minutes	16 minutes	18 minutes	20 minutes	22 minutes	24 minutes	26 minutes
		14:18	0.026	0.026	0.079	0.069	0.017	0.037	0.086	0.036	0.012	0.006	0.033	0.04	0.047	0.039
		20:50	0.008	0.013		0.015	0.011		0.01	0.007		0.008	0.014		0.01	0.015
		20:53	0.006	0.022		0.011	0.006		0.011	0.008		0.007	0.005		0.006	0.011
		19:56	0.015	0.013		0.013	0.006		0.001							
		15:00	0.014	0		0.011	0.002		0	0.006		0.005	0.01		0.03	
		15:08	0.006	0.024	0.002	0.002	0.002	0.009	0.017	0.023	0.011	0.011	0.006	0.002	0.012	0.002
		15:08	0.002	0.005	0.002	0.002	0.011	0.011	0.008	0.035	0.006	0.004	0.006	0.002	0.004	0.006

28 minutes	30 minutes	Avg	End	A.U.		
0.003	0.005	0.003	11:40	3008		
0.002	0.002	0.0024375	15:10	623		
0.003	0.003	0.003625	16:14	240		
0.066	0.095	0.0563125	16:50	240	aken at vent	
0.022	0.022	0.0195625	9:46	360.4		
0.003	0.002	0.0023125	10:23			
0.005	0.004	0.0035625	11:25			
0.011	0.012	0.009875	12:03			
0.019	0.014	0.0179375	12:46			
0.087	0.031	0.0619375	14:18			
0.004	0.004	0.005125	14:55			
0.028	0.023	0.032125	15:46			

28 minutes	30 minutes	Avg	End	A.U.		
0.028		0.0363125	14:38		Lagoon Fenceline	
		0.0069375	21;20		Property Line	
		0.0058125	21:23		Property Line	
		0.003	20:26		Property Line	
		0.004875	15:30		Property Line	
0.002	0.003	0.008375	15:38		Property Line	
0.002	0.001	0.0066875	15:38		Property Line	
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				

Unique Number	Lot/Barn Type	Storage Type	Monitoring Date	Wind Direction	Wind Speed	Temperature	Humidity	Barometric Pressure	Jerome #	GPS#

Latitude	Longitude	Start Time	0 minute	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	12 minutes	14 minutes	16 minutes	18 minutes	20 minutes	22 minutes	24 minutes	26 minutes

28 minutes	30 minutes	Avg	End	A.U.

Unique Number	Lot/Barn Type	Storage Type	Monitoring Date	Wind Direction	Wind Speed	Temperature	Humidity	Barometric Pressure	Jerome #	GPS#
S-OTTE-D-14	Confined	Lagoon	10/27/97	SW	0-5mph	44	90%		1539	
C-WRIG-D-12	Confined	Lagoon	10/17/97	SW	5-10mph	56	66%		1539	
S-LESU-D-13	Confined	Lagoon	10/24/97	NE	5-10mph	44	65%		1539	
C-WRIG-D-12	Confined	Lagoon	10/24/97	N/NW	10-20mph	39	39%		1539	
C-WRIG-D-12	Confined	Lagoon	12/16/97	SW	0-5mph	33			1537	

Latitude	Longitude	Start Time	0 minute	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	12 minutes	14 minutes	16 minutes	18 minutes	20 minutes	22 minutes	24 minutes	26 minutes
		18:58	0.005	0.007	0.005	0.005	0.005	0.004	0.005	0.006	0.006	0.008	0.008	0.006	0.006	0.008
		10:50	0.005	0.008	0.012	0.004	0.034	0.063	0.005	0.01	0.002	0.01	0.006	0.008	0.007	0.004
		19:14	0.01	0.006	0.005	0.005	0.006	0.06	0.007	0.009	0.008	0.004	0.005	0.008	0.009	0.01
		21:35	0.015	0.005	0.019	0.024	0.011	0.008	0.013	0.013	0.021	0.027	0.015	0.004	0.008	0.032
		19:45	0.005	0.003	0.007	0.003	0.002	0.002	0.001	0.007	0.004	0.003	0.003	0.003	0.003	0.003

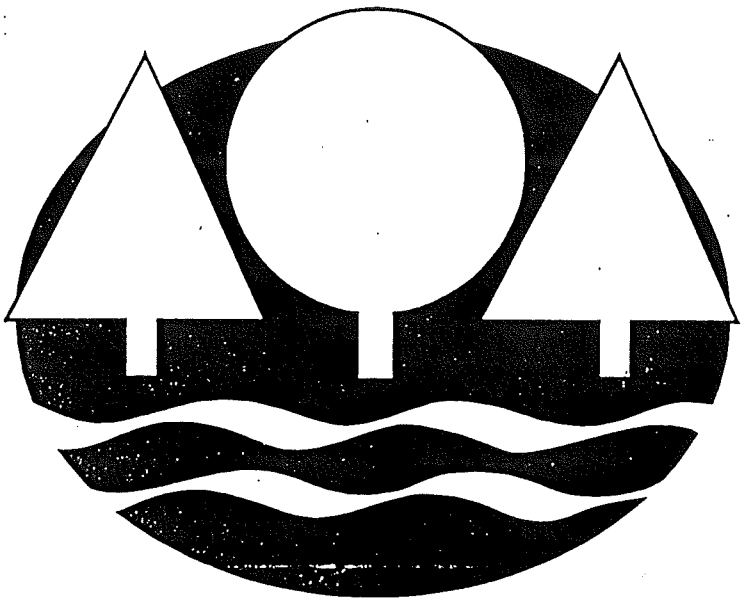
28 minutes	30 minutes	Avg	End	A.U.		
0.009	0.006	0.0061875	19:28	1199.8		
0.01	0.005	0.0120625	11:20	1,400		
0.009	0.009	0.010625	19:44			
0.016	0.013	0.01525	21:55			
0.003	0.004	0.0035	20:15	Property Line		
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				

Unique Number	Lot/Barn Type	Storage Type	Monitoring Date	Wind Direction	Wind Speed	Temperature	Humidity	Barometric Pressure	Jerome #	GPS#
Jerome-25	Confined	Litter Pack	10/24/97	NE	10-15mph	42	99%		1539	
Jerome-6	Confined	Litter Pack	10/24/97	NE	10-20mph	44	78%		1539	
Jerome-7	Confined	Litter Pack	10/24/97	NE	10-20mph	44	78%		1539	
Jerome-6	Confined	Litter Pack	10/24/97	NE	10-20mph	44	70%		1539	

Latitude	Longitude	Start Time	0 minute	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	12 minutes	14 minutes	16 minutes	18 minutes	20 minutes	22 minutes	24 minutes	26 minutes
		15:23	0.003	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001
		15:54	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
		16:34	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.001
		17:10	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

28 minutes	30 minutes	Avg	End	A.U.
0.002	0.001	0.0014375	15:53	
0.002	0.002	0.002125	16:24	
0.002	0.003	0.002125	17:04	
0.005	0.005	0.005	17:40	
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		

MPCA



AIR SAMPLING STRATEGY OF HYDROGEN SULFIDE AROUND ANIMAL FEEDLOTS IN MINNESOTA

A JOINT PROJECT OF THE

MINNESOTA POLLUTION CONTROL AGENCY

AIR QUALITY COMPLIANCE AND ENFORCEMENT SECTION

SPECIAL POLLUTANTS UNIT

AND

WATER QUALITY NONPOINT SOURCE SECTION - FEEDLOT UNIT

October, 1997

TABLE OF CONTENTS

I Authorization ..... page 1

II Purpose ..... page 1

III Duration ..... page 1

IV Geographic Area ..... page 1

V Methodology ..... page 2

A. Equipment and Technique ..... page 2

B. Sampling Points ..... page 4

C. Site Selection ..... page 5

1. Complaints ..... page 6

2. Swine ..... page 6

3. Dairy ..... page 8

4. Beef ..... page 9

5. Poultry ..... page 9

6. Land Application ..... page 10

D. Fence Line Issues ..... page 10

E. Biosecurity ..... page 10

F. Regional Staff Notifiication ..... page 11

VI Data Management and Analysis ..... page 11

Appendices

I Authorization

This project has been authorized by the State of Minnesota legislature specifically to address hydrogen sulfide emissions from feedlots. Minnesota Statute § 116.0713 states in part that the Minnesota Pollution Control Agency (MPCA) shall:

> "Monitor and identify potential livestock facility violations of the state ambient air quality standards for hydrogen sulfide, using a protocol for responding to citizen complaints regarding feedlot odor and it's hydrogen sulfide component, including the appropriate use of portable monitoring equipment that enables monitoring staff to follow plumes;"

The purpose of the authorization is to address odors through various environmental regulatory mechanisms statewide. In order to efficiently undertake this legislative task, it is necessary to characterize the feedlot odor problem in the state. This H_2S sampling strategy is intended to gather data regarding H_2S concentrations around animal feedlots in the state to determine the scope of the odor problem.

The Odor investigation is a joint operation between the MPCA's Water Quality Nonpoint Source Section - Feedlot Unit (Feedlots) and Air Quality Compliance and Enforcement Section - Special Pollutants Unit (Special Pollutants).

II Purpose

The purpose of this phase of the project is to gather H_2S concentration data around the various types of feedlots in the state of Minnesota. This information will be used for gaining better understanding of this issue, regulation, and overall program development purposes. This information will be useful in the construction of a legislative report on this issue prior to the February 1998 legislation.

III Duration

This H_2S data sampling phase is intended to last approximately 45 days; weather permitting, from mid October to the end of November. This is typically a time of the year when the manure storage units throughout the State are emptied and the waste is land applied. The number of odor complaints recorded by the agency also increases during this time of year. If the sampling strategy outlined in this document is successful, it will likely be used in later periods of H_2S monitoring.

IV Geographic Area

Currently, the geographic area identified by the MPCA for odor monitoring is southern, central and western Minnesota. This study area represents the agricultural base of the State and provides a diverse collection of various manure storage and handling practices as well as different types of livestock.

3. Data will be recorded in a log sheet (see Appendix A) and other information recorded in a bound and page numbered book which is used only for this purpose. The book will be kept in the personal possession of the field scientist and not shared or loaned out. Data and other information will be recorded using water proof ink, not felt tip or pencil. Mistakes should be corrected with one horizontal line through the error.

4. All data entry will include the following information:

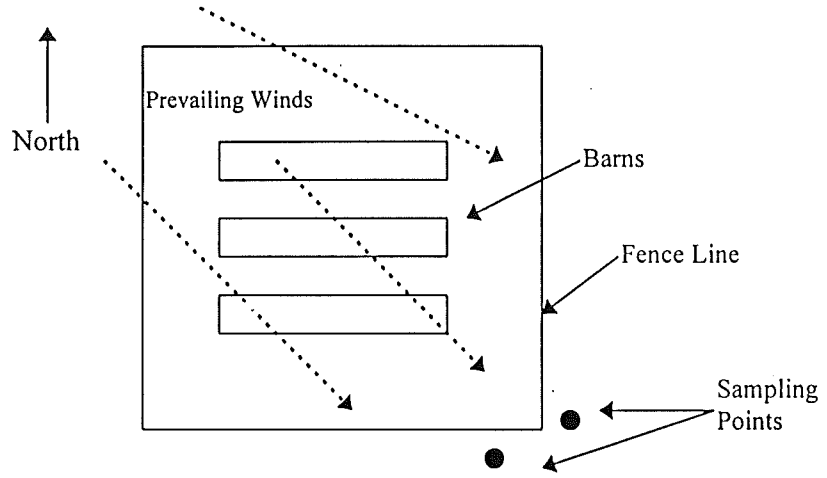
   A. The ID of the monitor used on that day.
   B. The date and time of each sample taken.
   C. The PPB value from the display; if the value is zero, it will be recorded as valid data.
   D. The location of the sample; this may include descriptive terms, but will normally use a sketch map of the site with code letters for the location (location A, B, C, etc.). The map will have the cardinal directions noted and will have some indication of distance scale even if approximate.
   E. Meteorological data will be recorded as available. A compass is needed for establishing sample location and can also be used to observe the wind direction. Descriptive terms for the wind may be used such as "light and variable," "calm" "strong and Gusty," etc. The wind direction will be noted on the site map. No sampling can be done in the rain or heavy fog as the detector in the Jerome can be damaged by excess water. A thermometer will be available and the temperature recorded although this is not as important as the wind conditions. Sky cover will be noted such as "clear with light cumulus" or "solid stratus overcast," etc.
   F. The presence of odor will be noted along with some descriptive terms to describe the quality of the odor such as "strong and pungent" or "swampy and musty," etc.
   G. Any physical activities occurring at the site will be noted, such as unusual road traffic or construction activities.
   H. The zero cartridge accessory for the Jerome will be used at the start of sampling and at the end of the period and the zero response from the monitor recorded as "zero response," this response should be 3 PPB or less.
   I. The field scientist should sign their name at the bottom of the logbook page.

5. The field scientist will have to use their best judgment in order to chose the best sampling locations for determining the time averaged values. The general idea would be to monitor the highest ambient level occurring at the location on that sampling day. The highest values would generally be assumed to occur at the fence line on the downwind side of the site; however, this may not always yield the highest concentrations. Some field judgment will have be exercised and a number of locations may have to be surveyed in order to discover the plume characteristics for that sampling day. Most people can smell H_2S at a level as low as 8 ppb, so the presence of odor may be helpful in choosing the sample locations. There also may be logistical limitations for the selection of the sampling locations or occasions when the sampling would be done at a prechosen location such as at a complainant residence.

Figure #2

Sample Point Locations for Feedlot Air Sampling

(Not to scale)



Some facilities will have an actual fence line delineating the operation. However, most sites will not have an actual fenced boundary. The fence line for our purposes at these facilities will be the approximate perimeter of the operation. Biosecurity measures and methods shall be observed during all monitoring exercises. (see Biosecurity section).

C. Site Selection

In an effort to begin to characterize the H_2S issue, approximately 20 sites have been chosen which will represent the various types of operations and manure storage and management. These sites were chosen from the feedlot unit's odor complaint log and from the animal feedlot permit database.

The MPCA has maintained a log of odor complaints since August of 1996. The data recorded includes the location of the alleged source of the odor, wind direction, humidity, barometric pressure, time of day, odor intensity, and any comments the complainant cared to share. There are approximately 70 entries into the odor log as of October, 1997. Not all sites recorded on the odor complaint log are added to the monitoring program. The sites added to the program have frequent odor events recorded throughout the year. The sites on the odor complaint log are mostly confined hog operations with either concrete pit or earthen holding basin manure storage.

The sites selected from the animal feedlot permit database were chosen based on livestock type and manure storage technique. These facilities are typically over 2,000 animal units in size. The larger sites were chosen because of their potential for odor.

B. **Watonwan Feeder Pigs - Watonwan County**

1. **MPCA-I 2213(A)**

This site is located on the NW quarter of the SW quarter of section 26, Fieldon township. It is a farrowing/gestation facility with a total of 623 animal units. The facility is comprised of a total confinement barn and a earthen holding basin manure storage system.

2. **MPCA-C 5452**

This site is located on the SE quarter of the SE quarter of section 26, Fieldon township. It is a feeder pig facility with a total of 240 animal units. The facility is comprised of a total confinement barn and a underground concrete pit manure storage system.

C. **Robert Schemel Site - MPCA-I 1298(A)R - Renville County**

This site is located on the SW quarter of the NW quarter of section 31, Emmet township. It is a farrowing/gestation facility with a total of 1,378 animal units. The facility is comprised of a total confinement barn and a aerated earthen lagoon manure storage system.

D. **Jerome Forst Site - MPCA-I 1359(A) - Nicollet County**

This site has a partial and total confinement livestock operation for the hogs and uses an earthen holding basin as well as a manure pack system for manure storage. There is currently an experimental odor abatement project being conducted at this site.

E. **Neal Johnson Sites - Renville County**

The Johnson sites are located in Renville County under various feedlot permits. The sites use various manure and livestock storage methods. See Appendix B for a list of the existing feedlot permits and site locations.

F. **Swine Complex, Inc - MPCA-I 1997(A)R - Rock County**

This site is located on the SE quarter of the NW quarter of section 11, Springwater township. It is a farrowing/gestation facility with a total of 964 animal units. The facility is comprised of a total confinement barn and a underground concrete pit manure storage system.

G. **Churchill Co-op Sites - Renville County**

1. **MPCA-I 1338(A)**

This site is located on the SW quarter of the NW quarter of section 10, Brookfield township. It is a farrowing/gestation facility with a total of 535 animal units. The facility is comprised of a total confinement barn and a earthen holding basin manure storage system.

expand. The facility is comprised of total confinement barns and a earthen holding basin manure storage system.

4. Beef

The beef production facilities were chosen from the existing field of permits that the MPCA has issued over the past twenty years. Each site is >2,000 animal units. Each operation utilizes a different manure storage system. None of these sites appear on the odor complaint log. A copy of the feedlot permits can be found in Appendix D.

L. Earl Schwartz - MPCA-C 1601 - Polk County

This site is located on the SW quarter of the SW quarter of section 23, Tilden township. It is a beef facility with a total of 2,000 animal units. The facility is comprised of partial confinement barns and an earthen holding basin manure storage system.

M. Bernard and David Their - MPCA-C 5596R - Nobles County

This site is located on the NW quarter of the NE quarter of section 20, Dewald township. It is a beef facility with a total of 2,750 animal units. The facility is comprised of partial confinement barns and a manure pack storage system.

N. Joseph Neusch Site - Permit Application Submitted - Martin County

This site is located on the NW quarter of the NE quarter of section 28, Silver Lake township. It is a beef facility with a total of 2,200 animal units. The facility is comprised of partial confinement barns and earthen basins and manure pack storage systems.

5. Poultry

The poultry sites consist of turkey and chicken facilities. None of the sites chosen for this monitoring program appear on the odor complaint log. These sites were chosen based on size (>2,000 animal units) and manure storage techniques. A copy of these feedlot permits appear in Appendix E.

O. Jack Frost, Inc - MPCA-C 3974 - Sherburne County

This site is located on the NW quarter of section 15, Big Lake township. It is a broiler chicken facility with a total of 2,976 animal units. The facility is comprised of total confinement barn and manure pack storage system.

P. Jerome Foods, Inc - Various Sites - Dodge County

yourself with some type of disinfectant. If possible, space visits to swine operations a day apart to avoid any potential pathogen transport from one site to the next.

F. Regional Staff Notification

It is important to keep the regional MPCA staff aware of when central office MPCA staff will visit their area to do air monitoring. As a rule, contact the regional feedlot and air quality staff a day in advance of the visit. The regional staff will likely have important information about the facility you are monitoring and also additional sites which may not have been reported.

VI Data Management and Analysis

Data collected in the field will be kept at the central office of the MPCA in Saint Paul. The data will be in the form of field notebooks, data sheets and in digital format. The digital data sets will be stored in a format compatible with the Microsoft Excel ® spreadsheet program. The Excel spreadsheet program was selected because it has a number of advantages. It is used widely throughout the MPCA and other state and local agencies as well as the university system. Data can be easily manipulated and graphed, and then reformatted or inserted in other applications.

Analysis of the data will be conducted by the MPCA staff. The data will be compared to the state's existing H_2S ambient air standard as well as other parameters such as temperature, humidity, wind speed and facility type. The MPCA will also seek other existing data sets from counties and individuals currently collecting H_2S data in the field.

SF-00006-05(4/86)

DEPARTMENT: POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE: December 22, 1997

TO: Michael J. Sandusky
Acting Division Manager
Air Quality Division

FROM: Peder A. Larson
Commissioner

PHONE: 296-7301

SUBJECT: Approval of Two Measurement Methods for Hydrogen Sulfide

Pursuant to Minn. R. 7009.0060, I, Peder A. Larson, Commissioner of the Minnesota Pollution Control Agency (MPCA) hereby approve the following two methods for measuring concentrations of hydrogen sulfide in the ambient air. It should be noted that both methods must be operated in a continuous fashion so as to capture as valid data at least 75 percent of all possible 30 minute periods in one year. The 30 minute periods will start at the beginning of the hour and the half-hour and averaged as 30 minute blocks.

Option 1: The use of an ambient air quality monitor for sulfur dioxide, approved by the U.S. Environmental Protection Agency, as set forth in the Code of Federal Regulations, Volume 40, part 53, operating with a designated full scale range of 500 parts per billion or less, together with a thermal oxidizer to convert reduced sulfur gases to sulfur dioxide. Before making the measurement, the person seeking to make the measurements must develop and receive MPCA approval of a Quality Assurance Plan that provides operational procedures for each of the activities described in Code of Federal Regulations, title 40, part 58, appendix A.2.2. The following operational checks must be performed on a periodic basis as part of the Quality Assurance Plan:

(1) The thermal oxidizer must be demonstrated by the user to operate at an efficiency of 98 percent or better in the conversion of hydrogen sulfide to sulfur dioxide in an ambient air matrix at the operational flow rate of the monitor. This conversion efficiency must be demonstrated at a hydrogen sulfide input of at least 80 percent of full scale.

(2) A scrubber for the removal of ambient sulfur dioxide must be incorporated ahead of the thermal oxidizer. This scrubber must be shown to remove at least 98 percent of sulfur dioxide input up to 80 percent of full scale without affecting the concentration of hydrogen sulfide in the incoming sample stream.

A list of EPA-approved sulfur dioxide monitors, "The EPA list of Designated Reference and Equivalent Methods," is available from the EPA or the MPCA upon request. Commercial

vendors for thermal oxidizers with sulfur dioxide scrubbers are also available, but the user is responsible for the demonstration of the performance of the equipment, as described above.

Option 2: The use of MDA Scientific "Chemcassette®" Model 7100 or Model SPM for hydrogen sulfide. MDA Scientific is part of Zellweger Analytics, Inc. Both models utilize the same sensitized paper tape principle of operation. Model SPM has a range of detection from 3 to 90 parts per billion as 15 minute averages and may be unsuitable for recovery of 75 percent of all possible 30 minute periods in one year where high levels of hydrogen sulfide may be present. Model 7100 has a detection range from 3 to 5000 parts per billion.

These monitors must utilize the manufacturer's "low level" hydrogen sulfide paper tape cartridge with the instrument programmed for a minimum detection limit of at least 3 parts per billion for an averaging period of 15 minutes. Before making the measurement, the person seeking to make the measurements must develop and receive MPCA approval of a Quality Assurance Plan that provides operational procedures for each of the activities described in Code of Federal Regulations, title 40, part 58, appendix A.2.2. As recommended by the manufacturer, the Quality Assurance Plan should take into consideration the possible need for a sample stream humidification for this method if the ambient air is very dry, such as it is in winter.

Any continuous monitor using the sensitized paper tape method which the Commissioner finds is sufficiently similar in performance to the MDA Scientific "Chemcassette®" models described above may also be used.

RATIONALE FOR DECISION

In adopting these two methods for measuring concentrations of hydrogen sulfide in the ambient air, I hereby adopt the statements of fact and rationale set forth in the attached memorandum from Michael Sandusky dated December 19, 1997, entitled "Request for Approval of Measurement Method for Hydrogen Sulfide.

PAL:jmd

Attachment

Rick -
FYI
NC

Pollution Control Agency

Air Quality Division

Public Notice Regarding Measurement Methodologies for Determining Compliance with the Ambient Air Quality Standards for Hydrogen Sulfide

NOTICE IS HEREBY GIVEN that the Commissioner of the Minnesota Pollution Control Agency (MPCA) has approved the following two methods pursuant to *Minnesota Rules* 7009.0060 for measuring concentrations of hydrogen sulfide in the ambient air. It should be noted that both methods must be operated in a continuous fashion so as to capture as valid data at least 75 percent of all possible 30 minute periods in one year. The 30 minute periods will start at the beginning of the hour and the half-hour and averaged as 30 minute blocks.

Option 1: The use of an ambient air quality monitor for sulfur dioxide, approved by the United States Environmental Protection Agency (EPA), as set forth in the *Code of Federal Regulations*, Volume 40, part 53, operating with a designated full scale range of 500 parts per billion or less, together with a thermal oxidizer to convert reduced sulfur gases to sulfur dioxide. Before making the measurement, the person seeking to make the measurements must develop and receive MPCA approval of a Quality Assurance Plan that provides operational procedures for each of the activities described in *Code of Federal Regulations*, title 40, part 58, appendix A.2.2. The following operational checks must be performed on a periodic basis as part of the Quality Assurance Plan:

(1) The thermal oxidizer must be demonstrated by the user to operate at an efficiency of 98 percent or better in the conversion of hydrogen sulfide to sulfur dioxide in an ambient air matrix at the operational flow rate of the monitor. This conversion efficiency must be demonstrated at a hydrogen sulfide input of at least 80 percent of full scale.

(2) A scrubber for the removal of ambient sulfur dioxide must be incorporated ahead of the thermal oxidizer. This scrubber must be shown to remove at least 98 percent of sulfur dioxide input up to 80 percent of full scale without affecting the concentration of hydrogen sulfide in the incoming sample stream.

A last of EPA-approved sulfur dioxide monitors, "The EPA list of Designated Reference and Equivalent Methods," is available from the EPA or the MPCA upon request. Commercial vendors for thermal oxidizers with sulfur dioxide scrubbers are also available, but the user is responsible for the demonstration of the performance of the equipment, as described above.

Option 2: The use of MDA Scientific "Chemcassette®" Model 7100 or Model SPM for hydrogen sulfide. MDA Scientific is part of Zellweger Analytics, Inc. Both models utilize the same sensitized paper tape principle of operation. Model SPM has a range of detection from 3 to 90 parts per billion as 15 minute averages and may be unsuitable for recovery of 75 percent of all possible 30 minute periods in one year where high levels of hydrogen sulfide may be present. Model 7100 has a detection range from 3 to 5000 parts per billion.

These monitors must utilize the manufacturer's "low level" hydrogen sulfide paper tape cartridge with the instrument programmed for a minimum detection limit of at least 3 parts per billion for an averaging period of 15 minutes. Before making the measurement, the person seeking to make the measurements must develop and receive MPCA approval of a Quality Assurance Plan that provides operational procedures for each of the activities described in *Code of Federal Regulations*, title 40, part 58, appendix A.2.2. As recommended by the manufacturer, the Quality Assurance Plan should take into consideration the possible need for a sample stream humidification for this method if the ambient air is very dry, such as it is in winter.

Any continuous monitor using the sensitized paper tape method which the Commissioner finds is sufficiently similar in performance to the MDA Scientific "Chemcassette®" models described above may also be used.

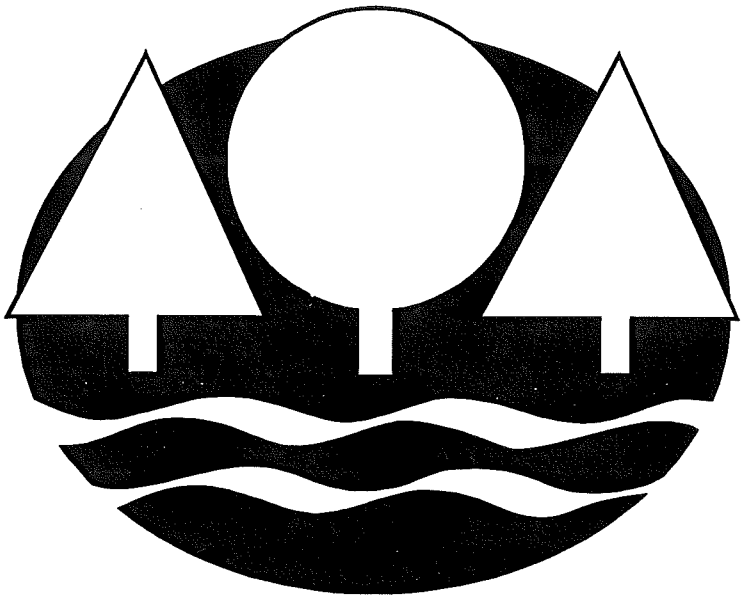
For questions regarding the approved methods and to obtain a copy of the Technical Support Document which explains the development of the recommendations please contact:

Dean Fundine
Air Quality Division
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, Minnesota 55155-4194
(612) 296-7338

Peder A. Larson
Commissioner

DRAFT 1/16/98

MPCA



AIR SAMPLING STRATEGY OF HYDROGEN SULFIDE AROUND ANIMAL FEEDLOTS IN MINNESOTA

A JOINT PROJECT OF THE

MINNESOTA POLLUTION CONTROL AGENCY

AIR QUALITY COMPLIANCE AND ENFORCEMENT SECTION

SPECIAL POLLUTANTS UNIT

AND

WATER QUALITY NONPOINT SOURCE SECTION - FEEDLOT UNIT

January, 1998

DRAFT 1/16/98

TABLE OF CONTENTS

List of Figures ..... *i*
Table of Authorities ..... *i*
I Authorization ..... page 1
II Purpose ..... page 1
III Duration ..... page 2
IV Geographic Area ..... page 2
V Methodology ..... page 2
A. Jerome Meter Protocol ..... page 2
B. Screening and Data Collection ..... page 6
1. Types of Data Collection ..... page 6
a. Compliance screening ..... page 6
b. Research sampling ..... page 6
i. Biosecurity ..... page 7
C. Selected Sites for the 1998 Hydrogen Sulfide Monitoring ..... page 7
1. Complaints ..... page 7
2. Swine ..... page 7
3. Dairy ..... page 9
4. Beef ..... page 9
5. Poultry ..... page 9
D. Complaint Response ..... page 9
1. Regional Staff Notifiication ..... page 10
VI Data Management and Analysis ..... page 10

Appendice
Sample Datasheet ..... Appendix A
Feedlot Odor Log ..... Appendix B

List of Figures

Sample Location Determination Diagram ..... Figure #1
Compliance/Research Monitoring Diagram ..... Figure #2
Environmental Response Plan ..... Figure #3

Table of Authorities

Statutes

Minnesota Statute § 13.03 subd. 1
Minnesota Statute § 13.06 subd. 2a
Minnesota Statute § 17.139
Minnesota Statute § 116.0713
Minnesota Statute § 116.075

Rules

Minnesota Rule 7009.0060

I. AUTHORIZATION

This project has been authorized by the State of Minnesota legislature specifically to address gaseous hydrogen sulfide emissions from feedlots. Minnesota Statute § 116.0713 states in part that the Minnesota Pollution Control Agency (MPCA) shall:

> "Monitor and identify potential livestock facility violations of the state ambient air quality standards for hydrogen sulfide, using a protocol for responding to citizen complaints regarding odor and it's hydrogen sulfide component, including the appropriate use of portable monitoring equipment that enables monitoring staff to follow plumes;"

The purpose of the authorization is to address feedlot odors using a quantifiable and identifiable gas emission known to be a compound present in odorous gases at confined animal feeding operations (CAFO's). The purpose of this strategy is to screen feedlot facilities for compliance with the state hydrogen sulfide ambient air quality standard (Minn. R. 7009.0060). A secondary goal of the program is to determine the overall characteristics of the feedlot odor problem.

The regulation of hydrogen sulfide emissions from CAFO's is a joint operation between the MPCA's Water Quality Nonpoint Source Division - Feedlot Unit (Feedlots) and the Air Quality Compliance and Enforcement - Special Pollutants Unit (Special Pollutants).

II. PURPOSE OF THIS DOCUMENT

The purpose of this document is to establish a field operating procedure for MPCA staff during the upcoming 1998 hydrogen sulfide air emission sampling season. The primary purpose of the hydrogen sulfide initiative is to determine whether a feedlot is in compliance with the state ambient air quality standard for hydrogen sulfide. This information is termed "Compliance Data". The determination of compliance shall be made at the property boundary of the facility and beyond. A secondary purpose of the program is to gather field data that will be used to research the effectiveness of various technologies. This information is termed "Research Data" and will be collected on the property of the feedlot facility.

III. DURATION

The MPCA will respond to odor complaints throughout the year. However, the agency will begin an intensive effort of compliance monitoring around the state in approximately March of 1998. Compliance monitoring will continue throughout the year until weather prohibits extensive travel. The agency will continue to respond to complaints after the season of intensive compliance and research data collection.

IV. GEOGRAPHIC AREA

The primary animal agricultural base of the state is located in the southern, central and western portions of the state. Most of the odor complaints recorded in the odor complaint log indicate that these regions of the state have facilities where odor from animal agriculture is allegedly a problem. As a result, much of the hydrogen sulfide compliance monitoring activities conducted during this phase shall be devoted to these areas of the state.

V. METHODOLOGY

A. Jerome Meter Protocol

This preliminary screening for the determination of compliance with the state standard will use the Arizona Instruments Jerome 631-X H_2S monitor (Jerome Meter) to gather data in the field. The following protocol for the use of the Jerome Meter has been developed by Dean Fundine, Analytical Services Group - MPCA:

> This protocol is to describe the use of the Arizona Instruments Jerome 631-X H_2S monitor to gather data in the vicinity of suspected H_2S sources; it is not to replace or duplicate the Arizona Instrument "operational manual" for the monitor. It is required that all operation of the monitor be conducted in accordance with the manufacturer's recommendations in the "operation manual".
>
> The Jerome meter is not a continuous running time averaging monitor but is a unit that produces a measurement consisting of a nominal 30 second integrated average each time the sample button is pushed. The type of data of most interest to the MPCA is time averaged data over such intervals as one hour, one-half hour, one day, or some other specified interval. All averaged data must be collected at a fixed location for the averaging period. The minimum averaging time for any type of

meaningful interpretation of data is for a 15 minute period. This means that the Jerome meter must be used in a manner that involves pressing the sample button a number of times during a specified period and recording the parts per million (ppm) response numbers from the digital display in an appropriate data logbook. The manufacturer has produced some options that have potential for automating the data gathering process. The Agency has these options available but feels they will not be suitable for the primary mode in which the monitor will be used. For special projects where AC power and a protected sample location are available the automated accessories may be useful.

The following points must be observed for meaningful data to be gathered with the Jerome meter:

1. The monitor used must have a valid calibration verification form on file from the MPCA. This verification will be performed by the Agency using its own protocol and standard gases. The Agency will not defend data relying only on the Arizona Instruments "certificate of instrument calibration".

2. All monitored values must be properly recorded in an MPCA datasheet (See Appendix A). The Jerome is very handy and simple to use; this invites haphazard and casual use of the instrument. For useable data to be gathered all results must be recorded in the proper manner as they are displayed on the monitor.

3. Data should be recorded on the data sheets which are used only for this purpose. The datasheets should be kept in the personal possession of the field scientist and not shared or loaned out. Data should be recorded using ink such as a ball point pen. A felt tip pen or pencil should not be used. Mistakes should be corrected with one horizontal line through the error.

4. All data entry should include the following information:

a. The ID of the monitor used on that day.

b. The date and time of each sample taken.

c. The PPB value from the display. If the value is zero, the zero should be recorded as valid data.

d. The location of the sample. This may include descriptive terms but should also use a map or sketch of the site with code letters for the location (location A, B, C, etc.). The map should have the cardinal

directions noted and should have some indication of distance scale even if approximate.

e. Meteorological data. A compass is needed for establishing sample location and can also be used to observe the wind direction. Descriptive terms for the wind may be used such as "light and variable", "calm", "strong and gusty", etc. The wind direction should be noted on the site map. No sampling can be done in the rain or heavy fog as the detector in the Jerome can be damaged by excess water. A thermometer should be available and the temperature recorded although this is not as important as the wind condition. Sky cover should be noted such as "clear with light cumulus" or " solid stratus overcast" etc. There may be occasions when actual meteorological gear will be used at the site.

f. The presence of odor. Some descriptive terms to describe the quality of the odor such as "strong and pungent" or "swampy and musty" should be recorded.

g. Physical activities occurring at the site. A record should be made of any activity observed during sampling such as unusual road traffic or construction activities

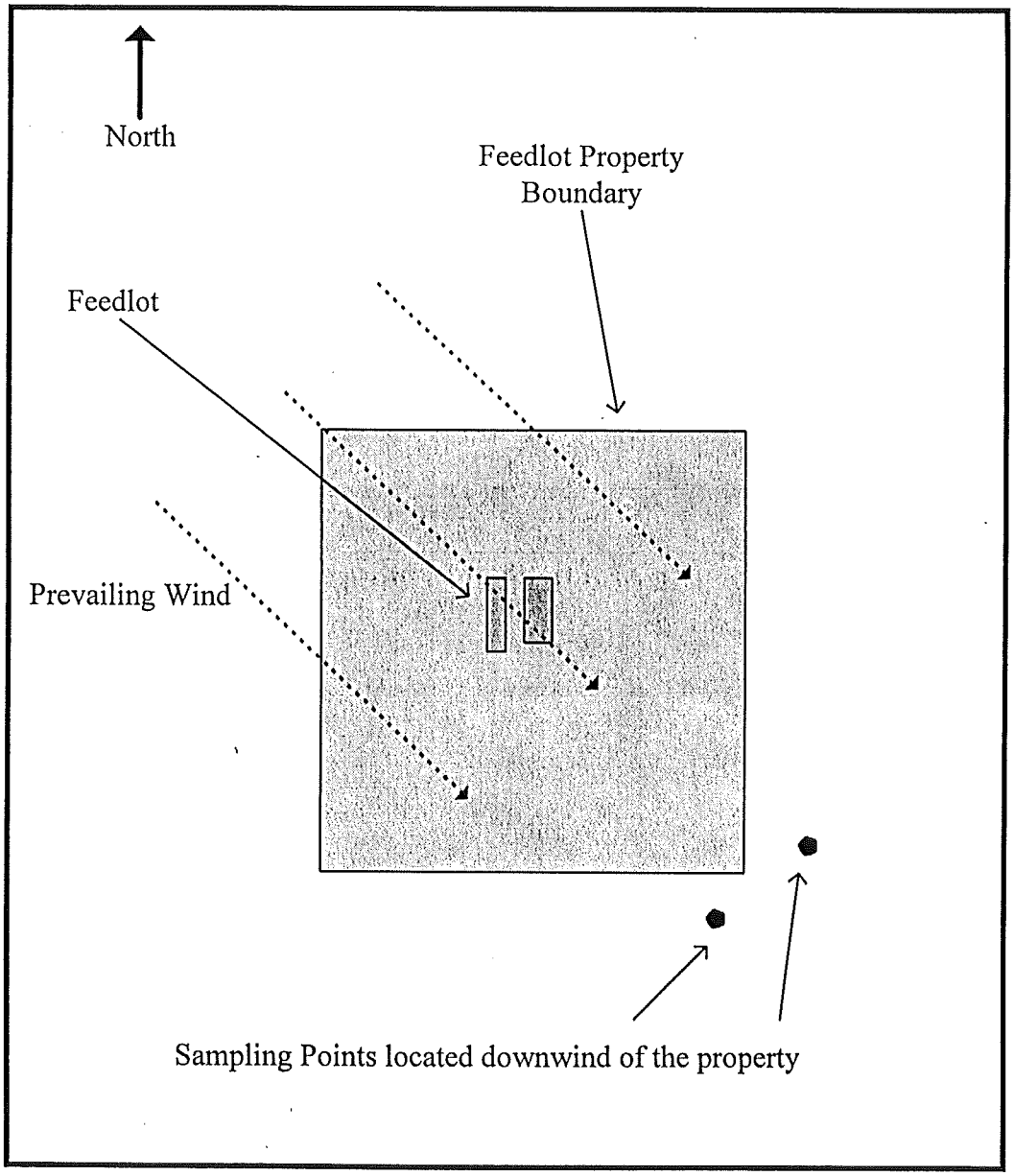
h. The "zero" response of the monitor. The zero cartridge accessory for the Jerome should be used at the start of sampling and at the end of the period and the zero response from the monitor recorded as "zero response"; this response should be 3PPB or less.

i. The name of the person who gathered the data. The field scientist should sign their name at the bottom of the datasheet and any logbook used to record additional notes.

5. The field scientist will have to use their best judgment in order to choose the best sampling locations for determining the time averaged values. The general idea would be to monitor the highest ambient level occurring at the facility on that sampling day. Ambient air means air that has crossed the property boundary of the facility and to which a member of the public could have access. A preliminary survey of number of the locations may have to be conducted in order to discover the plume characteristics for that sampling day. Most people can smell H_2S at a level as low as 8ppb so the presence of odor may be helpful in choosing the best sample location. The sense of smell may not always be reliable because prolonged exposure to high levels of H_2S can deaden the olfactory nerves. There also may be logistical limitations for the selection of a sampling location or occasions when the sampling would be done at a pre-chosen location such as at a complainant residence. Topography may also play a role in site selection with the possibility of cooler and

Figure #1

Diagram of sampling points for feedlot hydrogen sulfide monitoring.



heavier air, carrying the H_2S, collecting in low spots in the terrain. The location of all facility will be recorded with the use of a global positioning system (GPS).

6. It may be difficult to determine the best time to conduct the sampling. The concentration of any pollutant in the air will vary considerably depending on the specific weather conditions at the time of measurement. Any data collected will reflect the H_2S levels only during the time the field scientist is at the location. Many problems seem to occur at nighttime hours or at relatively infrequent intervals. It is likely that a number of visits to a location, possibly involving non-standard work hours, will be required to fully assess the site condition using the Jerome meter. In order to address these time related problems, the Agency has procured another type of H_2S monitor, the MDA "chemcassette" monitor. This unit can run at a site in unattended operation for at least 24 hours.

7. As has been noted earlier it is necessary to obtain a number of readings from the Jerome in order to calculate a time averaged value. The preferred time averages are one-half hour and one hour periods; shorter times may be recorded if logistics dictate or if a large number of locations need to be examined but these shorter time periods will not be as useful as the one-half or one hour data. Note that it is best to gather data as duplicate measurements; in other words the sample button is pressed twice to produce two readings in series. A 15 minute averaging period should contain at least 5 evenly spaced duplex measurements. The actual number of measurements desired is statistically a function of the variability of the data on that day. Data that is seen to be highly variable should cause the field scientist to sample at greater frequency. For a one hour average, the sample button could be pressed twice in series every 5 minutes for a total of 12 duplex readings in the hour. There may be occasions when the data will be collected as "traverse" data; in this procedure a series of duplex readings may be collected at fixed intervals across a source plume or going to or from the source in distance. This is a survey approach and any averages calculated from this data would not be from a fixed location. This approach may be useful in determining the high point of concentration or looking at plume dispersion characteristics.

8. Upon completion of sampling it will be necessary to produce a data report in a format suitable for electronic storage and retrieval. The field data described in section 4 items a through i will be made available as a spreadsheet or other convenient file with all averages calculated and any descriptive fields of data or comment added.

B. Screening and Data Collection

The initial determination of compliance with the state hydrogen sulfide ambient air quality standard is determined through a screening process (See Figure #2). The screening process involves air sampling of hydrogen sulfide emissions from feedlot facilities. The following is a discussion of the types of data collection conducted, biosecurity, complaint response and the sites selected for the 1998 hydrogen sulfide monitoring season.

1. Types of data collection

The purpose of the feedlot hydrogen sulfide initiative is to identify feedlot facilities that are not in compliance with the state hydrogen sulfide air quality standard and return these facilities to compliance. Once the determination of potential noncompliance is made, the MPCA will work with the facility to bring it back into compliance with the state standard. The determination of potential noncompliance is made through an initial screening process that employs air sampling of hydrogen sulfide emissions from the feedlot facility. This is known as *Compliance Screening*. Occasionally, the need for further hydrogen sulfide emission data will be necessary when investigating the effectiveness of various technologies. This data is collected on the site of the feedlot and is termed *Research Sampling*. The following is a distinction between the two types of monitoring.

a. Compliance Screening

Compliance screening is conducted for the purpose of determining compliance with the state air quality standard for hydrogen sulfide. This type of screening occurs at the property boundary and beyond. Property boundaries will be determined through the use of county plat maps. The data collected during these sessions is used for the purpose of compliance determination and can also be used for research purposes. (See Figure #3)

b. Research Sampling

Research sampling is conducted on the property of the facility. This type of sampling is conducted when a technology is introduced that could affect the emission levels, or in characterizing the emissions from an existing technology. This type of sampling is conducted with the permission of the landowner and is not being conducted for the determination of compliance with the state air quality hydrogen sulfide standard. (See Figure #3) While conducting research monitoring on site, MPCA staff will abide by any biosecurity protocol in place at the facility (Minn. Stat. §17.139) and conduct themselves in a manner which does not interfere with the normal operations at the facility.

Animal Feedlot Hydrogen Sulfide (H2S) Compliance Approach Flowchart

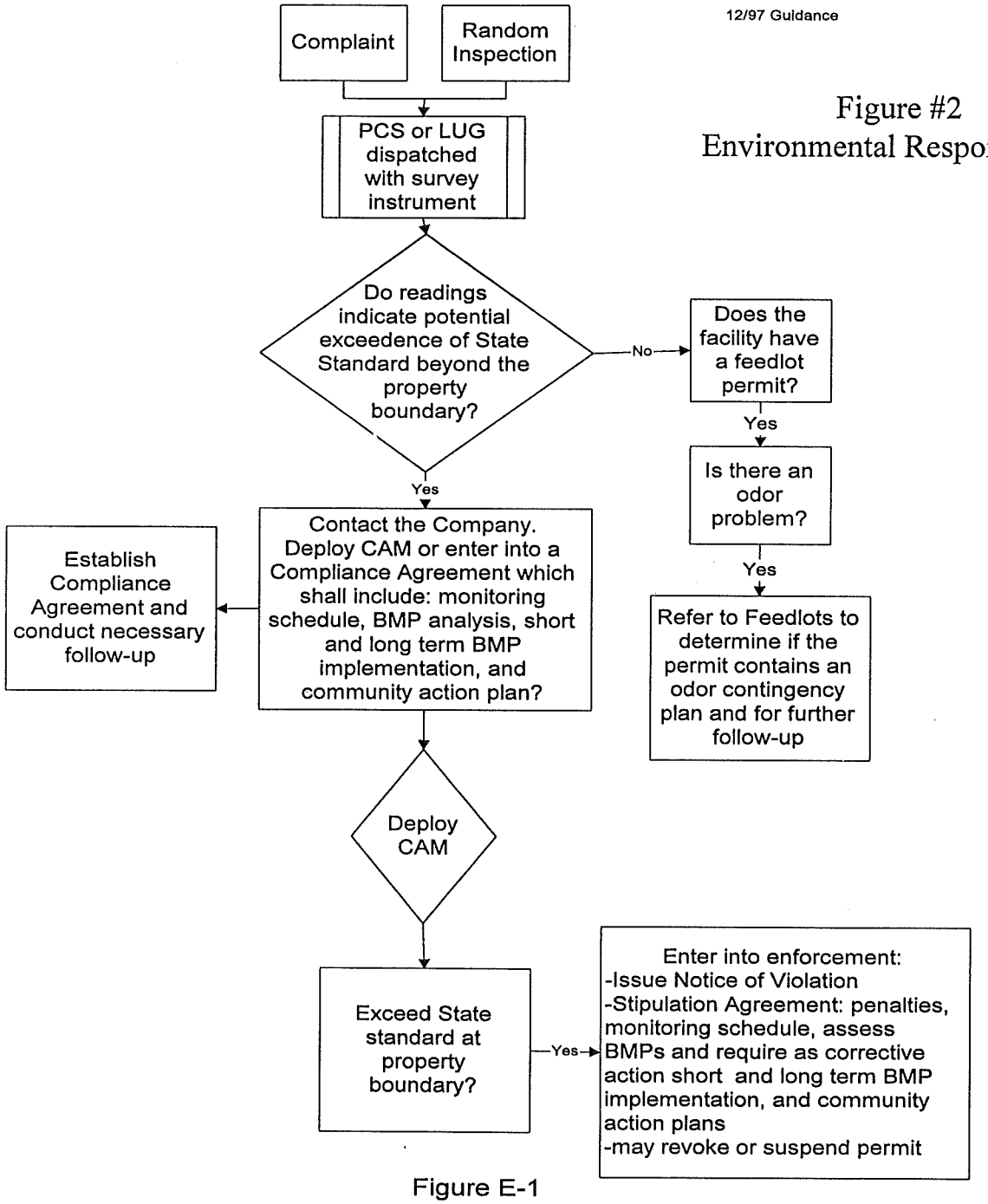


Figure #2
Environmental Response Plan

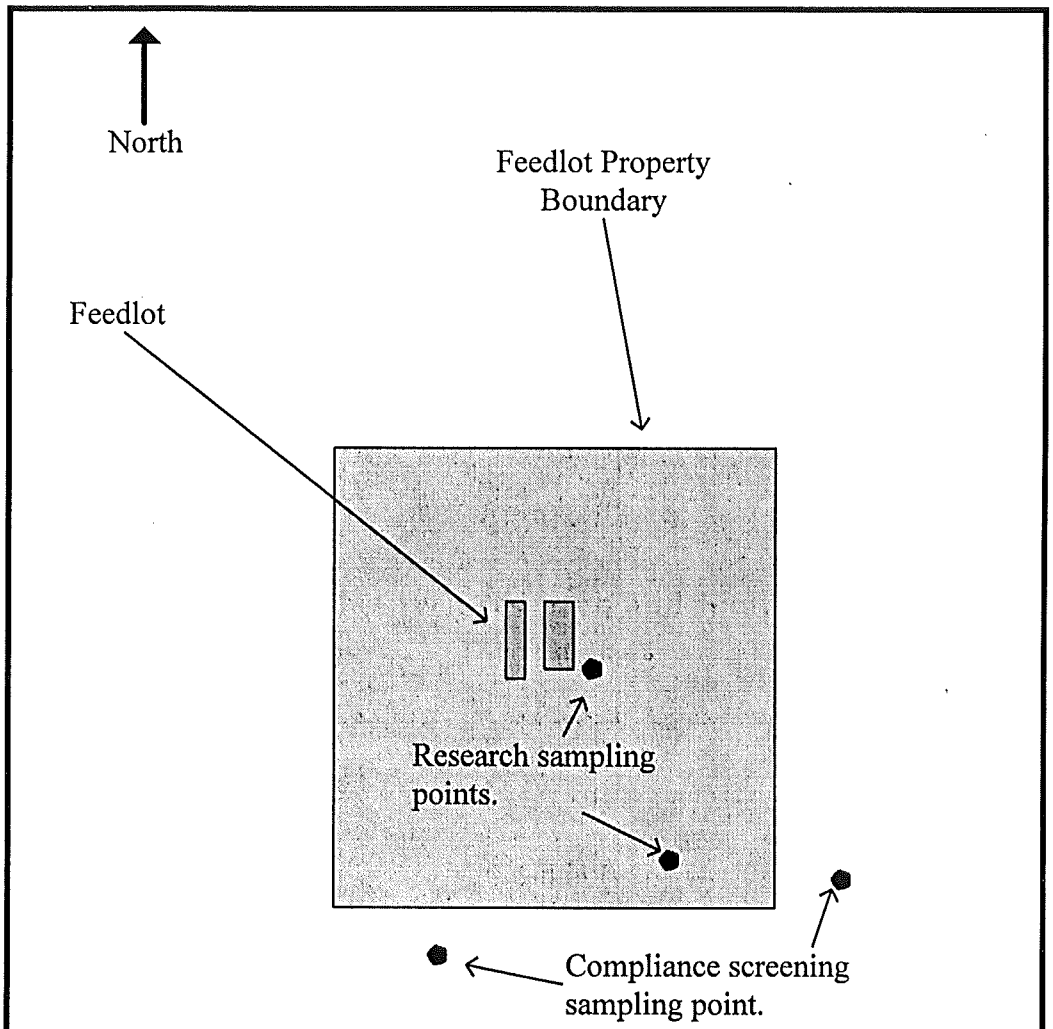
Figure E-1

NOTE

The MPCA, its Air Quality Division, and the Attorney General's Office Reserve the right to act at variance with the ERP, including penalty determination processes, to change the ERP at any time, or not to commence litigation without prior initiation of settlement discussions, based upon applicable law and relevant facts of a specific case. This ERP is not intended, and cannot be relied upon to create any rights, substantive or procedural, that can be enforced in litigation or any administrative proceeding with the State of Minnesota. Nothing in this ERP shall be construed to restrict any action that may be taken by the MPCA or Attorney General on behalf of the State of Minnesota, in any litigation that is commenced for violations of environmental laws.

Figure #3

Spatial distinction between research and compliance monitoring.



Research data is collected on the feedlot property. Compliance data is collected at the property boundary and beyond. Compliance data can be used for research purposes. Research data cannot be used for the determination of compliance.

DRAFT 1/16/1998

i. Biosecurity

Organisms such as bacteria, viruses, fungus, and parasites can seriously damage or destroy the health of livestock and poultry. These organisms can be unknowingly transmitted to a feedlot facility by means of clothing, equipment, vehicles and exposed skin. The MPCA may request access to the facility property for the purpose of conducting research sampling. The request for access and the biosecurity procedures shall be determined prior to entry on the property by MPCA staff. If a facility does not have a biosecurity program, the MPCA field staff shall conduct the following procedure:

1. Prior to entry into a farm animal facility or farmstead, MPCA Staff shall prepare a solution of an approved sanitizer mixed with water according to label instructions in a clean 5 gallon plastic bucket. Mix 2 to 4 gallons of the solution. Approved sanitizers include Lysol, Laro, Environ, Cresl-400, Tek-Trol, Discan, Synphenol-3, and Nolvasan.

2. Clean coveralls and rubber boots must be worn. The boots must have been scrubbed with the sanitizing solution, scrubbing off all manure and dirt before and after entering a farm facility.

C. Selected Sites for the 1998 Hydrogen Sulfide Monitoring Season

The sites selected for compliance monitoring during the 1998 season have received complaints and are entered into the odor complaint log (See Appendix B). Sites with a (*) appearing next to the entry on the list indicates that an odor complaint has been received by the MPCA about this feedlot. These sites shall receive compliance level air monitoring. Sites on this list that are not part of the odor complaint log were chosen as control sites because of their size and manure storage technology and will also receive compliance level air monitoring. Please be aware that the manure storage type for each facility is identified from either the actual permit or the MPCA computer database.

1. Complaints

Feedlot odor complaints are received by the MPCA throughout the year. The complaints are logged and the MPCA responds to the complaints through compliance monitoring where appropriate. Any feedlot facilities that receive odor complaints throughout the 1998 monitoring season will be added to the monitoring list and receive compliance level monitoring.

2. Swine

Site/Facility	Manure Storage Type	County	Permit Number
*Roger Kingstrom	Concrete Pit/Earthen Holding Basin	Renville	MPCA-I 1157(A)R
*ValAdCo - Lippert Site	Earthen Holding Basins	Renville	NPDES

*ValAdCo - Tisdale Site			NPDES
*Jerome Forst	Earthen Holding Basin & Manure Pack	Nicollet	MPCA-C 7013
*Watonwan Co. Fdr Pig Co-op *Watonwan Co. Fdr Pig Co-op	Earthen Holding Basin Concrete Pit	Watonwan	MPCA-I 2213(A) MPCA-C 5452
*Menay Bros. Hog Farm	Concrete Pit	Mower	MPCA-C 5405
*Neil Johnson	Earthen Basin	Renville	various sites and permits
*Swine Complex, Inc.	Concrete Pit	Lincoln	MPCA-C 6719
*Pristine Pork	Concrete Pit Concrete Pit	Roseau	MPCA-C 5955 MPCA-C 5956
*Churchill Co-op	Earthen Holding basin Concrete Pit	Yellow Medicine	MPCA-I 1381(A) NPDES
*Shady Farms	not known	Renville	no permit available
*Exetare Exetare Partnership	Earthen Holding basin Concrete Pit	Yellow Medicine	MPCA-I 1381(A) MPCA-C 6466
*Holden Farms	Aerated lagoon and Concrete Pit	Rice	MPCA-C 3229 MPCA-C 3599 MPCA-C 3590R2 MPCA-I 1914(A)
*Gerhardt Farm Hog Works		Martin	
*Jim Kuhl	Concrete Pit and Daily Haul	Carver	Carver County Permit
*Buffalo Run	Concrete Pit	Waseca	MPCA-C 6904
*Dennis Engels *Wallace Engels	Concrete Pit and Earthen Basin	Lyon	MPCA-C 1085R3 MPCA-I 2107(A)R
*FAST Development	Earthen Holding Basin	Waseca	MPCA-C 6219
*Robert Schemel	Aerated Lagoon	Renville	MPCA-I 1298(A)R
*Robert Schmeising	Concrete Pit and Daily Haul	Blue Earth	MPCA-C 1195R2 and county permits
*Dennis Magnuson	Daily Haul Concrete Pit Earthen Basin	Freeborn	MPCA-C 3916 MPCA-I 2364(A)R MPCA-I 1968(A) MPCA-I 1524(A)

3. Dairy

Site/Facility	Manure Storage Type	County	Permit Number
*Metro Dairy	Earthen Holding Basin	Wright	MPCA-I 1780(A) MPCA-I 1960(A)R
*Robert Dahlheiner	No information available	Stearns	No permit on file
Little Pine Dairy	Earthen Holding Basin	Otter Tail	MPCA-I 1437(A)
MNDAK Dairy	Earthen Holding Basin	Le Seuer	NPDES
*Halquist Dairy	Earthen Holding Basin	Carver	Carver County Permit

4. Beef

Site/Facility	Manure Storage Type	County	Permit Number
*Jerry Endeson	Manure Pack	Otter Tail	MPCA-I 2247(B)
Earl Schwartz	Earthen Holding Basin	Polk	MPCA-C 1601
Joeseph Neusch		Martin	permit pending
Don DeLanghe	Earthen Holding Basin	Lyon	NPDES

5. Poultry

Site/Facility	Manure Storage Type	County	Permit Number
*Golden Oval	Deep Pack and Stockpiling	Renville	MPCA-C 5438
Jack Frost, Inc	Manure Pack	Sherburne	MPCA-C 3974
Jerome Foods	Various Systems	Dodge	Various Sites under different permits
Jona Baer	Concrete Pit	Clay	MPCA-C 4168

D. Complaint Response

As indicated by the feedlot odor complaint log, feedlot odor complaints are received throughout the year (See Appendix B). The MPCA has adopted the following procedure when addressing feedlot odor complaints. A feedlot odor complaint is received either in person by MPCA staff or through a recorded message on the MPCA's feedlot odor complaint line. Once the complaint is received, it is recorded on the feedlot odor complaint log.

The names of individuals who register complaints with state agencies or political subdivisions concerning violations of state laws or local ordinances concerning the use of property are classified as confidential per Minn. Stat. § 13.06 subd. 2a. The complainant has complete anonymity when bringing a complaint about a facility.

The MPCA staff will try to gather as much information about the odor condition as possible from the complainant. The MPCA will respond to the complaint by screening the facility for compliance with the state ambient air quality standard for hydrogen sulfide where appropriate. Agency staff will also meet with the facility to inform them of the situation and also meet with the complainant if possible.

1. Regional Staff Notification

In certain situations, regional MPCA feedlot staff may respond to feedlot odor complaints. The regional MPCA staff will monitor for compliance with the state's ambient air quality standard for hydrogen sulfide and also meet with complainants and feedlot facility staff where appropriate

VI. Data Collection and Management

Data collected in the field shall be recorded on datasheets (See Appendix A). This data shall be entered into a digital database at the MPCA. The compliance monitoring data will be analyzed to determine whether a facility has met the state ambient air quality standard. Data collected for the purpose of research shall be referred to the appropriate staff.

It is important to note that almost all data collected in the field is available to the public upon request. State statutes specify that all government data is public, unless a particular law (or temporary classification by the Commissioner of Administration) makes it otherwise.

Appendix A

Data Sheet

H2S Field Log 10/20/97

Page ____of____

Company Name:
Facility Name:
Street Address:
City: Zip:
Permit #
Site contact:
phone number:

Operation (circle):

Swine	Poultry	Cattle	Dairy

Storage (circle)

Pit	Lagoon	Slurry storage
Other:		

Field conditions:

Wind direction:			Wind Speed:	
calm	light	variable	strong	gusty

Temperature:	Humidity:
Barometric Presure:	

Odor (circle)

strong	pungent	swampy	musty
Other:			

Physical activities on site (unusual road traffic, construction etc.)

_____

_____

_____

Name:
Signature: Date:

Monitoring date (mo/day/yr):		Jerome Monitor #		GPS #		
Start time: end time:		GPS Latitude:		Longitude:		
Location 1	0.0	2.0	4.0	6.0	8.0	comments
0:00						
10:00						
20:00						
30:00		30 Minute Avg.=				
Location 2	0.0	2.0	4.0	6.0	8.0	
0:00						
10:00						
20:00						
30:00		30 Minute Avg.=				
Location 3	0.0	2.0	4.0	6.0	8.0	
0:00						
10:00						
20:00						
30:00		30 Minute Avg.=				
Location 4	0.0	2.0	4.0	6.0	8.0	
0:00						
10:00						
20:00						
30:00		30 Minute Avg.=				
Location 5	0.0	2.0	4.0	6.0	8.0	
0:00						
10:00						
20:00						
30:00		30 Minute Avg.=				
Location 6	0.0	2.0	4.0	6.0	8.0	
0:00						
10:00						
20:00						
30:00		30 Minute Avg.=				

☐ Additional notes in log book
(check if yes)

Source/Sampling Sketch

Appendix B

Odor Complaint Log

Facility		**CO**	**NOx**	**PM10**	**SO2**	**PM**	**VOC**
Glencoe P&L	lim PTE	41.5	247	13.1	19.7	14.2	14.7
	actuals	5.5	28.1	1.4	1.4	1.6	0.9
NBPC#12	lim PTE	98.7	233	19	9.3	19	13.2
	actuals	same ----------					
Globe Tool	lim PTE						53.5
	actuals						31.1

HAPs	
3.4	
0.1	
3.3	
---------->	
50	
29.4	

MPCA Odor Log

Complaint No.	Date Call Received (m/d/y)	Time call received	Staff receiving call	Details	Name of suspected facility?	Address	County	Township	Section	Q/Quarter section	Type of animals at suspected facility?	Where were you when odor noticed?	Time of day odor noticed? (am/pm)	Were the odors? continuous, intermittent, or fleeting
1	5/15/96	2:15pm	H. Siddens		Exetare		Yellow Medicine	Tyro	34 & 35		hogs	in yard		
2	8/1/96	3:00	H. Siddens		Waldo Petersen- Sale barn located in city limits.		Yellow Medicine				hogs & cattle	in house and yard		continuous
3	8/1/96		H. Siddens		Dennis Engels and Wallace Engels		Lyon	Westerheim	35		hogs		Evenings and when the weather is changing	
4	9/4/96	4:00	H. Siddens		Farm 1 mile North of Vesta		Redwood				hogs			
5	9/4/96	6:13pm	DO8		?	1 mile north of Vesta	Redwood				hogs		4:00pm	
6	9/25/96	9:27	Paul; forwarded from Dave Nelson		VALADCO (Lipert site)		Renville	Norfolk	27		hogs	inside house	Sep 16, 1996; first thing in the morning, 6-7:00	intermittent
7	10/18/96	approx 1:00 pm	R. Leaf		Roger Kingstrom (sp?) did not track down file		Renville				10 - 12 hog barns	inside house and outside front door	Calendar of three monthsof odors, was unbearable today.	
8	10/29/96	1:00	D. Nelson		ValAdCo (lippert site)		Renville	Norfolk				In yard NW of facility	Odors started at 6:00	hasn't left
9	12/6/96	10:25	K. Brynildson		Roger Kingstrom MPCA-I 1157(A)R		Renville	Winfield	36	SE/NW	Hogs - Lagoon system			
10	12/20/96	3:05	D. Nelson		ValAdCo Lippert site		Renville	Norfolk	27	SE	Hogs, lagoon system	in house	odors are bad in house even with charcoal filters	since 6:00 AM
11	1/2/97		D. Nelson		ValAdCo Tisdale site		Renville	Norfolk	29		Hogs	in house		
12	1/2/97		D. Nelson		ValAdCo Lippert site		Renville	Norfolk	27		hogs	in house		
13	1/21/97		Paul: referred from Pat Mader		ValAdCo - "both sites"		Renville	Norfolk	27 & 29		hogs	in house	evening of 1/20/97; worst at 11 am on 1/21/97	N/A
14	3/5/97	2:00	David Nelson		ValAdCo		Renville	Norfolk	27 & 29		hogs	house		
15	3/26/97	9:30	Pete S.		Paul Maney		Mower	Windom	15		hogs	outside	all day	continuous

MPCA Odor Log

Complaint No.	How long did odors continue?	Intensity of the odors?	Prevailing wind direction?	Wind speed?	Air temperature during occurrence?	Relative Humidity?	Barometric pressure? (rising or falling)	Any unusual activity? (e.g. land appl)	Monitoring results if taken?	Have you reported this problem before?	Comments
1											
2	all day										horrible odors, fly problems, and dead animals
3			from SE								
4			from South					cleaning pits			
5	9/4/96	unlivable	so.								apparently hog farm is cleaning hog pit, wind from the south is making the smell unliveable.
6	contiued all day Monday and onto Tuesday; got worst on Wed, Thurs the same, Friday off and on in am, pm wind changed then cattle odors	Mon & Tue - bad, Wed & Thur the worst, Fri - bad (not home over the weekend)	Mon & Tue - E wind, Wed & Thur - SE wind, Fri - S wind in am, N wind in pm	5 - 10 mph (estimate)	65, 31.5 baro, hum 49%, wind speed 5 10mph	49%	31.5 (N/A)	none noted	no	yes	blacked out at 2:00, first time this season, for approx a minute, could not see, after ~10 min back to 'normal', headaches, shakey, nauseated, sinuses blocked, diaerreha, all kids at daycare affected
7	Refer to calendar (available upon request)								(60 ppb outside fr door)	No	Husband too upset to call, but very bad for him too.
8	All day	Very bad	From SE	est 10 - 15	45					yes	Kids removed from house.
9	December 3 and Dec. 6 - Thought odors would decrease with winter months, but they have not.				20 -30 F					yes	
10	All day	Very bad, a major problem when shoveling snow.		10 - 15 mph	4 - 7 F	44 % in the house				yes	Daughter Kimberly does not feel good, says tummy hurts and is sleeping. Very unlike her. No one else there due to snow conditions. Back of legs hurt, hard to breathe, nose burns and face and hands are itchy. Headaches. Sinus blocked. Sewer smell.
11	26-Dec	Feels better when leaves the home for a while								yes	terrible headache, daughter has been sick, encouraged to call Rita Messing of MDH
12	12/27 - 12/31	Feel better when wind shifts								yes	" "
13	1/20 - 1/21	Very bad at 11 am	no wind (1/21/97)	no wind (1/21/970	40 F outside;68 F inside	22% inside	29.3 inside	none given	N/A	yes	kids/adults headache-stomach upset
14										yes	Also passed on complaints about Watonwan Feeder Pig, and the "Johnson facility in Renville County" She wants to ensure that her family has protectioin from nasal legions and mentioned evidence of health concerns at 2 ppb.
15	days	very bad								no	it stinks

MPCA Odor Log

Complaint No.	Staff lead	Action Taken:	Results of investigation:	Source contacted on:
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14		She specifically requested letters to facilities that had citizen monitoring to let them know that they have a problem. Also wanted liquid level measurements in lagoons		
15				

MPCA Odor Log

Complaint No.	Date Call Received (m/d/y)	Time call received	Staff receiving call	Details	Name of suspected facility?	Address	County	Township	Section	Q/Quarter section	Type of animals at suspected facility?	Where were you when odor noticed?	Time of day odor noticed? (am/pm)	Were the odors? continuous, intermittent, or fleeting
16	4/3/97	2:30	Jim Sullivan		Paul Meaney		Mower	Windham	15		hogs	outdoors	all day	continuous
17	5/7/97	2:30	David Nelson		Jerome Forrest		Nicollet	N. Mankato ?			hogs	in house and yard	any time	intermittent
18	6/5/97		Ron Leaf- forwarded to Paul		Holden Farms	Not Falling Brook,Twin Oaks?	Rice	Northfield	either 21 or 17		hog	driving by in car, south of the site	12:00pm	N/A
19	6/10/97	am	Ron Leaf		ValAdCo	Sect 27 &/or 29	Renville	Norfolk	27/29		hogs	at house		
20	6/11/97	10:30	David Johnson		Beet Plant; ValAdCo	Crooks twp	Renville	Crooks			hogs, beet processing	in house	evening hours	continuous
21	6/11/97		Paul - from Holly		ValAdCo		Renville	Crooks	30	Sw 1/4	hogs	home		
22	6/11/97		Paul - from Holly		Christianson Farms		Lincoln	Marble	22					continuous
23	6/14/97	9:18pm			ValAdCo		Renville	Norfolk	27		hogs	home	early am or late pm	
24	6/15/97	late night	ron leaf		Churchill	Section 22	Renville	Brookfield	22		hogs	house	west wind	
25	6/15/97	8:34pm			ValAdCo		Renville	Norfolk	27		hogs	home	noon	
26	6/16/97	am	Jim Sullivan		Neal Johnson	Section 15, 23,22	Renville	Hector	15,22,23		hogs	house/field	all the time	wind direction dependant
27	6/20/97	am	Ron Leaf		Holden, Pine Grove	21	Rice	Northfield	21		hogs	home	s-sw wind	
28	6/21/97	pm	Randy Ellingboe		Scherping - Metro Farms		Wright	Woodland			dairy cows			
29	6/24/97	am	Ron Leaf		?	near Hector	Renville							
30	6/24/97	am - 7/1	Randy Ellingboe		Churchill Co-op		Renville	Brookfield	22		hogs	house	pm	
31	6/25/97	am - 7/1	Randy Ellingboe		Churchill Co-op		Renville	Brookfield	22		hogs	house	pm	
32	6/25/97	am	Jim Sullivan		?	Waldorf	Waseca	?	?	?	hogs	house/car	all the time	wind direction dependant
33	6/26/97	am - 7/1	Randy Ellingboe		Churchill Co-op		Renville	Brookfield	22		hogs	house	all day	
34	6/30/97	am	David Johnson		ValAdCo		Renville	Norfolk	27		hogs	house/out	all the time	wind direction dependent
35	6/30/97	am	Ron Leaf		Flora Twp. site		Renville	Flora	6		hogs	home	all day	
36	6/30/97	am	Paul:forwarded from Beth Lockwood		Jerry Endeson	Fergus Falls	Otter Tail			N/A	900-1000 cattle	N/A	am	N/A
37	6/30/97	am	Paul:forwarded from Beth Lockwood		Pristine Pork	N/A	Roseau	N/A	24	N/A	hogs	N/a	am, every monring	N/A
38	6/30/97	am	Paul - from Beth Lockwood		Pristine Pork		Roseau		24		hogs	home	am every morning	continuous

MPCA Odor Log

Complaint No.	How long did odors continue?	Intensity of the odors?	Prevailing wind direction?	Wind speed?	Air temperature during occurrence?	Relative Humidity?	Barometric pressure? (rising or falling)	Any unusual activity? (e.g. land appl)	Monitoring results if taken?	Have you reported this problem before?	Comments
16	last few days	very bad	wind from S	n/a	around 60	n/a	n/a	_ots of flies	n/a	no	worst in 16 years; also concerned about MOPRO
17	every time wind is from that direction	terrible. Feels sick and hard to live with.						no		yes, many times	Terrible. Hard to live with. Head aches and feel sick.
18	odor stayed in car for a period of time after passing the site, windows down	overwhelming, different smell then normal	out of the North? south of lagoon when smelled odor	strong winds	approx. 70	n/a	n/a	no	n/a	no	drive by this site reasonably often, have smelled this site before, but this bad, thishas been the worst occurrence
19	It stinks as of 6/6 through 6/11 odors									yes	
20	4 days	very strong	ENE	light to strong winds	50 night ,75 day	n/a	n/a	no	n/a	many times have spoken with city of Renville	people not feeling well, says kids are getting sick from smell
21	since 6/7		SE								Husband is on oxygen. Spraying W/airplane. Irrigating.
22			SE								Constant smell. Headaches -nauseous sinus infections
23	past 2 weeks	terrible odor									Has talked to Ron Leaf . What is being done?
24	wind dependent	very bad at night, headaches	west	light						not to pca	also tried to call managers and consultant
25		terrible odor									Odor is so bad that the wife gets diarrhea. Called county Commissioner. When will something be done?
26	days	very strong	West and north	light	60 night 80 day	n/a	n/a	no	no	no	Migrant workers refuse to work in the fields and son had to sell house and move because of the odor
27											
28		high									
29			west to southwest								
30	afternoon	bad	easterly							yes	headaches, nose stuffed-up
31	all night	bad	easterly							yes	bad all next day, too
32		very bad Shuts down the house									This is from the Stroebel (FAST) farm
33	all day	bad	easterly							yes	
34	wind dependent	very strong	all directions	light	65night 85day	n/a	n/a	no	no	yes	this is 4th year, says nothing being done.
35	sat/sun 6/28 and 6/29 all day, 6/30 am	very strong									took report from phone message
36	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	yes - to Mark Steuart (DL)	There are 900-1000 head of cattle; has had cattle for 30 years and claimed manure has never been hauled away.
37	daily; June 27, 28, 29, 30	very intense, especially a problem when there are temp inversions	SE on Jun 27-29, SW on Jun 30.	N/A	70 deg, temp inversion on Jun 27, 28, 29; overcast on the 30th	high humidity	N/A	N/A	N/A	yes - to Mark Steuart (DL)	Has kept a log of odors, Jun 27-30; started marking problems on calendar since May; claims facility has not emptied their tanks, almost full only 4' to go in tank
38	since May	very intense	SE wind		70 degrees	high					Odor every am. Especially a problem when there are temp. inversions. Facility hasn't emptied tanks; almost full; only 4' to go in tank.

MPCA Odor Log

Complaint No.	Staff lead	Action Taken:	Results of investigation:	Source contacted on:
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28	RLE			
29				
30	RLE			
31	RLE			
32				
33	RLE			
34				
35				
36				
37				
38				

MPCA Odor Log

Complaint No.	Date Call Received (m/d/y)	Time call received	Staff receiving call	Details	Name of suspected facility?	Address	County	Township	Section	Q/Quarter section	Type of animals at suspected facility?	Where were you when odor noticed?	Time of day odor noticed? (am/pm)	Were the odors? continuous, intermittent, or fleeting
39	6/30/97	am	Paul - from Beth Lockwood		Jerry Endeson's Feedlot			Fergus Falls			900 - 1,000 cattle			
40	7/1/97	1:30 PM	Kim Brynildson		Jerome Forst		Nicollet				hogs	house	all the time	
41	7/1/97	p.m.	David K. Johnson		?	Waldorf	Waseca	?	?	?	hogs	house/car	all the time	?
42	7/1/97		Ron Leaf		ValAdCo		Renville	Norfolk	27 & 29		hogs	home	all day	wind depd.
43	7/1/97		Ron Leaf		ValAdCo		Renville	Norfolk	27/29		hogs	home	"	"
44	7/1/97		Ron Leaf		ValAdCO		Renville	Norfolk	?		hogs	home		
45	7/2/97	am	Ron Leaf		ValAdCo		Renville	Norfolk	27/29		hogs	home	wind depd	"
46	7/2/97	9:25am			Neil Johnson Farm	Rt 2 Box 184	Renville	Hector			hogs	home		intermittent
47	7/8/97	am	Ron Leaf		ValAdCo		Renville	Norfolk	27/29		hogs	home	all day	continuous
48	7/8/97	am	Ron Leaf		ValAdCo		Renville	Norfolk	27/29		hogs	home	all day	continuous
49	7/11/97	1:30pm	Paul - from Beth Lockwood		Gerhart Farm Hog Works (Robert Gerhart)	Rt. 1, Box 203AA	Martin	Welcome			hogs	home		
50	7/14/97	am	Jerry H. forwarded to Ron Leaf		Gerhart Farm Hog Works	R 1, Box 203AA, Welcome	Martin				hogs	town of Ceylon		
51	7/16/97	9:05am	Paul - from Beth Lockwood		Pristine Pork		Roseau	Malung	24			home		
52	7/16/97	1:07pm	Paul - from Beth Lockwood		Pristine Pork		Roseau	Malung	24					
53	7/16/97	6:20am	DO7		Golden Oval	340 Dupont Ave.	Renville	Renville			chicken	home	5:30am	continous
54	7/17/97	8:55am	Paul - from Beth Lockwood		Jerome Forest Farm	RR 2	Nicollet	Gibbon			hogs			
55	7/17/97	9:00am	Paul - from Beth Lockwood		hogs?beet plant?chickens?		Renville				hogs	home		
56	7/18/97	2:30 PM	Kim Brynildson		Several sites located around Ceylon - Gerhart Farms north of town		Martin				hogs	town of Ceylon	all times of day	continuous
57	7/18/97	2:00pm	Holly		ValAdCo		Renville				hogs	home		
58	7/21/97	2:05pm	Ron L.		?									
59	7/22/97	9:00 AM	Paul - from Beth Lockwood		Shady Farm	7 mi. S. of Renville	Renville				hogs	home	7-20 & 7-22pm	

MPCA Odor Log

Complaint No.	How long did odors continue?	Intensity of the odors?	Prevailing wind direction?	Wind speed?	Air temperature during occurrence?	Relative Humidity?	Barometric pressure? (rising or falling)	Any unusual activity? (e.g. land appl)	Monitoring results if taken?	Have you reported this problem before?	Comments
39											Feedlot has had cattle for 30 years and has never hauled away any manure.
40		very strong, headaches						no		yes	Has enclosed deck with glass and changed duct work in house to keep odors out. Last fall he passed out. Is considering legal action against owner or county for permitting site. Has lived here 48 years and does not think he should be the one to move.
41	?	very bad seems to come thru walls	?	?	?	n/a	n/a	?	?	yes	took report from phone message
42	wind depd.	stinks								yes	"it still stinks here" phone message
43	"	very bad/horrible	from SE							yes	also bad on the 26th,27,28,29,30th of June
44										?	message on voice mail
45	"									yes	has calendar log of June and July
46			west wind							yes	Complaintant & neighbors have attended several meeting re: this odor. Has been reported several times over last 2 years.
47		very bad		light		rain				yes	very bad last sunday during the rain. Located down slope of facility; drains to home.
48			from SE	light						yes	it reeks
49											Has developed allergies & has gone to Rochester with her health problems. Waste is washing into lake and streams. Water from tap smells.
50											Concerns of odors affecting health
51											When wind is calm - odor is everywhere - when wind is blowing - odor follows the wind direction.
52											7/6 - 7/16 has dates and times of odor. Has been keeping track.
53		foul odor									foul odor from a chicken farm. Also, a fly problem
54		very bad	SE								When there is SE wind the hog smell is very bad.
55		strong odor									Strong odor - thins it comes from stinky water being sprayed on fields.
56		very bad	From NW	light	85 - 90 degrees	high					Odors are affecting health - alergies diagnosed in Rochester
57		worse than ever									Nauseating - worse than ever. Hope that something is being done. Also said that beet plant was horrible.
58	7/20/97										Location - mile marker 139 on I90
59											

MPCA Odor Log

Complaint No.	Staff lead	Action Taken:	Results of investigation:	Source contacted on:
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				

MPCA Odor Log

Complaint No.	Date Call Received (m/d/y)	Time call received	Staff receiving call	Details	Name of suspected facility?	Address	County	Township	Section	Q/Quarter section	Type of animals at suspected facility?	Where were you when odor noticed?	Time of day odor noticed? (am/pm)	Were the odors? continuous, intermittent, or fleeting
60	7/22/97		Paul T. - from Holly S.		Shady Farms	7 miles S. of Renville	Renville				hogs		evening 7/20 & morning 7/22	
61	7/23/97		Paul T. - from Rick Strassman		unknown	City of Renville	Renville				hogs	in town of Reville	eveing	
62	7/24/97		Paul T. - from Rick Strassman		Jerome Forst		Nicollet	Weston			hogs			
63	7/27/97	4:20pm	Dave Nelson		ValAdCo		Renville	Norfolk	27/29		hogs	home	virtually every evening	continuous
64	7/30/97		Paul T. - form Ron L.		Jerome Forst		Nicollet	Weston			hogs			
65	8/4/97		Paul T.		Buffalo Run		Waseca	Otesco	13		hogs	home	all times	contiuous
66	9/5/97	2:45p.m.	Dave J.		Neil Johnson	Cty rd 22 N of 212 between sec 22 ,23 and 15	Renville	Hector	22,23,15		hogs	home	am/pm	continuous
67	9/18/97				Swine Complex, Inc		Rock	Springwater			hog	home		
68	10/1/97		Jim Sullivan		Robert Schemel		Renville				hogs			
69	10/6/97	830am	Ron L.		Robert Dahlheiner	Hwy 44 towards Farhaven?	Stearns				Dairy	home	all day	all day
70	10/6/97	1100am	Ron L.		Scherping Farms/Metro Dairy		Wright	Woodland	15?		dairy	home	day	most days some nights
71	10/6/97	1140am	Ron L.		Scherping Farms/Metro Dairy		Wright	Woodland	15?		dairy	home	day	
72	10/6/97	130pm	Ron L.		Scherping Farms/Metro Dairy		Wright	Woodland	15?		dairy	home	day/night	worse in am and late pm
73	10/27/97		Randy E.		Watonwan Co. Fdr Pig Co-op	Lewisville	Watonwan	Fieldon	26	SW	Hogs		on 10/24/97	continuous
74	10/29/97		Jim Sullivan		Halquist dairy/Jim Kuhl		Carver	San Francisco			Dairy/Hogs			continuous
75	10/30/97		Jim Sullivan		Dennis Magnussen		Freeborn	Newry	35		Hogs	Home		continuous
76	10/30/97		Jim Sullivan		Swine Complex, Inc		Lincoln	Marble	27		Hogs	Home		
77	11/24/97		Jim Sullivan		Metro Dairy	Winstead	Wright				Dairy		late afternoon	
78	12/16/97		Jim Sullivan		Metro Dairy	Winstead	Wright				Dairy		late afternoon	
79	12/18/97		Jim Sullivan		Dennis Wilson	Cherry Grove	Fillmore	York	15		Hog	home	throughout the day	
80	12/18/97		Jim Sullivan		Robert Schmezing		Blue Earth	Vernon Center			Hog	Home/school	continuous	
81	12/22/97		Jim Sullivan		Valadco - Lippert Site		Renville				Hog	home		
82	12/25/97		Jim Sullivan		FAST Development		Waseca				Hog	home		
83	7/21 & 30/97		Paul T.		Sherping Dairy		Wright	Woodland	15		dairy	home	late pm	

MPCA Odor Log

Complaint No.	How long did odors continue?	Intensity of the odors?	Prevailing wind direction?	Wind speed?	Air temperature during occurrence?	Relative Humidity?	Barometric pressure? (rising or falling)	Any unusual activity? (e.g. land appl)	Monitoring results if taken?	Have you reported this problem before?	Comments
60		bad									referred to Region 4 from AQCES by Schnick_S
61		heavy stench on town									
62			SE wind								
63	all evening	could cut it with a knive								yes	Generally disatified with our efforts
64		bad	SE wind								
65			calm					spreading manure, 500' aaway from property			using land not on permit, injecting but not all getting into ground
66	July 8, 20, 21, 22, 27, 28, 29 and 14 days in August	strong odor	No.	no wind / light wind	70's and up	humid	falling	no		no	When wind is from the north, particularly bad.
67											
68											
69	most of summer has been bad	unbearable								no	lives 2 miles from facility. Is not alwasy detecable at this location, but can smell it when the condiitons are right.
70	all summer, worse last couple weeks	have to keep windows closed	se	worse with more wind, very bad at calm nights	70					yes	very good to talk to live person instead of VMail, also wants us to look into the culvert at this site draining into/out of the ditch. The ditch is dry this year instead of full of water.
71	all summer									no	voice mail messsage
72	all summer, worse over 24-26 of Sept. and Sept 30. and this weekend 10/3-10/5									?	odor plume sits in a low area to the wwest of the basins
73								Lagoon reconstruction		yes	Jim Sullivan coincidentally out within 2 days of event
74											Will have to continue monitoring to determine a response.
75											may be some water quality issues associated with this facility
76											Responded to compliant - no odor present at time of visit
77											
78											
79											
80											
81											
82											
83		bad in the middle of the night, had to shut windows	west					emptying manure, semi trucks holding solids last week, diggers/equipment doing repair work		yes	14th really bad, ammonia smell,

MPCA Odor Log

Complaint No.	Staff lead	Action Taken:	Results of investigation:	Source contacted on:
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				

MPCA Odor Log

Complaint No.	Date Call Received (m/d/y)	Time call received	Staff receiving call	Details	Name of suspected facility?	Address	County	Township	Section	Q/Quarter section	Type of animals at suspected facility?	Where were you when odor noticed?	Time of day odor noticed? (am/pm)	Were the odors? continuous, intermittent, or fleeting
84	7/25/97-7/27/97	9:00 AM	David Johnson		Gerhardt Farms	Ceylon	Martin	Lake Belt	29		hogs	town of Ceylon	all day	continuous
85	8/7 & 8/1997		Paul T. - form Ron L.		Jerome Forst		Nicollet	Weston			hogs			
86														
87														
88														
89														
90														
91														
92														
93														
94														
95														
96														

MPCA Odor Log

Complaint No.	How long did odors continue?	Intensity of the odors?	Prevailing wind direction?	Wind speed?	Air temperature during occurrence?	Relative Humidity?	Barometric pressure? (rising or falling)	Any unusual activity? (e.g. land appl)	Monitoring results if taken?	Have you reported this problem before?	Comments
84	all weekend	very bad	from NW	breezy	85-90 degrees	high				yes	She and husband feel ill from fumes coming from hog farm
85		terrible	SE wind								"what is being done"
86											
87											
88											
89											
90											
91											
92											
93											
94											
95											
96											

MPCA Odor Log

Complaint No.	Staff lead	Action Taken:	Results of investigation:	Source contacted on:
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				
96				

SF-00006-05(4/86)

DEPARTMENT: POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE: December 19, 1997

TO: Peder A. Larson
Commissioner

FROM: Michael J. Sandusky 12/19/97
Acting Division Manager
Air Quality Division

PHONE: 296-7331

SUBJECT: Request for Approval of Measurement Method for Hydrogen Sulfide

Pursuant to Minn. R. 7009.0060 (1995), the Minnesota Pollution Control Agency (MPCA) staff is requesting approval from the Commissioner for two alternative measurement methodologies for determining compliance with the ambient air quality standards for hydrogen sulfide. The discussion below addresses the need for a measurement methodology for hydrogen sulfide, the requirements of Minn. R. 7009.0060, and the rationale for the MPCA staff's recommendation as to the selection of two alternative measurement methodologies. The two recommended methods are described on pages 6-7 of this memorandum.

BACKGROUND

The MPCA has adopted ambient air quality standards for hydrogen sulfide. Minn. R. 7009.0080 establishes the following ambient standards for hydrogen sulfide:

Pollutant/Air Contaminant	Primary Standard	Secondary Standard	Remarks
Hydrogen Sulfide	0.05 ppm by volume (70.0 micrograms per cubic meter		1/2 hour average not to be exceeded over 2 times per year
	0.03 ppm by volume 42 micrograms per cubic meter		1/2 hour average not to be exceeded over 2 times in any 5 consecutive days

There is no federal ambient air quality standard for hydrogen sulfide, and, as a result, the U. S. Environmental Protection Agency (EPA) has not established measurement methods for determining compliance with hydrogen sulfide ambient air quality standards.

Because there is no federally-established measurement method, the MPCA was not able to establish a measurement method for hydrogen sulfide by referencing federal regulations, as the MPCA has done with respect to ambient air quality standards for pollutants other than hydrogen sulfide (see Minn. R. 7009.0050, Measurement Methodology, Except for Hydrogen Sulfide). Instead, the MPCA rules provide for establishment of a measurement method for hydrogen sulfide through the approval of the MPCA Commissioner. Minn. R. 7009.0060 provides:

> For hydrogen sulfide, measurements made to determine compliance with the standards shall be performed in accordance with any measurement method approved by the commissioner. The commissioner shall approve a measurement method where the sensitivity, precision, accuracy, response time, and interference levels of the method are comparable to that of the measurement methods for the other pollutants described in part 7009.0050; and when the person seeking to take the measurement has developed and submitted to the agency a quality assurance plan that provides operational procedures for each of the activities described in Code of Federal Regulations, as amended, title 40, part 58, appendix A.2.2., Quality Assurance Requirements for State and Local Air Monitoring Plans.

Up to this time, MPCA staff had not officially submitted to the Commissioner for approval a measurement methodology for hydrogen sulfide. Hydrogen sulfide is a member of a class of compounds known as the "reduced sulfur gases." For many years, the MPCA staff has routinely conducted monitoring for reduced sulfur gases as an undifferentiated class of pollutants. However, recently there has been an increased interest in monitoring ambient concentrations of hydrogen sulfide due to odor complaints that the MPCA has received with respect to large animal feedlots, which have proliferated over the last few years. Hydrogen sulfide is the most prevalent reduced sulfur gas produced by anaerobic decomposition of biological wastes (producing the classic "rotten egg" smell). Also, in the 1997 session of the Minnesota Legislature, the MPCA has been specifically directed to conduct hydrogen sulfide monitoring in connection with feedlots, including appropriate use of portable monitoring equipment. Minn. Stat. § 116.0713 (Supp. 1997). Hydrogen sulfide emissions are also a concern in other industries, including wastewater treatment, pulp and paper, and the oil and gas industry. Therefore, there is a need for the MPCA to have an approved measurement methodology for hydrogen sulfide.

DEVELOPMENT OF THE RECOMMENDATION FOR MEASUREMENT METHODOLOGIES FOR HYDROGEN SULFIDE

In developing a recommendation for measurement methodologies for hydrogen sulfide, the MPCA staff has had to deal with three practical limitations that make selecting a method somewhat difficult. These three practical limitations are discussed below.

First, the ambient air quality standards for hydrogen sulfide, Minn. R. 7009.0080, specifies two time periods in which only two excursions above the specified 30 minute average value are allowed; these are periods of five consecutive days for the .03 parts per million (ppm) number and one year for the .05 ppm number. This means that the compliance method must be able to monitor all (or an acceptably high percentage) of the 30 minute periods during the two mentioned time frames. This requirement limits measurement methodology choices to automated, continuously running monitors. Other methods, such as those used for workplace compliance, that can assess only shorter time periods of a few hours, may miss an exceedence and therefore not be able to demonstrate whether compliance at the site has been achieved. Therefore, in developing its recommendation, MPCA staff searched for automated, continuously running measurement methodologies for hydrogen sulfide.

Second, Minn. R. 7009.0060 requires the Commissioner to approve a method "comparable to that for other pollutants described in part 7009.0050." Minn. R. 7009.0050 pertains to "all ambient air quality standards except hydrogen sulfide," which consist of the pollutants known as "criteria pollutants:" ozone, carbon monoxide, hydrocarbons, sulfur dioxides, particulate matter, nitrogen dioxides, lead, and PM_{10}. All of these criteria pollutants are regulated by EPA, and EPA has adopted regulations governing measurement methodologies for them. (See Code of Federal Regulations references in part 7009.0050.) The EPA measurement methodologies for criteria pollutants were developed through exhaustive engineering and research, as EPA treated the need to develop monitoring methodologies for these pollutants as a national priority. Because there is no federal ambient air quality standard for hydrogen sulfide, EPA did not develop a federal reference measurement method for it. Thus there are no measurement technologies for hydrogen sulfide in existence which are exactly comparable to the federal measurement methods for criteria pollutants. However, the MPCA staff interprets the word "comparable" as used in Minn. R. 7009.0060 to mean "comparable insofar as is technically possible at this time." This interpretation is reasonable, because at the time the MPCA adopted part 7009.0060, the MPCA knew that hydrogen sulfide was not federally regulated and did not have a federally developed monitoring methodology. Therefore in developing its recommendation, the MPCA staff looked for measurement methodologies for hydrogen sulfide that are comparable, insofar as is technically possible at this time, to federal measurement methodologies for criteria pollutants.

Third, hydrogen sulfide is a member of a class of compounds known as the "reduced sulfur gases." The term "total reduced sulfur" (TRS) includes all of the reduced sulfur compounds which may be present in polluted air, including mercaptans and other non-oxidized sulfur gases. There are in existence reliable methods for measuring TRS, and the MPCA has routinely monitored for TRS as an undifferentiated class of pollutants. However, monitoring for compliance with hydrogen sulfide ambient air quality standards means measuring only one reduced sulfur gas from a mixture of several other types of reduced sulfur gases present in TRS. At this time there are very few continuous monitoring methods with hydrogen sulfide selectivity and adequate accuracy that are available. Monitoring for hydrogen sulfide by utilizing a TRS measurement method is currently the most widely used, not only at the MPCA, but nationally.

This measurement method involves the use of one of several available types of sulfur dioxide monitors equipped with a sulfur dioxide scrubber and a TRS thermal oxidizer. Although the MPCA staff recognizes that TRS monitoring measures more than just hydrogen sulfide, the staff believes that this measurement methodology is useful for hydrogen sulfide monitoring, as discussed below.

In developing a recommendation the MPCA staff has examined the existing methods for measuring hydrogen sulfide and how they conform to the requirements of Minn. R. 7009.0060. The methods assessed are: 1) the TRS measurement method; 2) the sensitized tape monitor developed by MDA Scientific; and 3) the Arizona Instruments "Jerome" 631-X portable monitor. Each of these methods is discussed below.

1. TRS Measurement Method.

MPCA has many years of experience with TRS monitoring at various locations. The MPCA owns the equipment for this measurement method, as do many companies and other governmental entities. This method uses an EPA-approved criteria pollutant monitor for sulfur dioxide with the addition of a sulfur dioxide scrubber and a thermal oxidizer. The equipment for the method is very reliable and of high quality. It operates with excellent stability, precision, and accuracy. As such, the performance of this system for monitoring hydrogen sulfide is the most comparable to that of the measurement methods for criteria pollutants with the exception of the "interference level" component. This method does not separate hydrogen sulfide from other TRS gases which may be in the air. If hydrogen sulfide is present, it is detected, but if other TRS gases are also present, they will also be measured as a part of the total response. If one is interested only in hydrogen sulfide, the response to other reduced sulfur gases introduces a "positive bias" in the hydrogen sulfide data.

The TRS measurement method is still useful for measuring hydrogen sulfide even with the above-described positive bias because hydrogen sulfide is the most likely of the TRS gases to be found in the ambient air. Hydrogen sulfide is a true gas with a boiling point of -60.2 degrees Centigrade (C). Methyl mercaptan, the next lightest TRS gas, boils at +6.0 degrees C. The other TRS gases have even higher boiling points and would need elevated temperatures to be present in the ambient air in large amounts (although it should be noted that very small volumes of these gases in ambient air may be problematic, at least from a nuisance perspective).[1]

Therefore "total" reduced sulfur detected through monitoring is likely to include mostly hydrogen sulfide. Thus, although one cannot say with certainty that the TRS measured by this

[1] The higher temperatures and highly reducing atmospheres needed to form and volatilize the heavier TRS gases are not found in typical biological waste sources such as lagoons or manure storage tanks. They are found in the pulp and paper industry in various digesters and cookers for the breaking down of pulp fiber. Heavier TRS gases have been found in significant concentrations in emissions from the pulp and paper industry. The pulp and paper industry has recognized the problem nature of TRS emissions and has dedicated serious effort to their reduction without much regard to the individual TRS compounds present in their emissions.

method correlates 100 percent with the presence of hydrogen sulfide, nevertheless the TRS monitoring results are useful in making determinations regarding compliance with hydrogen sulfide ambient air standards.

It is also possible to show compliance with the hydrogen sulfide ambient air quality standards with this method. If the equipment is operated over the specific period of time and there is no TRS response above the ambient air quality standards, one can determine that the standard has not been exceeded since the hydrogen sulfide component cannot be greater than the whole (TRS).

The MPCA staff believes that the use of an EPA-approved ambient sulfur dioxide monitor, equipped with a sulfur dioxide scrubber and a TRS oxidizer, to measure ambient concentrations of hydrogen sulfide constitutes a measurement method that is comparable, insofar as is technically possible at this time, to federal measurement methodologies for criteria pollutants. Therefore, as set forth in the "Recommendation" section of this memorandum, the MPCA staff is recommending that the Commissioner approve this method for monitoring hydrogen sulfide.

When using this method for measuring hydrogen sulfide, measurements of TRS will be regarded as an acceptable "surrogate" for hydrogen sulfide. If the monitoring results demonstrate any excursions above the hydrogen sulfide ambient air quality standards, compliance will be achieved by working to reduce TRS emissions (principally hydrogen sulfide) so as not to exceed the ambient air quality standards.

2. MDA Scientific Sensitized Tape Monitor.

During the course of examining various TRS measurement methods, the MPCA staff has evaluated the MDA Scientific "Chemcassette®" toxic gas system for measuring hydrogen sulfide. MDA Scientific is part of Zellweger Analytics, Inc. This is the only system that the MPCA staff has found for continuous hydrogen sulfide monitoring for which the manufacturer claims total specificity for hydrogen sulfide and which also has adequate sensitivity for .003 ppm (3 parts per billion (ppb)) or less. The MPCA has purchased and evaluated two of these units. The system is fully automated and suitable for long-term unattended operation. It is also available with a portable (direct current powered) option, (Model SPM) which greatly simplifies monitoring logistics.

The "Chemcassette®" system uses a sensitized paper tape to monitor hydrogen sulfide by a color change reaction. The manufacturer acknowledges that this method is sensitive to the moisture content of the ambient air and to minor production variations in the tape itself. The manufacturer claims accuracy within 25 percent for its portable sampler, as compared with the MPCA's 10 percent quality assurance limit for criteria pollutant monitors. As such, the accuracy of the system is not as "comparable" to that of the criteria pollutant monitors as one would like. However, based on examination of this system, the MPCA staff believes that proper attention to

the humidity effects and the application of a rigorous quality assurance program (such as that operated by the MPCA) will address theses deficiencies. Therefore the MPCA staff believes that the use of the MDA Scientific "Chemcassette®" system to measure ambient concentrations of hydrogen sulfide constitutes a measurement method that is comparable, insofar as is technically possible at this time, to federal measurement methodologies for criteria pollutants. Thus, as set forth in the "Recommendation" section of this memorandum, the MPCA staff is recommending that the Commissioner approve this method for monitoring hydrogen sulfide.

3. The "Jerome" Portable Monitor.

Another system the MPCA has evaluated for the assessment of TRS gases is the Arizona Instruments "Jerome" 631-X portable monitor (Jerome meter). The Jerome meter does not measure hydrogen sulfide exclusively and will respond in varying degree to other TRS gases. The MPCA has purchased four of these units to assist in source evaluation. The Jerome meter is a truly portable, hand-held monitor with excellent sensitivity for ambient survey work. The monitor is not a true continuous monitor but is designed for spot monitoring for up to a few hours at a time with an attendant operator. As such, the data collected by this monitor is totally dependent on the operator's choice of when to conduct monitoring.

It is not possible to use this method to monitor all 30-minute intervals of the period of time required in Minn. R. 7009.0080, the rule establishing ambient air quality standards for hydrogen sulfide. Periods of high concentrations, such as nighttime or under specific weather conditions, may easily be missed with this type of monitor. As such, this unit cannot be used for demonstrating compliance with ambient air quality standards for hydrogen sulfide. Therefore, the Jerome meter is <u>not</u> comparable to federal measurement methodologies for criteria pollutants and the MPCA staff does not recommend approval of this method for monitoring hydrogen sulfide for compliance with ambient air quality standards.

RECOMMENDATION

The MPCA staff recommends that the following two methods be approved by the Commissioner pursuant to Minn. R. 7009.0060 for measuring concentrations of hydrogen sulfide in the ambient air. It should be noted that both methods must be operated in a continuous fashion so as to capture as valid data at least 75 percent of all possible 30 minute periods in one year. The 30 minute periods will start at the beginning of the hour and the half-hour and averaged as 30 minute blocks.

<u>Option 1:</u> The use of an ambient air quality monitor for sulfur dioxide, approved by the EPA, as set forth in the Code of Federal Regulations, Volume 40, part 53, operating with a designated full scale range of 500 ppb or less, together with a thermal oxidizer to convert reduced sulfur gases to sulfur dioxide. Before making the measurement, the person seeking to make the measurements must develop and receive MPCA approval of a Quality Assurance Plan that provides operational procedures for each of the activities described in Code of Federal Regulations, title 40, part 58,

appendix A.2.2. The following operational checks must be performed on a periodic basis as part of the Quality Assurance Plan:

(1) The thermal oxidizer must be demonstrated by the user to operate at an efficiency of 98 percent or better in the conversion of hydrogen sulfide to sulfur dioxide in an ambient air matrix at the operational flow rate of the monitor. This conversion efficiency must be demonstrated at a hydrogen sulfide input of at least 80 percent of full scale.

(2) A scrubber for the removal of ambient sulfur dioxide must be incorporated ahead of the thermal oxidizer. This scrubber must be shown to remove at least 98 percent of sulfur dioxide input up to 80 percent of full scale without affecting the concentration of hydrogen sulfide in the incoming sample stream.

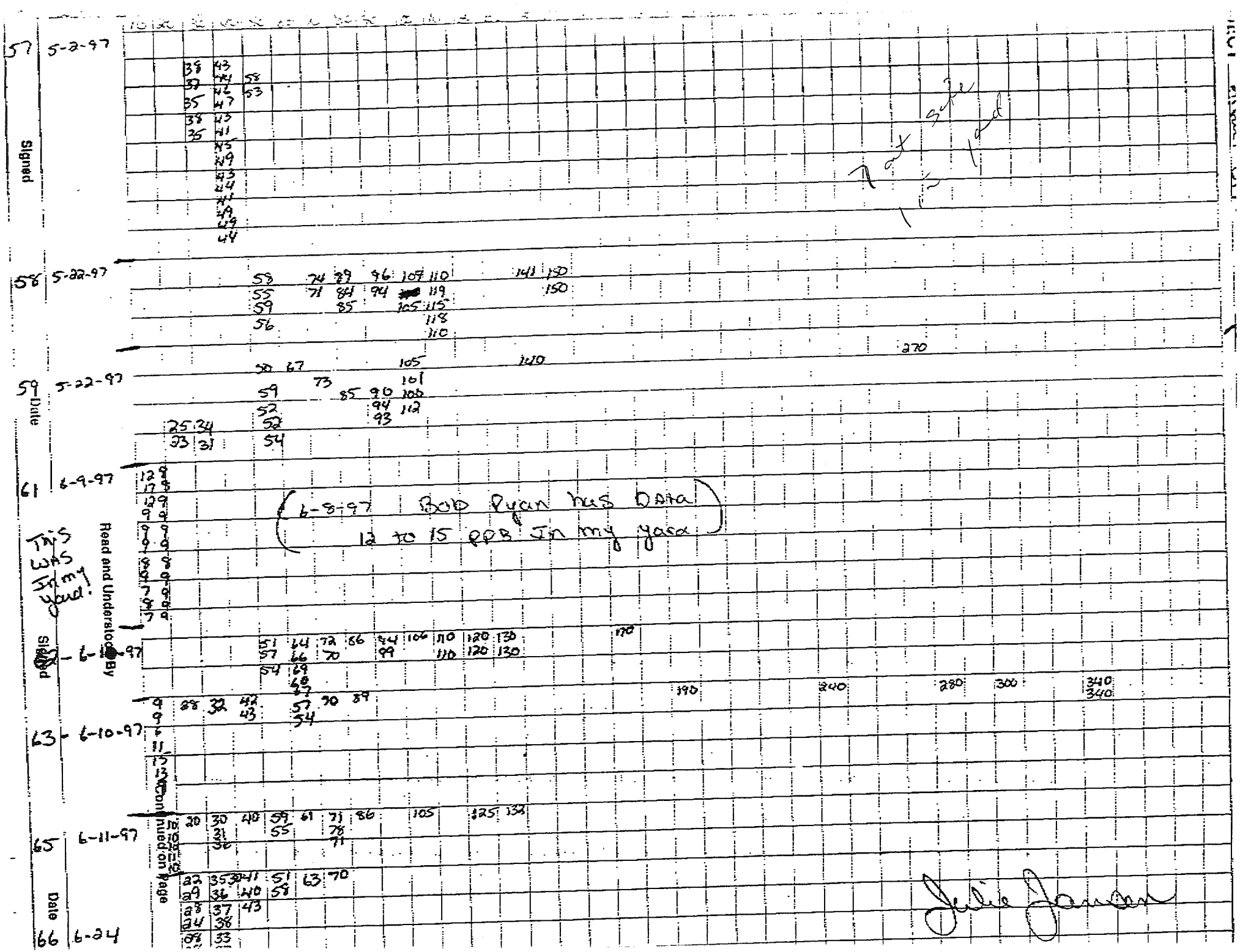
A list of EPA-approved sulfur dioxide monitors, "The EPA list of Designated Reference and Equivalent Methods," is available from the EPA or the MPCA upon request. Commercial vendors for thermal oxidizers with sulfur dioxide scrubbers are also available, but the user is responsible for the demonstration of the performance of the equipment, as described above.

Option 2: The use of MDA Scientific "Chemcassette®" Model 7100 or Model SPM for hydrogen sulfide. MDA Scientific is part of Zellweger Analytics, Inc. Both models utilize the same sensitized paper tape principle of operation. Model SPM has a range of detection from 3 to 90 parts per billion as 15 minute averages and may be unsuitable for recovery of 75 percent of all possible 30 minute periods in one year where high levels of hydrogen sulfide may be present. Model 7100 has a detection range from 3 to 5000 parts per billion.

These monitors must utilize the manufacturer's "low level" hydrogen sulfide paper tape cartridge with the instrument programmed for a minimum detection limit of a least 3 ppb for an averaging period of 15 minutes. Before making the measurement, the person seeking to make the measurements must develop and receive MPCA approval of a Quality Assurance Plan that provides operational procedures for each of the activities described in Code of Federal Regulations, title 40, part 58, appendix A.2.2. As recommended by the manufacturer, the Quality Assurance Plan should take into consideration the possible need for a sample stream humidification for this method if the ambient air is very dry, such as it is in winter.

Any continuous monitor using the sensitized paper tape method which the Commissioner finds is sufficiently similar in performance to the MDA Scientific "Chemcassette®" models described above may also be used.

MJS:jmd


Signed
Date
Read and Understood By
Signed
Date
(6-8-97 Bob Ryan has Data
12 to 15 ppb In my vase)
Julie Johnson

PROJECT Lipari Site Lagoon B Sect. 22 Norfolk

NOTEBOOK NO. _____

Continued From Page _____

30 min. Cont. monitoring

Test #1 6-10-97 Test #2 6-10-97 Test #3 6-10-97 Test #4 6-10-97

Ammonia Tri Parts Per million

Signed

Date

Read and Understood By

Signed

Date

Continued on Page

PROJECT [illegible]

Continued From Page

Test Number 5-9

Day Thurs Date January 22 1993

Section 27

Township Wilkie

Lagoon B

Readings

Time	Before 11:40 p.m	After
	.140	
+3	.067	
+6	.050	
+9	.105	
+12	.057	
+15	.090	
+18	.085	
+21	.094	
+24	.093	
+27	.052	
+30	.220	
+33	.121	
+34	.073	
+39	.100	
+42	.112	
+45	.052	
+48	.034	
+51	.031	
+54	.025	
+57	.022	
+60	.054	

	Before	After
Temperature	20	20
Humidity	23	23
Windspeed	2-9	8-11
Winddirection	180 S	150 SE
Barometer	30	29.95
Observersky	Cloudy	Cloudy
ZeRoad	OK	OK
Filterwarn	OK	OK

120' Away .115

F. 81 ppb

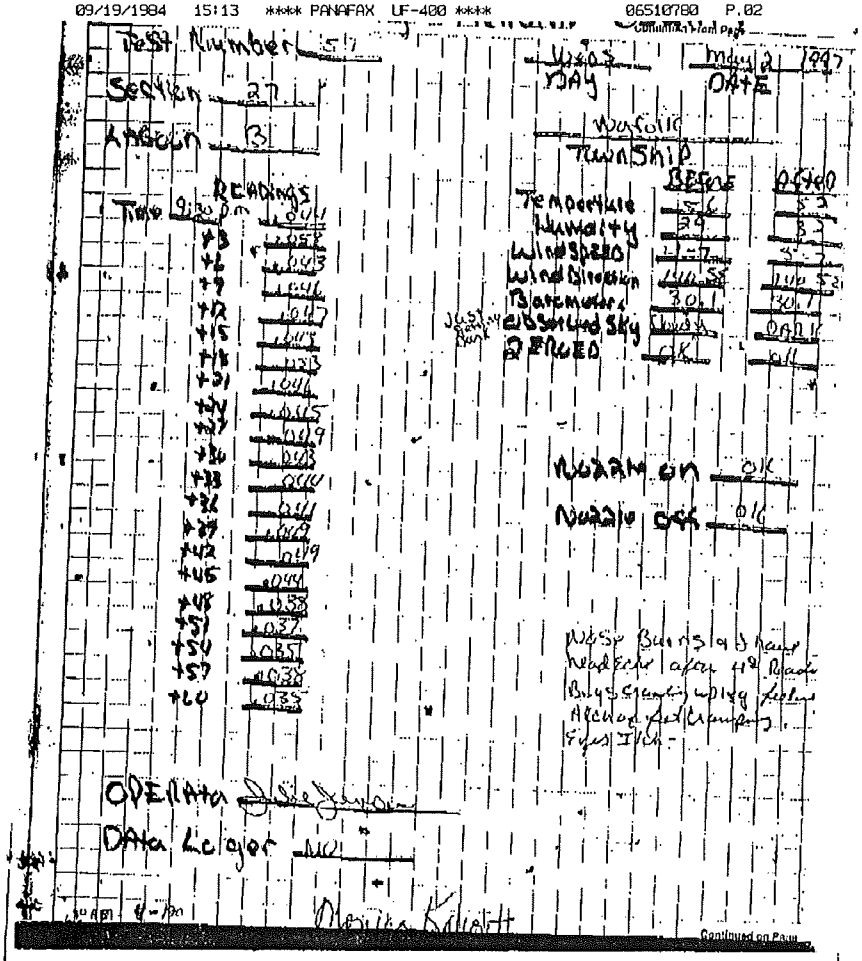
OPERATOR Julie Jones

Data Logger NO

Continued on Page

Read and Understood By

Signed Date Signed Date



Test Number 57
Section 27
Lagoon B
Readings
Time 9:30 a.m.
Day Wed
Date May 2 1984
Norfolk
Township
Before
After
Temperature 56 53
Humidity 34 33
Windspeed 7-7 5-7
Wind Direction NW SE NW SE
Barometer 30.1 30.1
Overcast Sky Clear Clear
Zeroed OK OK
Nozzle on OK
Nozzle off OK
Wasp Burns 9 & Heavy
Rehearse after 1st Blank
Buys Spanish Whisky Lobby
Affidavit Test Complete
Eyes Itch
Operator Julie Jones
Data Logger Mon
Monica Kakouri
Continued on Page

PROJECT Sulfur Gas Testing Pemiscot County
Continued from Page
Test Number 58
Section 32
Lagoon B
Readings
Time 8:30 a.m.
Day Thurs
Date May 3 1984
Norfolk
Township
Before
After
Temperature 52 70
Humidity 32 93
Windspeed 16 24
Wind Direction NW SE NW SE
Barometer 29.92 30
Overcast Sky Cloudy Cloudy
Zeroed OK OK
Nozzle on OK
Nozzle off OK
All Started at 9:30
Also using N.A.S. Bridge
Amoco Bridge 9th Exp.
Sulfur Pipeline Bridge
Monica Kakouri
Operator Julie Jones
Data Logger Mon
Continued on Page

Read and Understood By

Norfolk Township Section 27 Sheet1 1997 Calm 10 Nursery Facility Lagoon B

Date	2 may	22 may	22 may	9 June	9 June	10 June	10 June	11 June	24 June	26 June	27 June	15 July	16 July	30 July	8 Aug
Start Time	9:30p.m	5:35pm	6:40pm	10:09p.m	11:15pm	7:30pm	8:30p.m.	6:45pm	6:03Am	9:30pm	6:57pm	11:58p.m	1:03 A.m	9:50pm	11:20pm
	.044	.089	.140	.012	.140	.120	.240	.125	.035	.080	1.300	.102	.001	.062	.060
	.058	.074	.067	.017	.150	.094	.340	.105	.036	.041	.160	.065	.080	.047	.089
	.043	.141	.050	.012	.140	.099	.340	.132	.041	.080	.044	.165	.080	.053	.100
	.046	.096	.105	.009	.140	.064	.300	.071	.040	.075	.034	.073	.003	.058	.098
	.047	.071	.059	.009	.140	.170	.280	.059	.023	.080	.049	.048	.080	.046	.062
	.043	.150	.046	.009	.110	.130	.190	.059	.029	.046	.031	.020	.086	.054	.065
	.053	.150	.085	.009	.085	.110	.057	.086	.028	.044	.067	.021	.080	.050	.055
	.041	.084	.094	.009		.086	.028	.078	.024	.055	.064	.088	.001	.038	.081
	.045	.085	.093	.007		.072	.089	.071	.037	.056	.036	.073	.000	.035	.047
	.049	.109	.052	.009		.051	.042	.030	.038	.066	.065	.130	.001	.046	.076
	.043	.058	.270	.007		.057	.043	.031	.051	.103	.112	.088		.051	.056
	.044	.094	.101	.008		.106	.009	.010	.033	.094	.059	.069		.053	.064
	.041	.055	.073	.008		.120	.009	.020	.028	.079	.099	.107		.059	.080
	.049	.119	.106	.009		.066	.006	.055	.037	.053	.046	.080		.049	.060
	.049	.115	.112	.009		.054	.011	.061	.058	.038	.065	.070		.056	.051
	.044	.110	.052	.009		.130	.015	.010	.033	.030	.063	.072		.045	.081
	.038	.118	.034	.009		.110	.013	.010	.030	.023	.040	.117		.043	.059
	.037	.059	.031	.008		.070	.009	.040	.070	.023	.038	.089		.047	.060
	.035	.110	.025	.009		.069	.054	.036	.043	.017	.061	.081		.044	.039
	.038	.105	.023	.009		.060	.032	.011	.063	.028	.030	.124		.045	.060
	.035	.056	.054	.009		.067	.070	.010	.028	.033	.030	.084		.056	.076
					15 mins										
mean	.044	.098	.087	.009	.093	.091	.104	.053	.038	.053	.119	.086	.001	.049	.068
min	.035	.055	.023	.007	.085	.051	.006	.010	.022	.017	.030	.048	ND	.035	.039
max	.058	.150	.270	.017	.150	.170	.340	.150	.070	.103	1.300	.102	.006	.062	.100

Bridge color grade 2.5

Badge color grade 1

1½ miles Away

1 monitoring site 1.3 miles west.

Norfolk Township Section 27 Location in survey facility Lagoon B

Sheet 2 1997

Date 3 Sept	
Start Time 9:38am	
	.062
	.036
	.045
	.025
	.044
	.030
	.026
	.028
	.051
	.038
	.018
	.022
	.028
	.036
	.029
	.032
	.020
	.015
	.014
	.021
	.020
mean	.031
min	.014
max	.062

Norfolk Township Section 17 Data Issue, Facility

Sheet1 1996

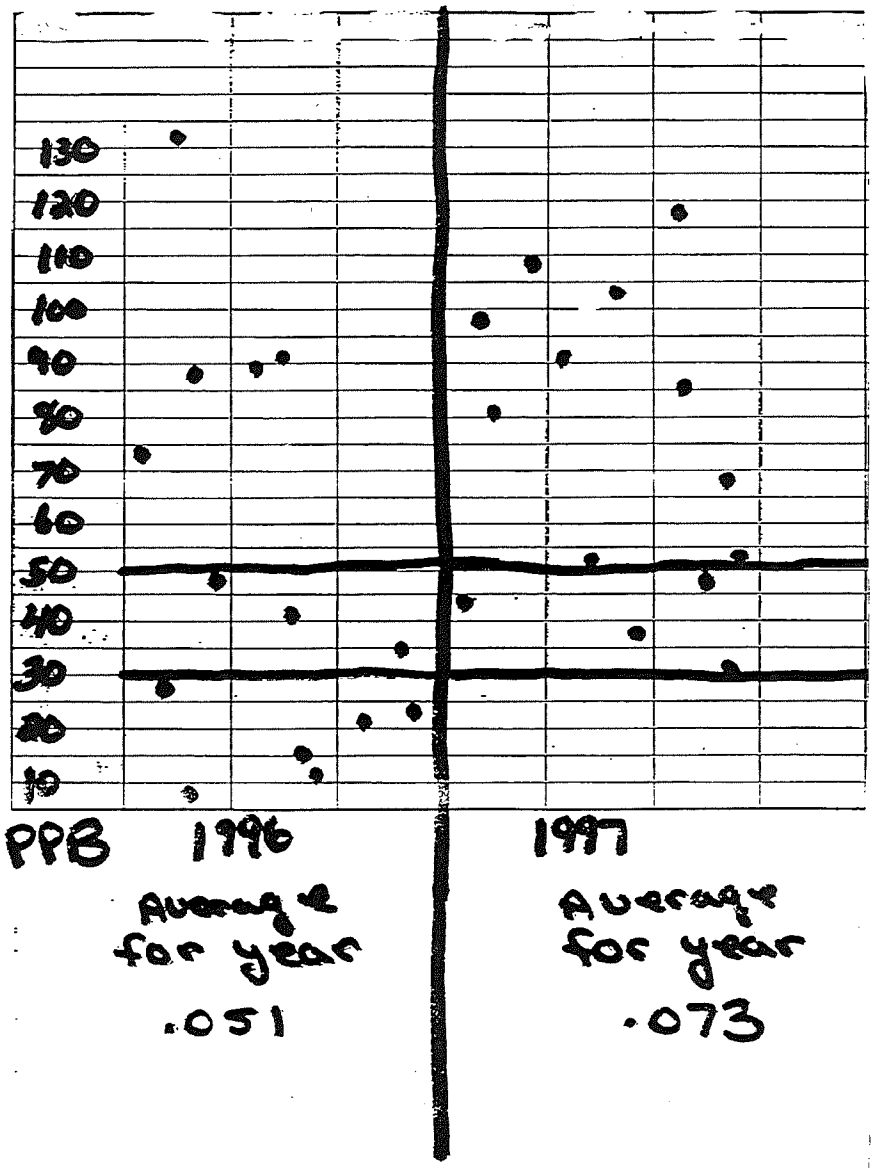
Lagoon B

Date	16-May	17 May	18 May	19-May	29-May	31-May	1 July	4 July	7 July			11 Aug	11 Aug	12 Aug	12 Aug
Start time	7:24pm	3:25pm	8:30 am	2:35p.m.	3:40p.m	8:30pm	5:02p.m	6:27pm	7:22pm			9:45pm	11:12pm	5:33pm	9:32p.m.
									Cont.	Cont.	Cont.				
	.052	0.120	.031	.023	.040	.012	.049	.066	.066	.170	.130	.044	.009	.009	.022
	.092	0.120	.035	.081	.003	.010	.042	.220	.110	.051	.048	.063	.007	.011	.033
	.084	.037	.036	.097	.000	.010	.055	.180	.019	.056	.048	.049	.035	.015	.023
	.074	0.320	.017	.067	.000	.010	.042	.130	.046	.300	.220	.038	.034	.004	.027
	.051	0.110	.025	.093	.008	.010	.026	.053	.039	.140	.050	.057	.039	.006	.025
	.105	.132	.013	.064	.000	.012	.038	.093	.040	.033	.056	.063	.030	.038	.028
	.068	.040	.052	.104	.016	.017	.031	.027	.026	.048	.230	.073	.034	.013	.027
	.079	.089	.038	.170	.014	.014	.025	.056	.018	.063	.120	.031	.012	.004	.036
	.035	0.170	.035	.130	.005	.013	.093	.069	.040	.040		.047	.013	.002	.041
	.090	0.280	.034	.107	.003	.011	.017	.042	.032	.076		.051	.011	.005	.017
	.060	0.170	.009	.083	.015	.011	.140	.120	.040	.066		.037	.009	.009	.019
	0.110	.070	.019	.023	.005	.010	.034	.023	.170	.011		.042	.013	.002	.012
	.060	0.200	.008	.117	.003	.013	.049		.200	.030		.044	.016	.007	.019
									.042	.064		.042	.066	.005	.015
									.024	.041		.054	.000	.009	.017
									.006	.040		.035	.000	.026	.016
									.060	.047		.039	.017	.029	.022
									.069	.032		.038	.014	.032	.031
									.160	.027		.033	.007	.020	.021
									.022	1.200		.010	.005	.016	.023
									.035	.057		.003	.005	.011	.025
									.120	.030					
									.040	.035					
mean	.074	.134	.027	.039	.009	.012	.049	.090			.092	.042	.015	.013	.023
min	.035	.037	.005	.023	.000	.010	.025	.023			.006	.003	.000	.003	.012
MAX	.116	.320	.052	.170	.040	.017	.140	.220			1.200	.071	.037	.038	.041

1 mile away

Sheet 2 1996

Date	16 Aug.	17 Aug
Start Time	9.06pm	7:41p.m
	.1035	.1070
	.1042	.1051
	.1037	.1049
	.1041	.1041
	.1031	.1024
	.1047	.1013
	.1036	.1013
	.1033	.1027
	.1028	.1050
	.1036	.1037
	.1032	.1022
	.1027	.1018
	.1036	.1016
	.1033	.1026
	.1041	.1018
	.1040	.1015
	.1033	.1006
	.1034	.1003
	.1032	.1002
	.1028	.1007
	.1029	.1007
Mean	.1035	.1024
Min	.1027	.1002
Max	.1047	.1070


130
120
110
100
90
80
70
60
50
40
30
20
10
PPB
1996
1997
Average for year
.051
Average for year
.073

Farm Name/Farmer	Street Address	City	State	Zip	Telephone Number	County	Permit Number	Unique Number	Type
ValAdCo - Lippert Site	P.O. Box 392	Renville	MN	56284	612-329-8415	Renville	NPDES MN 0062618	C-RENV-S-1	Swine
ValAdCo - Tisdale Site	P.O. Box 392	Renville	MN	56284	612-329-8416	Renville	NPDES	C-RENV-S-2	Swine
Robert Schemel	R.R. 2, Box 180	Renville	MN	56284	612-329-3716	Renville	MPCA-I 1298(A)R	C-RENV-S-3	Swine
Swine Complex, Inc.	101 W. Main, P.O. Box 381	Sleepy Eye	MN	56085	507-794-5310	Rock	MPCA-I 1997(A)R	C-ROCK-S-4	Swine
Churchill Co-op	R.R. 2, Box 200A	Hector	MN	55342		Renville	NPDES	C-RENV-S-5	Swine
Churchill Co-op	R.R. 2, Box 200A	Hector	MN	55342		Renville	NPDES	C-RENV-S-6	Swine
Rodney Johnson	621 Pacific Ave	Morris	MN	56267	612-589-1834	Roseau	MPCA-C 5955	C-ROSE-S-7	Swine
Rodney Johnson	621 Pacific Ave	Morris	MN	56267	612-589-1834	Roseau	MPCA-C 5955	C-ROSE-S-8	Swine
Neal Johnson	Route 2, Box 185	Hector	MN	55342		Renville	MPCA-I 1394(A)	C-RENV-S-9	Swine
Neal Johnson	Route 2, Box 185	Hector	MN	55342		Renville	MPCA-C 5772R	C-RENV-S-10	Swine
Neal Johnson	Route 2, Box 185	Hector	MN	55342		Renville	MPCA-C 4070R2	C-RENV-S-11	Swine
Virgil Scherping	P.O. Box 10	Winstead	MN	55395		Wright	(A)R2;MPCA-C 5920R;	C-WRIG-D-12	Dairy
MNDAK Dairy, Inc	R.R. 1	Cleveland	MN	56017	507-931-6303	Le Sueur	Pending NPDES	S-LESU-D-13	Dairy
Little Pine Dairy	Box 269 Industrial Blvd	Perham	MN	56573	218-346-4244	Otter Tail		S-OTTE-D-14	Dairy
Tilden Farms	R.R.1 Box 27	Mentor	MN	56736	218-637-8186	Polk	MPCA-C 1601	S-POLK-B-15	Beef
Bernard and David Their	Route 2, Box 228	Rushmore	MN	56168	507-478-4137	Nobles	MPCA-C 5596R	S-NOBL-B-16	Beef
Joe Neusch	RR 2, Box 245	Fairmont	MN	56031	507-235-3688	Martin	MPCA-I 1129(B)	S-MART-B-17	Beef
Jack Frost, Inc	309 Lincoln Avenue Southeast	St. Cloud	MN	56301		Sherburne	MPCA-C 3974	S-SHER-P-18	Poultry
Jerome Foods, Inc	1116 N.W. 4th Avenue	Faribault	MN	55021		Dodge	MPCA-C 2666	S-DODG-P-19	Poultry
Jerome Foods, Inc	1116 N.W. 4th Avenue	Faribault	MN	55021		Dodge	MPCA-C 2665	S-DODG-P-20	Poultry
Jerome Foods, Inc	1116 N.W. 4th Avenue	Faribault	MN	55021		Dodge	MPCA-C 2664	S-DODG-P-21	Poultry
Jerome Foods, Inc	1116 N.W. 4th Avenue	Faribault	MN	55021		Dodge	MPCA-C 2663	S-DODG-P-22	Poultry
Dennis Magnusen			MN			Freeborn		C-FREE-S-23	Swine
Halquist Dairy			MN			Carver		C-CARV-D-24	Dairy
F.A.S.T.		Waldorf	MN			Waseca		C-WASE-S-25	Swine
Watonwan Feeder Pigs	Route 1, Box 60	Lewisville	MN	56060	507-375-3810	Watonwan	MPCA-I 2213(A)	C-WATO-S-26	Swine
Watonwan Feeder Pigs	Route 1, Box 61	Lewisville	MN	56060	507-375-3811	Watonwan	MPCA-C 5452	C-WATO-S-27	Swine

Unique Number	Lot/Barn Type	Storage Type	Monitoring Date	Wind Direction	ind Speed (MP	Temperature (F)	Humidity (%)	Barometric Pressure	Jerome #	GPS#
C-WASE-S-25	Confined	Flush/lagoon	10/21/97	NW	15-20mph	51	68%		1539	
C-WATO-S-26	Confined	lagoon	10/21/97	NW	5-10mph	41	50%		1539	
C-WATO-S-27	Confined	Concrete Pit	10/21/97	NW	10-15mph	47	48%		1539	
C-WATO-S-27	Confined	Concrete Pit	10/21/97	NW	10-15mph	47	48%		1539	
C-RENV-S-10	Confined	Lagoon	10/22/97	SE	0-5mph	31	58%		1539	
Johnson 23	Confined	Lagoon	10/22/97	SE-ESE	0-5mph	36	60%		1539	
Johnson 15	Confined	Lagoon	10/22/97	SW	0-5mph	42	70%		1539	
Churchill Co-op 21	Confined	Lagoon	10/22/97	SW/S	0-5mph	44	45%		1539	
Churchill Co-op 10	Confined	Lagoon	10/22/97	S	0-5mph	42	55%		1539	
ValAdCo	Confined	Lagoon	10/22/97	S/SE	5-10mph	47	49%		1539	
ValAdCo-29	Confined	Lagoon	10/22/97	S/SE	5-10mph	44	59%		1539	
C-RENV-S-3	Confined	Concrete Pit	10/22/97	S/SE	5-10mph	47	55%		1539	
Unique Number	Lot/Barn Type	Storage Type	Monitoring Date	Wind Direction	ind Speed (MP	Temperature (F)	Humidity (%)	Barometric Pressure	Jerome #	GPS#
C-RENV-S-1	Confined	Lagoon	10/29/97	S/SE	10-25MPH	47			1531	
C-NICO-S-28	Confined	Lagoon	10/10/97	S/SE	15-25MPH	60-65			1531	
C-NICO-S-28	Confined	Lagoon	10/10/97	S/SE	15-25MPH	60-65			1531	
C-NICO-S-28	Confined	Lagoon	8/28/97	E	0-5MPH	70-75			1531	
C-RENV-S-3	Confined	Lagoon	9/3/97	E	0-5MPH	70-75			1531	
C-RENV-S-3	Confined	Lagoon	9/3/97	E	0-5MPH	70-75			1530	
C-RENV-S-3	Confined	Lagoon	9/3/97	E	0-5MPH	70-75			1530	

Latitude	Longitude	Start Time	0 minute	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	12 minutes	14 minutes	16 minutes	18 minutes	20 minutes	22 minutes	24 minutes	26 minutes
		11:10	0.001	0.002	0.004	0.002	0.003	0.003	0.002	0.003	0.003	0.004	0.004	0.003	0.003	0.003
		14:40	0.003	0.002	0.002	0.003	0.003	0.002	0.003	0.002	0.002	0.003	0.002	0.003	0.002	0.003
		15:44	0.004	0.004	0.005	0.007	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.003	0.003
		16:20	0.035	0.033	0.041	0.052	0.028	0.076	0.057	0.031	0.043	0.064	0.092	0.037	0.075	0.076
		9:16	0.016	0.013	0.008	0.008	0.011	0.019	0.024	0.017	0.037	0.021	0.031	0.028	0.016	0.02
		9:53	0.003	0.002	0.002	0.002	0.002	0.001	0.002	0.003	0.002	0.002	0.002	0.003	0.003	0.003
		10:55	0.001	0.002	0.001	0.001	0.001	0.003	0.011	0.006	0.003	0.004	0.004	0.003	0.003	0.005
		11:33	0.028	0.003	0.011	0.003	0.016	0.009	0.003	0.013	0.008	0.007	0.006	0.004	0.016	0.008
		12:16	0.03	0.015	0.019	0.012	0.011	0.009	0.012	0.025	0.006	0.029	0.03	0.014	0.02	0.022
		13:48	0.065	0.032	0.061	0.047	0.049	0.105	0.08	0.077	0.021	0.096	0.06	0.1	0.046	0.034
		14:25	0.008	0.004	0.003	0.008	0.006	0.004	0.005	0.006	0.005	0.004	0.008	0.005	0.004	0.004
		15:16	0.035	0.046	0.028	0.067	0.024	0.029	0.026	0.034	0.044	0.019	0.023	0.015	0.04	0.033
Latitude	Longitude	Start Time	0 minute	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	12 minutes	14 minutes	16 minutes	18 minutes	20 minutes	22 minutes	24 minutes	26 minutes
		14:18	0.026	0.026	0.079	0.069	0.017	0.037	0.086	0.036	0.012	0.006	0.033	0.04	0.047	0.039
		20:50	0.008	0.013		0.015	0.011		0.01	0.007		0.008	0.014		0.01	0.015
		20:53	0.006	0.022		0.011	0.006		0.011	0.008		0.007	0.005		0.006	0.011
		19:56	0.015	0.013		0.013	0.006		0.001							
		15:00	0.014	0		0.011	0.002		0	0.006		0.005	0.01		0.03	
		15:08	0.006	0.024	0.002	0.002	0.002	0.009	0.017	0.023	0.011	0.011	0.006	0.002	0.012	0.002
		15:08	0.002	0.005	0.002	0.002	0.011	0.011	0.008	0.035	0.006	0.004	0.006	0.002	0.004	0.006

28 minutes	30 minutes	Avg	End	A.U.		
0.003	0.005	0.003	11:40	3008		
0.002	0.002	0.0024375	15:10	623		
0.003	0.003	0.003625	16:14	240		
0.066	0.095	0.0563125	16:50	240	aken at vent	
0.022	0.022	0.0195625	9:46	360.4		
0.003	0.002	0.0023125	10:23			
0.005	0.004	0.0035625	11:25			
0.011	0.012	0.009875	12:03			
0.019	0.014	0.0179375	12:46			
0.087	0.031	0.0619375	14:18			
0.004	0.004	0.005125	14:55			
0.028	0.023	0.032125	15:46			

28 minutes	30 minutes	Avg	End	A.U.		
0.028		0.0363125	14:38	Lagoon Fenceline		
		0.0069375	21;20	Property Line		
		0.0058125	21:23	Property Line		
		0.003	20:26	Property Line		
		0.004875	15:30	Property Line		
0.002	0.003	0.008375	15:38	Property Line		
0.002	0.001	0.0066875	15:38	Property Line		
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				

Unique Number	Lot/Barn Type	Storage Type	Monitoring Date	Wind Direction	Wind Speed	Temperature	Humidity	Barometric Pressure	Jerome #	GPS#

Latitude	Longitude	Start Time	0 minute	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	12 minutes	14 minutes	16 minutes	18 minutes	20 minutes	22 minutes	24 minutes	26 minutes

Unique Number	Lot/Barn Type	Storage Type	Monitoring Date	Wind Direction	Wind Speed	Temperature	Humidity	Barometric Pressure	Jerome #	GPS#
S-OTTE-D-14	Confined	Lagoon	10/27/97	SW	0-5mph	44	90%		1539	
C-WRIG-D-12	Confined	Lagoon	10/17/97	SW	5-10mph	56	66%		1539	
S-LESU-D-13	Confined	Lagoon	10/24/97	NE	5-10mph	44	65%		1539	
C-WRIG-D-12	Confined	Lagoon	10/24/97	N/NW	10-20mph	39	39%		1539	
C-WRIG-D-12	Confined	Lagoon	12/16/97	SW	0-5mph	33			1537	

Latitude	Longitude	Start Time	0 minute	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	12 minutes	14 minutes	16 minutes	18 minutes	20 minutes	22 minutes	24 minutes	26 minutes
		18:58	0.005	0.007	0.005	0.005	0.005	0.004	0.005	0.006	0.006	0.008	0.008	0.006	0.006	0.008
		10:50	0.005	0.008	0.012	0.004	0.034	0.063	0.005	0.01	0.002	0.01	0.006	0.008	0.007	0.004
		19:14	0.01	0.006	0.005	0.005	0.006	0.06	0.007	0.009	0.008	0.004	0.005	0.008	0.009	0.01
		21:35	0.015	0.005	0.019	0.024	0.011	0.008	0.013	0.013	0.021	0.027	0.015	0.004	0.008	0.032
		19:45	0.005	0.003	0.007	0.003	0.002	0.002	0.001	0.007	0.004	0.003	0.003	0.003	0.003	0.003

28 minutes	30 minutes	Avg	End	A.U.		
0.009	0.006	0.0061875	19:28	1199.8		
0.01	0.005	0.0120625	11:20	1,400		
0.009	0.009	0.010625	19:44			
0.016	0.013	0.01525	21:55			
0.003	0.004	0.0035	20:15		Property Line	
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				
		0				

Unique Number	Lot/Barn Type	Storage Type	Monitoring Date	Wind Direction	Wind Speed	Temperature	Humidity	Barometric Pressure	Jerome #	GPS#
Jerome-25	Confined	Litter Pack	10/24/97	NE	10-15mph	42	99%		1539	
Jerome-6	Confined	Litter Pack	10/24/97	NE	10-20mph	44	78%		1539	
Jerome-7	Confined	Litter Pack	10/24/97	NE	10-20mph	44	78%		1539	
Jerome-6	Confined	Litter Pack	10/24/97	NE	10-20mph	44	70%		1539	

Latitude	Longitude	Start Time	0 minute	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	12 minutes	14 minutes	16 minutes	18 minutes	20 minutes	22 minutes	24 minutes	26 minutes
		15:23	0.003	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001
		15:54	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
		16:34	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.001
		17:10	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

28 minutes	30 minutes	Avg	End	A.U.
0.002	0.001	0.0014375	15:53	
0.002	0.002	0.002125	16:24	
0.002	0.003	0.002125	17:04	
0.005	0.005	0.005	17:40	
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		
		0		

Animal Feedlot Hydrogen Sulfide (H2S) Compliance Approach Flowchart

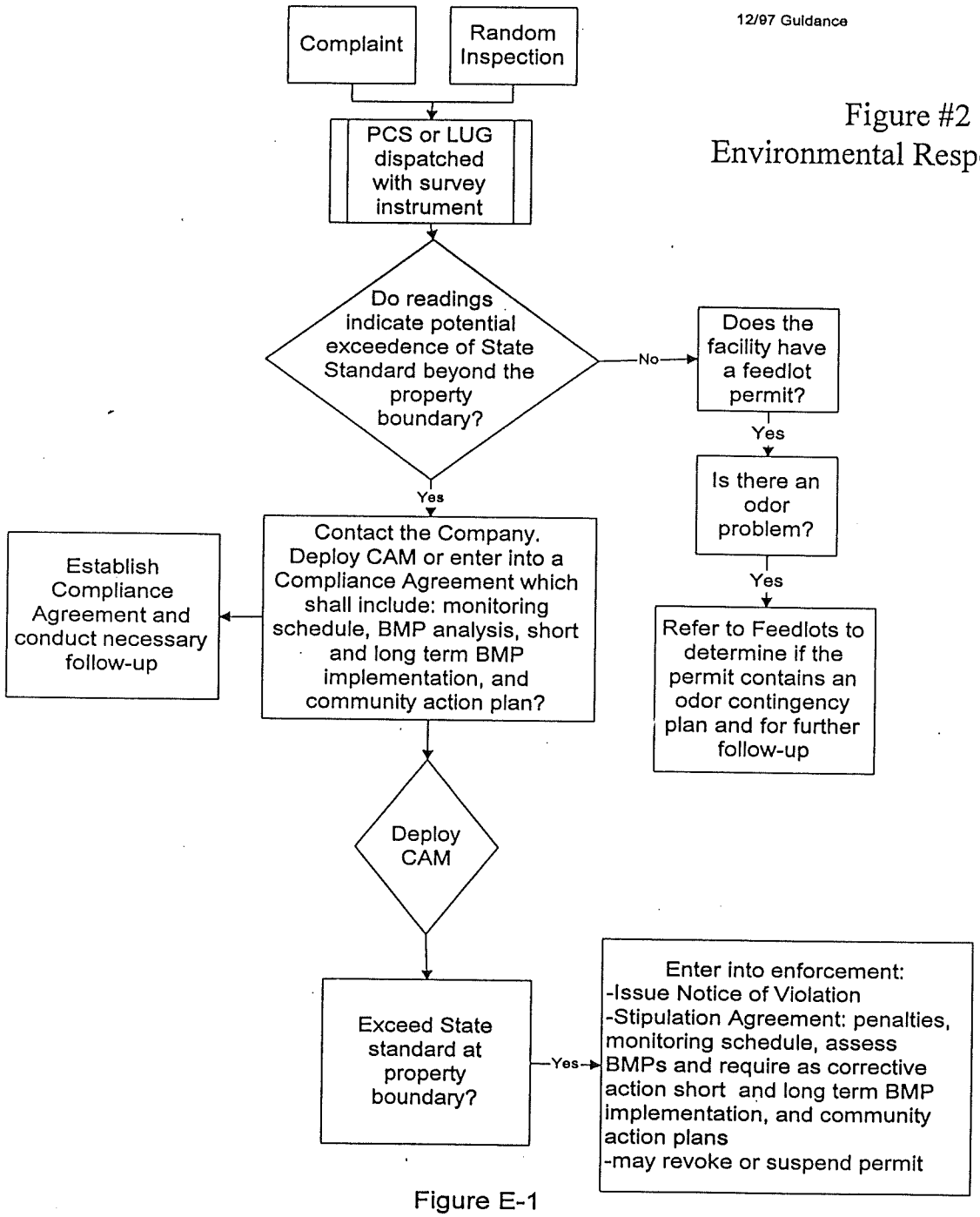


Figure #2
Environmental Response Plan

Figure E-1

NOTE

The MPCA, its Air Quality Division, and the Attorney General's Office Reserve the right to act at variance with the ERP, including penalty determination processes, to change the ERP at any time, or not to commence litigation without prior initiation of settlement discussions, based upon applicable law and relevant facts of a specific case. This ERP is not intended, and cannot be relied upon to create any rights, substantive or procedural, that can be enforced in litigation or any administrative proceeding with the State of Minnesota. Nothing in this ERP shall be construed to restrict any action that may be taken by the MPCA or Attorney General on behalf of the State of Minnesota, in any litigation that is commenced for violations of environmental laws.