STATE OF MINNESOTA

COUNTY OF RAMSEY

MINNESOTA POLLUTION

CONTROL AGENCY

In the Matter of the Proposed Rules,
6 MCAR § 4.6101, 6 MCAR § 4.6102,
6 MCAR § 4.6103, 6 MCAR § 4.6104,
6 MCAR § 4.6105, 6 MCAR § 4.6106,
6 MCAR § 4.6107, 6 MCAR § 4.6108,
6 MCAR § 4.6111, 6 MCAR § 4.6112,
6 MCAR § 4.6121, 6 MCAR § 4.6122,
6 MCAR § 4.6131, 6 MCAR § 4.6132,
6 MCAR § 4.6133, 6 MCAR § 4.6134,
6 MCAR § 4.6135, and 6 MCAR § 4.6136.

STATEMENT OF NEED
AND REASONABLENESS

I. INTRODUCTION

The subject of this rulemaking is the proposed adoption by the Minnesota Pollution Control Agency (MPCA) of rules governing sewage sludge management. These rules are proposed for adoption pursuant the Minn. Stat. § 116.07, subd. 4 (1981 Supp.) which authorizes the MPCA to adopt standards for sewage sludge.

Rulemaking on the proposed rules was authorized by the Agency on October 27, 1981. At the same time it authorized the initiation of rulemaking, the Agency found that the proposed adoption of the rules is noncontroversial in nature and directed that the rulemaking proceedings be conducted in accordance with the statutory provisions governing the adoption of noncontroversial rules, Minn. Stat. § 15.0412, subd. 4h (1981 Supp.). Accordingly, the rulemaking proceedings on the proposed rules are governed by that statute and no hearing will be conducted on the adoption of the rules unless, on or before January 27, 1981, seven or more persons submit to the Agency a written request for such a hearing.

In accordance with the requirements of Minn. Stat. § 15.0412, subd. 4h (1981 Supp.), this document, the Statement of Need and Reasonableness, was prepared and completed prior to the dates that the proposed adoption of the rules was noticed in the State Register.

The discussion provided in this Statement is divided into the following parts:

II. GENERAL OVERVIEW

A. Overview of Sewage Sludge Landspreading.

In order to understand the need for and reasonableness of specific portions of the proposed rules, it will be useful to have a general understanding of the principles of sewage sludge landspreading and the current status of sewage sludge disposal in Minnesota.

Sewage sludge is defined by Minn. Stat. § 115A.03, subd. 29 as "the solids and associated liquids in municipal wastewater which are encountered and concentrated by a municipal wastewater treatment plant." These solids do not include grit or screenings, which are removed prior to primary treatment and usually deposited at a landfill.

Raw sewage arriving at the treatment plant is processed by various methods to achieve a high quality effluent and to condition the sewage sludge. The quality and characteristics of the sewage sludge will vary, depending on the treatment process and the composition of the raw sewage. Sewage sludge can be derived from both primary and secondary treatment processes. Primary sludge is the result of the physical separation of the sewage solids from the liquids. Secondary sludge is sewage which has been altered by biological processes so that the organic matter in the sewage is broken down by microorganisms. Both primary and secondary sludges are considered unstabilized and highly putrescible, and have a large viable pathogen population. Before landspreading, sewage sludge must be further treated to increase handling efficiency and decrease public health concerns (pathogens) and nuisance conditions (odors).

Most sewage sludges are thickened to increase the solids content and therefore reduce the handling costs. Sewage sludge is usually thickened to at least 3% solids and sometimes is dewatered to make a solid material that is 20% solids or more.

The population of pathogenic microorganisms and the level of volatile organic substances can be reduced in a number of ways but the most frequently used method is digestion. Digestion processes vary, but generally the process involves the conversion of the sewage sludge organic matter into microbial cells. The effectiveness of the process depends on the temperature, the retention time in the digester, and the composition of the raw sewage. Other commonly used methods to reduce pathogens and putrescence are lime treatment, heat treatment and composting.

Sewage sludge contains relatively high levels of the major plant nutrients, nitrogen and phosphorus. These nutrients, and the high organic matter content, make sewage sludge a desirable soil amendment. The concern associated with the use of sewage sludge as a soil amendment arises from the fact that sludge contains other components which can cause adverse health and environmental effects. These components of concern are the heavy metals such as cadmium, nickel, lead, zinc and copper, synthetic organic compounds such as PCBs, and pathogenic microorganisms. The landspreading of sewage sludge creates the potential that these components of concern may contaminate surface and ground waters, impair food crop quality, decrease crops yields, and induce disease in man and animals.

Landspreading is the controlled application of sewage sludge to land at rates which will not overload the assimilative capacity of the soil. The soil system, which includes the microorganisms, chemical processes and physical environment, is the mechanism by which the sewage sludge components of concern are degraded, immobilized, or removed to diminish or eliminate their effect on the environment and on public health. Extensive research has been conducted to develop an understanding of the capacity of the soil for waste treatment and the best methods to ensure the safe utilization of sewage sludge. The research has shown that sewage sludge can be landspread without producing adverse effects if it is applied under controlled conditions.

When sewage sludge is landspread, it is applied at rates which will meet the nitrogen requirements of the crop to be grown, although in some cases the cadmium applied with the sewage sludge may be the limiting factor. The sewage sludge may be applied either on the soil surface or incorporated or injected into the soil. The actual amount applied will vary, but generally a quarter of an inch of dewatered sewage sludge or one inch of liquid sewage sludge applied over the soil surface, will provide sufficient nitrogen for a crop of corn. Sewage sludge can be applied to any crop but is not usually recommended for application to crops which may be eaten raw because of the potential for disease transmission.

In Minnesota, more than 80% of the municipalities that generate sewage sludge, dispose of it by landspreading. In some communities, sewage sludge is incinerated or deposited in sanitary landfills or lagoons. It is the policy of the MPCA to encourage the landspreading of sewage sludge over other disposal alternatives when it is economically feasible and managed in a manner to protect the public health and quality of the environment. Most sewage sludge is landspread on privately-owned farmland at the request of the landowner. In some cases, especially when the treatment plant has a limited storage capacity and the sewage sludge must be frequently landspread, the sewage sludge is applied to public property such as a municipal airport.

B. Format of the Proposed Rules.

The proposed rules have been divided into four general chapters. Rules 6 MCAR §§ 4.6101-4.6108 in Chapter Five address the general provisions of the rules. These provisions include the purpose, scope and applicability of the rules, the definitions applicable to the proposed rules, and procedural matters related to variances, applications and administration.

Chapter Six, 6 MCAR § 4.6111 and 4.6112, establishes the specific requirements applicable to landspreading sites, and Chapter Seven, 6 MCAR § 4.6121 and 4.6122, establishes the specific requirements applicable to landspreading facilities.

It is important to understand the distinction between landspreading sites and facilities. By definition, landspreading sites are property that is not owned, leased or rented by the political subdivision generating the sewage sludge being landspread. This is generally privately owned farmland but may include industrial/commercial property or public property not owned by the political subdivision. The proposed requirements and limitations for landspreading sites are very specific and may only be modified by obtaining a variance to the rules.

Landspreading facilities are property that is owned, rented or leased by the political subdivision generating the sewage sludge being landspread. The proposed requirements and limitations for landspreading facilities contain two alternatives for compliance. The rule contains general performance standards

and minimum design requirements; compliance with either limitation is acceptable. This format allows for greater flexibility in designing facilities for specific landspreading situations. Landspreading facilities can be divided into two classes depending on the operation of the facility. If the facility will be operated in accordance with all the minimum design requirements, it will be operated similarly to a landspreading site and therefore, be required to submit a similar level of information to the MPCA to obtain a permit. However, if the facility will be used more intensively than would be approved for a landspreading site, or which does not meet the minimum design requirements, additional information and/or monitoring must be provided prior to obtaining or revising a permit. Regardless of the method of operation, landspreading facilities must have a program to monitor ground water to determine the effect of the operation on ground water quality.

Chapter Eight, 6 MCAR §§ 4.6131 - 4.6136 establishes procedures and methodology for conducting certain analyses and other determinations required to be made pursuant to the proposed rules.

III. NEED FOR THE PROPOSED RULES

The need for the proposed rules (6 MCAR §§ 4.6101-4.6136) arises from four sources: A) The requirements of Minn. Stat. § 116.07, subd. 4; B) The potential for adverse environmental and health effects if sewage sludge is improperly managed; C) The widespread use of landspreading as a sewage sludge disposal alternative; and D) The need for standards which serve as a guide for correct landspreading procedures.

A. The Requirements of Minn. Stat. § 116.07, Subd. 4.

The Minnesota Legislature has mandated that the MPCA develop standards addressing the management of sewage sludge. The statute is quite specific as to the extent of the standards. The standards must address the degree of hazard of the sewage sludge, the suitability of the landspreading area, the design and operation of landspreading sites and facilities, and the volume and rate of sewage sludge application. It was necessary to develop very specific rules in order to fulfill each provision of the statute.

B. The Potential for Adverse Environmental and Health Effects if Sewage Sludge is Improperly Managed.

Extensive research has shown that the landspreading of sewage sludge is a safe method of disposal if it is properly managed. However, definite adverse effects have been identified in association with the mismanagement of sewage sludge or sewage sludge components. The components of concern in sewage sludge are the pathogens, heavy metals, synthetic organic compounds, and macronutrients such as nitrogen, phosphorus and salts. These components may impair the quality of surface and ground waters, affect the production of food chain crops and create other public health and welfare impacts if sewage sludge is improperly applied. It is necessary that the rules provide standards for the correct management of each of these components of concern. In addition, improper management of sewage sludge can cause odor, aesthetic and other nuisance conditions and may cause bird hazards at airports.

1. Pathogens.

Sewage sludge contains pathogenic organisms which reflect the occurrence of disease in the sewer service area. The number and type of pathogens vary widely

depending on the health of the sewered population and the method of sewage treatment. Bacteria, viruses, protozoa and parasitic ova are all present to some degree in the sludge as it is applied to land. Pathogens in sewage sludge may cause disease in humans if a route of infection exists. Disease causing organisms may be transmitted through direct contact with the sewage sludge, by contaminated food products, or by contamination of surface and ground water. Restrictions are needed to minimize the number of viable pathogens applied to the land and to reduce the routes for infection.

While it is possible for sewage sludge to contain pathogenic organisms, the level of pathogens associated with municipal sewage is greatly diminished during treatment plant processes and in the soil environment. Soil temperatures and moisture regimes, competition and predation by soil microorganisms, and sunlight are all effective in eliminating pathogens after sewage sludge is landspread. At this time, there is no evidence to indicate that landspreading of treated sewage sludge is a route of disease transmission. But, because some viruses and the ova of some intestinal parasites may survive long enough to present a potential for human infection, precautions must be taken to reduce animal or human contact with viable pathogens.

2. Metals.

Sewage sludge may contain heavy metals. The term "heavy metals" refers to the metals cadmium, nickel, lead, zinc and copper. From a human health standpoint, cadmium is the metal of greatest concern. The concern over cadmium arises from the fact that cadmium can be taken up by plants when high levels are present in acid soils. Cadmium tends to accumulate in the leafy tissue of plants and, if ingested, may cause adverse health effects. Cadmium accumulates in the liver and kidneys of animals. High levels of cadmium in the human diet may, over time, cause a chronic kidney condition. Cadmium is generally not accumulated in food grains and animal muscle tissue. The soil pH, cation exchange capacity (CEC), type of crop, and the amount of cadmium applied annually and cumulatively all affect the amount of cadmium taken up by the crop.

The other heavy metals, copper, zinc and nickel, must be regulated because of their potential to impair crop growth when high levels are present in the soil. Different soils and crops react differently to the effects of metal additions. Lead must be regulated because of the potential for adverse animal health effects from ingestion with soil. Unlike cadmium, there is very little concern that the annual application rates of these metals will produce adverse effects, although repeated applications will eventually produce high soil concentrations.

Heavy metals are relatively insoluble in the soil. Because of this, the chief method of transport is with eroded solids. Metals remain concentrated in the surface soil layers and are, therefore, susceptible to erosion. The impact of metals reaching surface waters varies. If the water is a source of drinking water, cadmium may be a human health concern. Very high metal concentrations may be toxic to some aquatic organisms. In addition, some aquatic organisms tend to accumulate metals, especially mercury and cadmium, in their body tissues. When this accumulation occurs in organisms harvested for food-chain purposes, it could present another route for high metal levels to enter the human food-chain.

Metal contamination of ground water has not been shown to be a major concern. However, the potential for such movement does exist, and especially in the case of cadmium, contamination could result in human health effects.

3. Synthetic Organic Compounds.

Synthetic organic compounds in sewage sludge include a broad range of substances. Research on many of these compounds has found the the level present in sludge, or the behavior of these materials, does not present a threat to human health. However, polychlorinated biphenyls (PCBs) due to their widespread occurrence in sewage sludges and potential for impacting human health, must be regulated. The soil has a capacity to degrade and adsorb many compounds, and many are volatilized to the atmosphere. However, because of the large number of synthetic organic compounds and the relatively recent development of them, extensive research on their behavior in the soil and on the long term effects of these compounds is limited. At present the potential risk from most of the compounds normally found in sewage sludge appears to be minimal due to their low concentrations and the mitigating effects of the soil environment. Of the many compounds found in sewage sludge, only a few are sufficiently toxic and persistent to be considered health risks and none have been shown to have contaminated ground waters as a result of sewage sludge application. However, if contamination occurred, the effects would vary according to the nature of the contaminant.

4. Macronutrients.

The macronutrients of concern in sewage sludge are nitrogen, phosphorus and certain salts. These components may cause ground and surface water contamination and reduce crop yields.

The effects of ground water contamination by macronutrients in sewage sludge are primarily risks from nitrate poisoning. Nitrates in drinking water can be converted to nitrites by microorganisms in the digestive tract of livestock and in the intestines of infants less than three months old. The resulting condition, called methemoglobanemia, disrupts the oxygen carrying capacity of blood.

The effect of surface water contamination by macronutrients is primarily the decline of water quality as a result of nitrogen and phosphorus enrichment. Nitrogen and phosphorus can be transported from a landspreading site in solution or with eroded particles. These nutrients can promote excessive algal growth which will subsequently deplete the oxygen supply of the water.

Salts of potassium, calcium, sodium and magnesium are often present in significant quantities in sewage sludge. In general there are two basic problems associated with high salt concentrations in soils. A disproportionate amount of sodium affects the soil structure and an excess of salt ions in the soil upsets the osmotic balance in the plant root zone, inhibiting water uptake by plants.

5. Nuisance Conditions and Bird Hazards.

The major nuisance condition associated with sludge landspreading is odor. Until the volatile solids in the sewage sludge have been stabilized, sewage sludge generates odors which may be objectionable to persons living near or traveling past the landspreading operation. Landspreading of sewage sludge may also create other nuisance conditions such as noise and dust generation, and may create a bird hazard at nearby airports. It is possible that large numbers of birds may be attracted to landspreading areas in the vicinity of airports. Airplanes which hit birds during take-off or landing may be damaged seriously enough to cause a safety hazard.

C. The Widespread Use of Landspreading as a Sewage Sludge Disposal Alternative.

In Minnesota approximately 80% of the municipalities generating sewage sludge landspread the sludge. Landspreading programs may require a few acres or several hundred acres to dispose of the sludge generated, and sludge may be

landspread once a year or several times a week. It is the policy of the MPCA to encourage the landspreading of sewage sludge as a beneficial utilization of resource, even when alternative disposal methods are available. The frequency and magnitude of this practice prevents the close surveillance and supervision of each operation by the MPCA. Although the impact of mismanagment in any individual situation may be insignificant, widespread and repeated mismanagement could create serious problems.

In the St. Paul-Minneapolis and Duluth areas, sewage sludge landspreading programs are monitored by the MPCA. In the first half of 1981 the MPCA reviewed 249 proposals to landspread sludge on sites in the St. Paul-Minneapolis area. Approximately 6% of the sites were rejected as unsuitable. On a statewide scale this would represent a considerable amount of MPCA and treatment plant staff time that would be wasted because of the lack of established criteria for evaluating potential landspreading sites. The proposed rules are needed in order to provide a basis to evaluate the pollution potential for each landspreading site based on definite, quantitive standards.

D. The Need for Standards Which Serve as a Guide for Local Ordinances and Conditions and for Correct Landspreading Procedures.

The rules must provide basic guidance for the operation of landspreading sites and facilities. Small treatment facilities which infrequently landspread sludge do not have the resources to hire a consultant to develop a landspreading program. The rules are needed to provide guidance as to the legally and environmentally acceptable methods of sewage sludge landspreading in an accessable format.

Local units of government are becoming increasingly active in reviewing MPCA letters of approval and permits and in developing local conditions and ordinances to regulate sewage sludge management. According to Minn. Stat. § 473.516, subd. 3, county and local units of governments within the Twin Cities metropolitan area may regulate sewage sludge management only to the extent that the conditions established are consistent with MPCA rules. The proposed rules will provide a basis for evaluating such conditions. The proposed rules will be useful to political subdivisions throughout the state as they develop local ordinances and restrictions regarding sewage sludge management.

IV. REASONABLENESS OF THE PROPOSED RULES

A. Reasonableness of the General Provisions.

The general provisions of the rule are necessary in order to provide the working structure for the adminstration of the sewage sludge landspreading program in Minnesota by establishing 1) who must comply with the rules, 2) how information must be submitted to the Agency, 3) how the Agency must respond, and 4) the terms which are used throughout the rule.

6 MCAR § 4.6101

The proposed variance rule is consistent with the standard language used in other Agency rules. It is reasonable to provide direction for parties seeking a variance.

6 MCAR § 4.6102

The proposed applicability rule is necessary to establish the legal responsibility for sewage sludge management and to identify the type of authorization which is required for different types of landspreading operations. It is also necessary to provide direction to municipalities that incinerate or process, store, or dispose of sewage sludge by some other method.

The rule assigns the responsiblity for compliance with the requirements of the rule to the parties which have the authority to manage the sewage sludge and the application area. The political subdivison which generates the sewage sludge maintains the most control over the quality of the sewage sludge and the selection of application areas and landspreading management, and therefore is primarily responsible for the proper disposal of the sewage sludge. However, other parties may also be responsible for sewage sludge management through contract with the political subdivision. The owner of land rented or leased to a political subdivision is responsible for the effects of any activities which were allowed on his property and is responsible for the future use of his land after the facility is closed, and must be included in a permit for a facility. The operator of a landspreading facility also shares the responsibility that the facility will not produce adverse effects and must also be legally included in the permit and the responsibilities attached thereto.

However, it is not reasonable to require the same degree of responsibility for the owners and operators of landspreading sites. In this case, the political subdivision will have the sole control of the landspreading activities at the site. The farmer receiving the sewage sludge cannot be held responsible for ensuring that the sewage sludge is of acceptable quality, that the correct application rates are applied, or that landspreading is conducted in accordance with the requirements of the rules.

6 MCAR § 4.6103

The majority of people using the rule will be wastewater treatment plant operators and local government officials. Typically these individuals are not familiar with agricultural, animal husbandry, soil science, or geologic terms that are used in the proposed rule. For this reason, it is reasonable to define the following terms in 6 MCAR § 4.6103:

animal feed	pasture crops
aquifer	pathogen
available nitrogen	quarry
available water holding capacity	root crops
bedrock outcrop	seasonal high water table
cation exchange capacity	sinkhole
cave	soil horizon
crops for direct human consumption	soil pH
fallow land	soil texture
food-chain crops	soil type
hundred year floodplain	spring
intermittent stream	ten year floodplain
mine	water table

The definition for fallow land is the only agriculture term which has a more limited scope than the common usage of the term. The definition was narrowed to include land that is relatively void of vegetation during the summer, sometimes referred to as black fallow. Under certain conditions, application of sewage sludge to fallow land may result in ground water contamination.

Several terms defined in the proposed rule are consistent with the definitions of Minn. Stat. § 105.37. These terms are lakes and ponds, rivers and streams, and surface water. These definitions are used because these water bodies are considered public (protected) waters and therefore considered important resources by the state. For the sake of consistency, it is reasonable to interpret the terms used in the proposed rule, which are based on the definition of public waters, in the same manner as the DNR has interpreted the terms in Minn. Stat. § 105.37.

The proposed rule also limits the size and type of wetlands. The definition follows the size limitation provided in Minn. Stat. § 105.37, subd. 15. Wetlands are protected in Minn. Stat. § 105.392. It is reasonable to protect wetlands that are protected under statutory provisions.

Three methods of sewage sludge application are defined in the proposed rule.

Surface application, immediate incorporation, and spray application are defined because different limitations apply to each method. The definition for immediate incorporation limits the applicability of the term to sewage sludge that is mixed with the soil within 48 hours of application. This time span is reasonable since it allows the farmer sufficient time to conduct tillage operations and a longer period may increase the potential for runoff, erosion, vector attraction and other impacts that incorporation alleviates. The definition for spray application includes only methods by which sewage sludge is applied under pressure, which may create conditions for aerosol formation. If the definition was not limited in this way, it could be misinterpreted to include application by various types of tank trucks and tank wagons.

Some of the definitions relate to sewage sludge. The definition for sewage sludge is taken from the Waste Management Act which required that these rules be developed. Sewage sludge solids are defined to assure that all sludge chemical parameters and application rates are expressed on a dry solids basis. The term putrescible sewage sludge is limited to sewage sludges with volatile solids contents of 70% or more. This is a reasonable level which treatment plants should be able to achieve. Volatile solids contents above 70% result in an odorous sludge that may attract vectors. It is reasonable to regulate certain aspects of sewage sludge management differently depending on the solids content of the sludge. Sewage sludges that can be handled as a solid can be managed differently than liquid sludges. For this reason, dewatered sewage sludge was defined to include this type of sludge.

Two definitions were taken directly from Minnesota Statutes. These include person and political subdivision.

In order to assist individuals using the rule, it is necessary to provide the location of the federal list of organic priority pollutants within the definition of organic priority pollutant.

The definitions for long term storage and short term storage simply restate what is already established in the rule in order to more clearly identify the differences between them.

The terms place of habitation, residential development, and recreational area were expanded from their common usage to include every conceivable situation that may be impacted by landspreading. It is necessary to specify in each definition the exact situations that should be considered so that there would be no questions regarding interpretation. Landspreading was defined so it could not be misinterpreted to include landfilling.

Landspreading areas were defined as landspreading sites or landspreading facilities based on land ownership. Landspreading sites and landspreading facilities are addressed differently throughout the proposed rules. Because of this difference, it is essential that the distinction between them be clearly established by definition.

6 MCAR § 4.6105-4.6106

The information required for an application for approval of a landspreading site or facility relates to the various requirements and limitations which will apply to the landspreading operation so that Agency staff can determine if the operation will be able to provide adequate protection for the environment and the health and safety of the public. To assist political subdivisions in submitting the required information for an approval, the Agency will provide standard application forms. The use of a form will make applications for approval easier and less burdensome for the treatment plant operator.

It is necessary to have basic information regarding the treatment and composition of the sewage sludge in order to verify the accuracy of the proposal. For example, it is not sufficient to know that sewage sludge is aerobically digested, the retention time and temperature must also be known in order to determine the degree of pathogen reduction. Also, the chemical characteristics of the sewage sludge must be determined within a reasonable time prior to sludge application. Sewage sludge characteristics can change rapidly due to changes in the influent quality, and samples should reflect the conditions which will be most similar to conditions which will exist at the time of sewage sludge landspreading. However, representative sampling, analyses and application development and processing take considerable time, so analyses more current than six months prior to application submittal would not be reasonable.

The information that is required to characterize the landspreading property and management relates to specific requirements and limitations regarding land suitability and operation procedures and also to the information necessary to identify all parties that may be involved with the proposal. In some cases the rule specifies acceptable sources to obtain the information to ensure that the decision to approve or deny the proposal is based on reliable data and also to provide the applicant with guidance in developing an application for a proposed site or facility.

Proposals for landspreading facilities must include all of the information required for landspreading sites and also some additional information. All landspreading facilities will be required to have a ground water monitoring program. The proposal must include information on the location and construction of the necessary monitoring wells. Although the actual sampling frequency and parameters will not be determined until the application is reviewed, basic information on the system is required in order to determine the suitability and reliability of the proposal.

The quality of the ground water must be determined before landspreading operations begin, in order to establish a standard for comparison with future water samples. The parameters required are those that are frequently associated with wastewater or sewage sludge analyses and are routinely performed by most analytical laboratories.

If the facility will be receiving applications of nitrogen or metals beyond the limits established for landspreading sites, the application must also contain evaluations of how the surface and ground water quality, public health and safety, and the food chain will be protected. Because landspreading facilities may differ a great deal, the required submittal information must be general in order to accommodate the great variety of landspreading options that my be developed and proposed. Part of the evaluation for ground water protection involves the identification of specific hydrogeologic and subsoil features. In order to make an evaluation of the potential for ground water contamination from sewage sludge application beyond the specified limits, it is necessary to know the subsurface characteristics to a greater depth than is required for sewage sludge application within the limits.

The source of the required hydrogeologic data will vary depending on the location of the facility, and the acceptable level of information must be determined on a site specific basis and therefore, cannot be specified in the rule. The specific information required will be used to determine the vulnerability of the aquifer to contamination and the potential for such contamination to impact wells in the area. The information obtained from the soil characterization will also be used to determine the effect of the facility on the aquifer quality by

providing information on the attenuation potential of the soil. It is reasonable to require more detailed information for facilities which present a greater pollution potential.

6 MCAR § 4.6107-4.6108

Based on past experience, the Agency has found it necessary to have a program to approve and permit landspreading operations. The agency has issued guidelines and a temporary rule regarding sewage sludge landspreading. Neither document required that approvals be obtained for landspreading operations, except those of the Metropolitan Waste Control Commission (MWCC). The program for approving MWCC proposals has worked successfully with relatively few problems. However, where landspreading was conducted without MPCA approval, problems have developed that could have been avoided by prior MPCA plan review and approval. For these reasons, a permitting/approval program is needed which will apply to every site and facility in the state. This is the only way that the MPCA can know in advance that sewage sludge will be properly managed.

The proposed rules regarding the administration of Letters of Approval and Permits have been developed through several years of Agency experience with sewage sludge landspreading programs. It is essential that the Agency's administrative program provide a reasonably convenient method for political subdivisions to obtain landspreading approval, and provide a fair and effective mechanism for public notification and the resolution of conflicts. The administrative procedures specified in the rule are essentially the same as those in effect with the temporary rule and are based on the program to administer permits issued through the National Pollutant Discharge Elimination System (NPDES) as prescribed in WPC 36. These procedures have, in the past, provided a reasonable compromise between the need of the political subdivision for rapid response to landspreading proposals, and the need to notify concerned parties and provide enough time to allow them to respond to the proposal.

B. Reasonableness of the Requirements and Limitations.

The landspreading of sewage sludge creates a potential for adverse effects on four major areas, ground water quality, surface water quality, food-chain quality and public health. The components of concern in sewage sludge are the macronutrients, metals, pathogens and synthetic organic compounds. Each of these components has the potential to affect one or more of the major areas of concern, depending on a number of factors. For example, under some circumstances nitrate may leach to ground water and reduce the quality of that water. If a shallow well intercepts that poor quality water supply, a public health problem could develop. If some of the sewage sludge applied to the land surface is washed into a nearby lake, nitrogen in the sewage sludge may create a surface water problem. Because of the interrelatedness of sludge landspreading effects and the interlocking nature of those effects, certain provisions of the rules may address several aspects of several problems. An example are the metal application limits which are set to protect 1) the yield potential of the land, 2) the quality of the food crop produced and 3) the ground water beneath the area. This part of the statement will address how each provision will prevent adverse impacts from each component of concern.

Performance Standards

6 MCAR § 4.6121 A.1, B.1, C.1, and D.1

The purpose of these rules is to provide for the protection of the public health and environment in the utilization or disposal of sewage sludge. It is necessary and reasonable to establish the goals or performance standards that

should be accomplished when designing and operating a landspreading facility. Since WPC-22 is the agency rule regarding ground water protection, the proposed rules use this as the standard with which all facilities should comply during operation. The state's surface waters are important resources used for recreation and consumption, and therefore, their uses and quality should be protected. The protection of the public health and safety is a major concern of the agency, consequently, it is reasonable to protect the public who live near or pass by a landspreading facility. Food-chain crops produced at a landspreading facility and consumed by the public may have an impact upon their health. It is essential, therefore, that the food-chain crops produced comply with quality standards established by state and federal agencies.

Analysis

6 MCAR § 4.6111 A.1-A.8

6 MCAR § 4.6122 A.1

The composition of sewage sludge varies a great deal, depending on the composition of the influent and the treatment process at the wastewater treatment plant. It is necessary for the Agency to know the composition of the sewage sludge in order to determine compliance with application rates and other restrictions specified in the proposed rules. Each parameter which the sewage sludge must be tested for relates directly to a requirement of the proposed rules, with the exception of chromium and mercury. Concern exists that chromium and mercury may be potential risks when sewage sludge is landspread. However, no adverse effects have ever been observed as a result of these metals in landspread sewage sludge and insufficient research exists to support specific application limits. The proposed rules require that sewage sludge be analyzed for chromium and mercury in order to identify sewage sludges which may require special consideration under certain circumstances.

The proposed rules specify standard methods for obtaining samples and analyzing for the required parameters in order to maintain uniformity and reliability in the information used to determine application rates.

The required frequency of sewage sludge sampling and analysis is weighted to minimize the burden for small treatment plants. Small treatment plants are required to monitor sewage sludge quality less frequently than larger treatment plants. In general, small treatment plants serve small, stable communities and sewage sludge quality does not vary a great deal, due to limited industrial discharges. However, the proposed rules provide for increased monitoring frequency if any parameter is present at high concentrations, or decreased frequency if it can be shown that the required schedule is not warranted due to sewage sludge quality, variability or landspreading frequency. Where more frequent analyses are required, the frequency is based on the concentration of the metals which exceed median levels as established in a survey of sludge quality from more than 200 treatment plants in Minnesota, Wisconsin, Ohio, Michigan, Illinois, Indiana, New Jersey and New Hampshire. For example, half the sewage sludges in these states contain less than 20 parts per million of cadmium. If a sewage sludge contains 20 or 40 parts per million, then analyses for cadmium must be conducted at twice or three times the minimum frequency in order to provide a more accurate basis for determining application rates.

The minimum frequency for sewage sludge sampling and analysis for landspreading facilities is once per year, however, more frequent sampling and analysis may be required if it appears necessary. The factors which will be considered in the Director's decision on monitoring frequency are specified in

the proposed rules. Because of the flexibility that is allowed in the design and operation of landspreading facilities, it is not possible to establish a monitoring schedule in the proposed rules that will be relevant in all situations. Some agency discretion is necessary in order to avoid unreasonable burdens on facilities which present minimal risk and to provide additional protection if a facility poses a high risk.

Pathogen Reduction

6 MCAR § 4.6111 B.1

6 MCAR § 4.6121 C.2.a

Raw sewage sludge contains high populations of viable pathogens that could present a serious disease hazard if the sewage sludge was applied where human contact was possible. The Environmental Protection Agency (EPA) has recognized this potential problem and has included minimum pathogen reduction requirements in its criteria for sewage sludge disposal (40 CFR Part 257). The proposed rules have adopted all of the EPA criteria relating to pathogen reduction, although the requirements have been rephrased to be more easily understood. The acceptable processes to significantly reduce pathogens (PSRP) are those which will produce a ten-fold reduction in viable pathogen levels.

Other processes (PFRP) may be used to essentially eliminate viable pathogens and are prescribed in 6 MCAR § 4.6136. However, this level of protection is unnecessary unless certain activities will be conducted at the landspreading site or facility. The conditions which require that the sewage sludge be treated by a process to further reduce pathogens (PFRP) will be discussed in the section of this statement which addresses management requirements.

Organic Priority Pollutants

6 MCAR § 4.6111 F.1-F.3

6 MCAR § 4.6121 D.2.c-D.2.d

The proposed rules also include the provisions regarding PCBs in sewage sludge that are established in the EPA criteria (40 CFR Part 257). The proposed rules set limits on the maximum levels of PCBs that may be present in sewage sludge that is landspread. If the sewage sludge contains more than ten parts per million of PCB, it must be managed differently, e.g. incorporated. If the sewage sludge contains more than fifty parts per million of PCB it may not be landspread. These restrictions are based on the need to prevent high levels of PCBs from entering the food chain, either through ingestion with soil, adhesion to food chain crops, or in runoff to surface waters.

The proposed rules specify that sewage sludge which contains high concentrations of priority pollutants must be analyzed for that pollutant and managed appropriately. Because the list of priority pollutants contain sixty-five compounds, it is not possible to establish limitations in the proposed rules for sludge containing varying amounts of every priority pollutant. Some degree of discretion is necessary in order to provide the flexibility to regulate the situations where organic priority pollutants may present a hazard, without imposing an unreasonable burden on those treatment plants which do not generate a sewage sludge which contains an organic priority pollutant and which do not require special consideration.

Soil Characteristics

6 MCAR § 4.6111 G.1-G.8, I.4, J.6-J.7, J.9

6 MCAR § 4.6121 A.2.b-A.2.c.

A number of soil factors interact to determine the suitability of land for sewage sludge application. The soil will be a factor in determining the amount of attenuation, retention and removal of waste components that will occur to prevent their migration downward to ground water or overland to surface waters.

The available water holding capacity (AWC) of a soil is the ability of a soil to hold water against the force of gravity and available for use by most plants. As it relates to sewage sludge landspreading, it is an indication of the capacity of a soil to retain sewage sludge components in the upper soil horizon long enough for soil and environmental mechanisms to attenuate those components. The AWC of a soil is frequently used to characterize a soil's suitability for various waste treatment operations because the degree of attenuation and removal of waste constituents is a function of the residence time of those constituents in the soil. A soil with a high ability to retain water will hold nitrate, pathogens, soluble metals and synthetic compounds within the soil treatment zone where soil mechanisms and crop uptake can act to reduce the potential that those components will move to groundwater.

The AWC of a soil changes with depth and is determined by the soil texture, structure and organic matter content. The proposed rules require consideration of the soil profile to a depth that will provide 6 inches of AWC. It is not reasonable to require a certain separation distance to the water table or bedrock based solely on a soil's surface texture. In some cases a soil may have a very high AWC (a fine texture) in the surface horizon but may be very coarse below, or, a soil may be coarse on the surface but the entire profile may be relatively impermeable. In either of these cases, the texture of the surface soil does not accurately characterize the soil profile and its ability to restrict leachate migration.

Depending on the specific nature of a soil profile, the required 6 inches of AWC will be obtained in varying soil thicknesses. For example, a soil which is uniformly loamy sand with an AWC of 0.07 in./in. would require a water table at least 7 feet below the surface in order to provide the required 6 inches of AWC.

The minimum of 6 inches of total AWC is based on research and recommendations by various governmental agencies, agricultural organizations and universities. Much research has been conducted measuring the movement of various sewage sludge components through different soil profiles. The depth of migration varied as a result of several factors, such as application rate, soil properties and nature of the component. Based on this research, 6 inches was selected as the most reasonable limit that would still provide adequate waste treatment. The AWC of a soil may be determined by direct analysis or from Soil Conservation Service (SCS) Soil Surveys, soil interpretation sheets or local SCS office personnel.

At a minimum, landspreading sites may not have less than 3 feet of soil between the sewage sludge application zone and the bedrock or water table. This minimum separation distance is specified to ensure that the physical filtering capacity of the soil is uniformly adequate. Areas that are too small to be located on a soil map may exist at a site. These areas may contain coarse conducting layers, vertical conduits, elevated water tables or bedrock; or soil properties which may be less suitable for sewage sludge application than the surrounding mapped soils. Therefore, a minimum separation distance of three feet is required to compensate for any variability within the soil that receives sewage sludge.

The texture of the soil at the zone of sewage sludge addition controls the retention of sewage sludge components at the soil surface, and affects both the food chain and ground water quality. The requirement that very coarse textured soils may not receive sewage sludge ensures that soluble sewage sludge components will not migrate rapidly from the soil surface where most of the soil physical, chemical and biological activities which attenuate and immobilize waste components take place, thereby affecting movement to ground water or plant

uptake. The texture of the soil determines the amount of adsorptive surfaces and reactive compounds that are present in the soil. The surface soil also usually contains the highest population of microorganisms, and the physical effects of ultraviolet light, freezing and drying are more extreme in the surface layer.

The soil permeability is the property of a soil that enables it to transmit water. The proposed rules specify a maximum permeability for the soil within the top five feet in order to further characterize the soil for waste treatment. The soil permeability must be used on conjunction with the surface soil texture and AWC requirements. A soil with a low permeability will not transmit water and soluble waste components below the plant rooting zone so rapidly that soil mechanisms cannot act to treat the waste. The proposed rules only prohibit sewage sludge application on soils which are uniformly coarse textured throughout the upper five feet.

The limitation of six inches per hour maximum permeability is based on Soil Conservation Service recommendations for soils suitable for waste disposal. A greater permeability would place the soil in a class which the SCS considers to have only a moderate limitation for waste disposal. Six inches per hour or less constitutes a slight limitation for waste disposal.

The following examples of various soil conditions will show how surface texture, permeability, the minimum depth to the water table, and AWC can be used to determine the suitability of a soil for sewage sludge application.

Soil thickness	A	B	C	D
0 - 12"	Coarse sand and gravel	Loamy Sand	Loam	Loamy Sand
12 - 36"	Sandy Loam	Loamy Sand	Sandy Loam	Sandy Loam
36 - 60"	Sandy Loam	Loamy Sand	Sand	Sandy Loam
Watertable at:	6 ft.	10 ft	5 ft	5 ft

Profile A has a very coarse surface but has, as a result of the sandy loam below the surface, an AWC of more than 6 inches above the water table and a permeability throughout the profile of less than 6 inches/hr. However, this soil is not suitable for sewage sludge application because the surface texture is too coarse.

Profile B is a uniform profile of loamy sand. The surface texture is acceptable according to the proposed rules and 6 inches of AWC are provided within the top 7 feet. However, this profile provides no barrier to rapid movement of water, every horizon has a permeability of 6 inches/hr. or greater. Therefore, this soil is not suitable for sewage sludge application.

Profile C shows a medium textured soil with a water table at five feet. The surface soil and permeability comply with the proposed rules. However, the soil is unsuitable because 6 inches of AWC is not present above the water table; the soil would be suitable if the water table was two feet deeper.

The soil in profile D may appear to be coarse and not suitable for waste treatment. However, although the profile provides only the minimum AWC and surface texture, it avoids being too permeable throughout the profile, and the combination of all these factors is sufficient to provide adequate waste attenuation. This soil would be acceptable for sewage sludge application according to the proposed rules.

It is necessary that the proposed rules distinguish between perched water conditions and seasonal high water table and not require protection for perched water conditions. Perched water is not used as drinking water supply nor is it, according to the definition in the proposed rules, connected to an aquifer. Perched water is a soil water condition and not considered a ground water table and, therefore, is not protected.

Sewage sludge may not be applied to soils which have karst or fractured bedrock within six feet of the soil suface. Karst and fractured bedrock are associated with ground water that is very vulnerable to contamination. Contaminants can move rapidly through this sort of bedrock with little or no attenuation or dilution. By requiring three feet more than the minimum separation distance of three feet, the rule provides additional protection for these sensitive aquifers. Bedrock maps exist which show where these conditions exist or this information may be obtained from the Minnesota Geologic Survey.

The storage of sewage sludge involves additional concerns regarding ground water protection. According to the proposed rules, sewage sludge may be stockpiled at a site for a few days or for as long as seven months. Although dewatered sewage sludge is largely impermeable and does not contain free moisture, the concern exists that the large amount of sewage sludge concentrated in one area will contribute to leachate generation and migration.

Where sewage sludge is stockpiled for short periods, the proposed rules only require that the same soil conditions for suitable landspreading sites apply to the stockpile site. Very little decomposition of the sewage sludge in the stockpile will occur in the one month that is allowed for short term storage. Therefore, the only concern for the ground water quality beneath the site arises from the sewage sludge that remains after the pile is removed. This is usually a small amount and can be considered comparable to the sewage sludge which is spread over the entire field, therefore the soil conditions that are suitable for landspreading also apply to short term stockpiles. Also, the soil located at the short-term stockpile site is usually plowed and cropped, consequently, nitrate leaching is controlled.

Long-term storage of sewage sludge, where sewage sludge may remain stockpiled for as long as seven months, may present a greater potential for ground water contamination due to the increased decomposition of the sewage sludge, which releases soluble components, and greater total precipitation which will encourage leachate production from the stockpile surface. Because of the increased potential for leachate production, the proposed rules require that the soil beneath the stockpile site have at least eight inches of AWC, which is two inches more than is required for short term stockpiles. Two soil borings are required at the site of long-term storage. Borings are required because storage sites are usually relatively small and soil maps are not of a scale to adequately indicate differences on such a site specific basis. The boring logs are used as a check to verify the soil map.

Location Characteristics

6 MCAR § 4.6111 G.10, H.1-H.3, H.5-H.7, I.2-I.3, J.2-J.5

6 MCAR § 4.6121 A.2.d, B.2.a-B.2.b, B.2.e

The potential for adverse effects from sewage sludge landspreading can in many cases be greatly reduced by maintaining certain distances between the sewage sludge application area and the area that may be affected. The distance that must be maintained will vary depending on the seriousness of the hazard, the degree that distance can mitigate the effect, and the presence of other mitigating factors such as land slope and soil texture.

Surface waters near a landspreading area may receive runoff water from that area. Some provisions of the proposed rules prevent the accumulation of excessive levels of waste components in the soil surface where they will be subject to erosion and transport from the site. Those provisions will be discussed in the section of this statement which addresses management requirements. In addition to the management requirements to minimize the effect of landspreading on surface waters, the proposed rules also provide requirements regarding the suitability of the property for landspreading. Waste components that are

transported over the soil surface, either with eroded particles or in solution, can be attenuated by the surface soil and vegetation so that the runoff water is cleaned of those components over a certain distance. The distance that is necessary depends on several factors. The soil texture, land slope, time of year and type of surface water are all factors which will determine the effect of the landspreading operation on surface water quality.

Soil texture will determine how rapidly the runoff water will infiltrate into the ground. Coarse textured soils will have much less runoff after a rainstorm than a fine textured soil with low infiltration. Therefore, a greater distance is needed for a fine textured soil before waste components will be absorbed into the soil. The specific soil permeability and surface texture requirements were discussed previously in the section of this statement addressing suitable soil conditions. However, as they relate to the separation distances required in the proposed rules, it is sufficient to characterize soils into two general textural classes, 1) coarse textured, and 2) medium and fine textured.

The slope of the application site has a direct impact on the potential for contaminant migration with surface runoff. As the land slope increases, the velocity of the runoff water increases. This results in an increase in the ability of the runoff water to detach particles from the soil mass and transport them from the field. The proposed rules specify various separation distances for different land slopes and management practices. If sewage sludge is injected or incorporated into the soil there is less potential for erosion of sewage sludge particles and therefore the acceptable land slope may be increased and the separation to surface water decreased without increasing the potential for adverse effects.

The infiltrative capacity of the soil will vary according to the time of year that sewage sludge application occurs. If the ground is frozen, infiltration is reduced and the potential for waste components to be transported from the site is increased. For this reason, the proposed rules specify increased separation distances for application during the months that the ground is frozen.

The required separation distances to intermittent streams are less than the required separation distances to other surface waters. Intermittent streams are generally not high quality waters for drinking or recreational uses and are often no more than a drainageway through a field. If an intermittent stream does not discharge to a surface water, application of sewage sludge within twenty five feet of the stream will not impair the usefulness of that water. If an intermittent stream discharges to a surface water there is an increased potential for adverse effects as a result of runoff. However, the rule specifies that the intermittent stream must flow for at least one mile from the point of sewage sludge application to the discharge point if the reduced separation distance will be allowed. Biological, chemical and physical process in the water and stream bed will provide the same attenuation mechanisms as the soil system so that waste components will not present a threat to the protected surface water.

Sewage sludge which is stored for long periods of time has an increased potential for erosion loss because no soil processes are able to act on the sludge components until after it is transported from the stockpile. Therefore, the rule requires a greater separation distance between long term stockpiles and surface waters or ten year flood plain unless measures to control runoff are used. Ten year flood plains are included in this restriction because the length of time sewage sludge may be stored at a long term stockpile increases the potential that eroded waste components may be transported to flood waters

without any soil treatment.

The separation distances to surface waters that are required for landspreading facilities differ from those that are required for landspreading sites. The required separation distances from a facility to surface water are based on the purpose of the Shoreland Management Act, Minn. Stat. § 105.485. One purpose of the Act (subd. 1) is to preserve the economic and natural environmental value of shorelands. According to the Act, shoreland means land located within 1000 feet of the normal high water mark of a lake or pond and 300 feet of a river or stream. The proposed rules are following the purpose of the Act by requiring the same setback distances specified in the Act for the location of a landspreading facility in the vicinity of a lake, pond, river or stream.

In addition to providing protection for surface waters, separation distances also protect drinking water wells and reduce nuisance conditions which may result from landspreading.

Wells in the vicinity of the landspreading operation are protected by the requirements which minimize the movement of waste components to ground water, and additionally, by separation distances between the well and the landspreading operation. Four types of wells are identified in the rules in regard to separation distances. Monitoring and sampling wells are exempt from any separation distances because of the need to locate these wells where they will be most useful in detecting contaminants. Public water supply wells have the greatest separation distance requirement because generally, such wells have a large zone of influence in order to supply water for a municipality. By drawing from a large area, the well has an increased potential to draw in contaminants from sources outside of the immediate area.

The required separation distances to private water supply wells are based on the potential risk presented by the landspreading operation. Landspreading facilities, because they are monitored, and if intensively used must have a hydrogeologic assessment, do not need separation distance requirements except in cases where very vulnerable wells are located nearby. Wells which are not in compliance with the Minnesota Well Code, that is, wells which are finished at a depth of less than fifty feet, are more easily contaminated than deeper wells. Therefore, the proposed rules specify a separation distance to only these wells in the vicinity of a facility.

Landspreading sites, although not monitored, present a lower potential for adverse impacts on well quality than landspreading facilities because of the less intensive use of the site. Therefore, a minimum separation distance to any private well is specified, regardless of the depth of the well.

Concerns for sewage sludge landspreading also include odor generation and the potential for infection either through direct contact or aerosols. The distance a storage area or landspreading operation is located from residences or areas frequented by the public will affect the aesthetic acceptability of the operation. Sewage sludges vary in the amount of odor generated, in some cases a distance of several thousand feet is not sufficient to completely eliminate the odor, while in other cases, the odor is not detectable within a few hundred feet. The required separation distances, of 200 and 600 feet between the landspreading site and residences and recreation areas will provide some reduction in odor intensity but are mainly to reduce the potential for inadvertent contact and disease transmission.

Aerosols which can transport pathogens can be generated from liquid sewage sludge application processes. Such aerosols generally do not travel far, but a

minimum separation distance will provide additional protection and also minimize the potential for small children and house pets to come in direct contact with sewage sludge.

If sewage sludge is injected into the soil, the potential for direct contact, aerosol formation and odor generation is greatly reduced and the required separation distances are reduced accordingly.

<u>Special Land Considerations</u>

6 MCAR § 4.6111 K.1, K.3

6 MCAR § 4.6121 B.2.c-B.2.d

The rule prohibits landspreading on certain types of land unless certain measures are met. Sewage sludge may not be deposited in caves, sinkholes or wetlands because of the very high potential for ground water contamination from such practices. Such practices are not consistent with agricultural utilization, which is the basis for effective waste treatment. In some cases, mines or quarrys may be reclaimed by sewage sludge application although generally such areas are not suitable for effective crop uptake of nutrients in the sewage sludge which would prevent their becoming contaminants. However, if the sewage sludge will be used as an amendment and an aid in a reclamation project, then its agronomic use is allowed by the rules.

Wetlands are defined in the rule to include those areas which are not protected waters according to the DNR but which are classified as Type 3, 4 and 5 wetlands according to the U.S. Department of the Interior. Minnesota Stat. § 105.392, Water Bank Program, establishes the policy of the State in regard to wetlands. It states that "The legislature finds that it is in the public interest to preserve the wetlands of the state and thereby to conserve surface waters, to preserve wildlife habitat, to reduce runoff, to provide for floodwater retention, to reduce stream sedimentation, to contribute to improved subsurface moisture, to enhance the natural beauty of the landscape and to promote comprehensive and total water management planning."

In addition, Minn. Stat. § 105.391, subd. 3 prohibits the drainage of wetlands. Undrained wetlands cannot meet the water table depth requirements of the rule and therefore cannot be used for sewage sludge application.

Organic soils, which are not classified in the proposed rules as coarse, medium or fine textured soils, should not be used for sewage sludge application due to the high water tables and flooded conditions frequently associated with them. However, if organic soils are adequately drained, and meet the other requirements for suitable soils, they may be used for sewage sludge application.

The prohibition of landspreading facilities in hundred year flood plains is based on the Federal criteria for the classification of solid waste disposal facilities and practices (40 CFR Part 257). Part 257.3-1 of the Federal criteria states that a facility may not result in washout of solid waste, so as to pose a hazard to human life, wildlife or land or water resources. This requirement has been interpreted to mean that the landspreading facility may not be located where a significant chance of flooding may occur. It is assumed that any flooding of the soil surface immediately after sewage sludge landspreading will result in washout, although the extent of the impact of such washout cannot be determined for all cases. Diking or berming of facilities would reduce or eliminate the potential for washout, however, practices that restrict the flow of the 100 year flood or reduce the temporary water storage capacity of the floodplain are also prohibited by the Federal criteria. 6 MCAR § 4.6121 C.2.d

The location of airports in relation to landspreading facilities is a factor

in determining the effect of the facility on the safety of the public. EPA criteria for the classification of solid waste disposal facilities (40 CFR Part 257) require that landspreading operations not present a bird hazard to aircraft. Activities at a landspreading facility may tend to attract birds which, if in the vicinity of low flying aircraft, may cause equipment damage and malfunction. The EPA criteria require that if the facility is located within specified distances of different types of airports, the facility must not present a bird hazard to aircraft. The MPCA has no staff to address bird hazards and consequently is not able to make such a determination; therefore, the rules require Federal Aviation Administration approval if the facility is located within the distance identified by the EPA as being a potential hazard area.

6 MCAR § 4.6111 E.4

In some cases it may be necessary to maintain a sewage sludge application site as fallow land. Fallow land may be used under certain limited conditions which will compensate for the lack of crop uptake. Management and site selection will affect the amount of nitrate formed and the extent it will move. The site selection considerations involve the soil texture and area of the state the site is located in.

The rule requires that the soil at a fallow land application site be fine or medium textured. Coarser textured soils have more air spaces which will encourage the formation and movement of nitrates due to the high oxygen level and permeability. Finer textured soils depress the formation and movement of nitrates and provides more optimum conditions for denitrification, which is the transformation of nitrate into gaseous forms that are volatilized to the atmosphere.

The annual precipitation at the landspreading site will be a factor in determining the extent of leachate migration. In areas of western Minnesota which receive less than 24 inches of annual precipitation, nitrate accumulates in the subsoil. In this area of the state, evapotranspiration generally exceeds precipitation, consequently conditions for leaching usually do not exist. Nitrate may move downward with percolating water but not so far that it cannot be reached by plant roots or move back up as soil water is drawn up by crop uptake and evaporation. Under these conditions, the potential for nitrate contamination of ground water is much reduced. An annual precipitation limit of 24 inches is specified in the rule because this limit corresponds to the area of the state where a nitrate soil test is used by the University of Minnesota to determine crop nitrogen requirements. This soil test is based on the fact that nitrate in the soil profile will not leach, but will be available the following growing season for crop uptake.

Application Rates.

6 MCAR § 4.6111 E.1-E.4, G.11

6 MCAR § 4.6121 A.2.e

Because the nitrogen content of sewage sludge is a major reason why sewage sludge is desirable as a soil amendment, crop nitrogen requirements are used as the basis for determining application rates, except when metal application rates are the limiting factor. The amount of sewage sludge that may be applied to a crop will depend on the amount of available nitrogen in the sludge, the nutrient requirements of the crop and the texture of the soil. Excessive applications of nitrogen will increase the potential for contamination of surface and ground waters and impair the quality of some crops. The nitrogen which is of concern is the nitrogen which is in the available form (readily mineralized and

inorganic). The total nitrogen in sewage sludge is not available for crop uptake or movement in solution, most is bound in organic forms. The amount of available nitrogen in sewage sludge has been determined by research studying mineralization of sewage sludge organic nitrogen and volatilization of ammonia from sewage sludges produced by various treatment processes. The amount of nitrogen that crops can utilize has been determined by agricultural research and is discussed in the part of this statement dealing with the appendices. The proposed rules correlate the amount of available nitrogen in the sewage sludge with the amount that a crop can utilize to determine the acceptable application rate. In addition, the soil texture is taken into account in the determination of crop nitrogen requirement because the soil texture and related conditions will be a major factor in denitrification. More nitrogen may be applied to crops on medium and fine textured soils because of the increased potential for gaseous loss of nitrogen via denitrification.

When sewage sludge is applied to fallow land, there is no crop utilization basis for determining acceptable application rates. The fallow land application rates specified in the rule represent estimates of the amount of nitrogen that will remain in the rooting zone under low precipitation and low soil permeability conditions.

The proposed rules also require that a crop be produced the year after sewage sludge is applied to fallow land. In addition to the nitrogen that was immediately available from the sewage sludge, more nitrogen becomes available as the organic matter in the sewage sludge mineralizes. This makes it especially important to produce a crop the year after sewage sludge is applied to fallow and to subtract the amount of nitrogen already in the soil from the total amount the crop will require.

Sewage sludge contains relatively high concentrations of phosphorus that will usually provide more than the crop requires when sewage sludge application rates are based on nitrogen requirements. After repeated applications, phosphorus may build up to very high levels in the surface soil. Most soils are able to retain a large amount of phorphorus within top few inches of soil which prevents phosphorus from moving down to ground water. In addition to being an efficient use of a resource, high levels of phosphorus in the surface soil may increase the potential for surface water contamination. If soil containing high levels of phosphorus is eroded and transported to surface water, it may contribute to excessive algal growth which will diminish the quality of that water. Four hundred pounds of extractable phosphorus per acre is a reasonable limit because it is within the amount that can be retained by the soil and is considerably above the level that is considered very high for crop production.

In order to prevent the accumulation of salts in the soil surface, the proposed rules require that the electrical conductivity, which is a measure of the concentration of soluble salts, be less than four millimhos per centimeter. Four millimhos per centimeter is the point where some plants begin to show adverse effects and reduced yields due to high soil salinity.

In order to ensure that sewage sludge is not causing adverse soil effects and to ensure that soil conditions are acceptable for successful crop production, the proposed rules require certain analyses to be conducted on a yearly basis. The parameters that must be monitored affect the management and productivity of the landspreading operation. The required analyses are routinely conducted by various soil testing laboratories for a reasonable fee.

6 MCAR § 4.6111 C.1-C.3, D.

6 MCAR § 4.6121 D.2.e-D.2.g

The proposed rules specify application limits for heavy metals in order to prevent their accumulation in the soil and subsequent contamination of surface and ground waters, but mainly to protect the productivity of the land and the quality of the crops produced.

The soil pH, cation exchange capacity (CEC), type of crop and the amount of cadmium applied annually and cumulatively all affect the amount of cadmium that is accumulated in the crop. Each of these aspects is addressed by the EPA criteria for classification of solid waste disposal facilities (40 CFR Part 257). The proposed rules are essentially the same as the EPA criteria with one exception. The EPA criteria allow two levels of cumulative cadmium application depending on the background soil pH. In Minnesota, no reliable means of determining background soil pH is available. After consulting with EPA staff and University researchers it was determined that the available methods to determine background pH are subjective and do not, in most cases, provide a relevant indication of what soil conditions will be in the future. Because the pH of the soil during the first few years after sewage sludge application is the most important factor in controlling plant uptake, the EPA criteria have been adapted to be more relevant to existing conditions in Minnesota and to reflect the results of current research on and understanding of cadmium/soil relationships.

The proposed rules specify that the maximum amounts of cadmium allowed by the EPA criteria may be applied, regardless of the soil's background pH. In some cases, this maximum level may exceed the level that would be allowed by the EPA criteria, if the background pH could be determined. However, since soil pH does not decrease rapidly with time and several years are available for the soil to bind cadmium, an eventual decrease in pH will not produce excessive cadmium availability. Therefore, it is reasonable to regulate soil pH only at the time of sewage sludge application. It is not reasonable to base cadmium application rates on a factor that cannot be measured (background soil pH). Therefore, the Agency feels that the most reasonable course is to allow the application of cadmium to all land at the maximum safe levels that the EPA will allow and also to require that the pH be maintained at a level which will reduce crop uptake of cadmium for several years after sewage sludge is applied, which is the time that cadmium is most available for uptake.

Under certain conditions it is reasonable to allow cadmium applications in excess of the cumulative limits. The acceptable conditions for application of high levels of cadmium are based on the EPA criteria for application of excessive cadmium to land, and in addition, the proposed rules require that vegetative tissue be sampled to ensure that excessive cadmium has not accumulated in the crop. Monitoring of vegetative tissue is also required if the annual cadmium application limits are exceeded, if certain crops are grown, or if the soil pH at a facility is lower than the required minimum.

The other heavy metals, copper, zinc, lead and nickel, are regulated because of their potential to impair crop growth when high levels are present in the soil and because of the potential for adverse animal health effects from ingestion with soil. Unlike cadmium, there is very little concern that the annual application rates of these metals will produce adverse effects. However, repeated applications will produce high soil concentrations. For this reason, only cumulative application limits are specified in the proposed rules. The limits are based on the cation exchange capacity (CEC) of the soil. The use of soil CEC does not mean that metals added with sludge are retained as exchangeable cations. The CEC is used as an index because it is related to soil properties which will minimize the plant availability of metals and it is easily estimated.

The application limits are recommended by the EPA and were developed by joint efforts of researchers in various Agricultural Experiment Stations, the U.S. Department of Agriculture and the U.S. EPA, and are also used in guidelines and rules from other states.

Management

6 MCAR § 4.6111 J.8., K.5

The application rates specified in the rules are based on pounds per acre. It is important that the sewage sludge be landspread evenly over the entire application area. If large amounts of sewage sludge are applied to some areas and none to others, mitigating soil and crop mechanisms may not be able to adequately treat the waste components and the pollution potential may be increased. Therefore, the proposed rules specify that sewage sludge must be applied evenly and uniformly to the site.

Where sewage sludge is stockpiled for a long period, there is an increased potential for more sewage sludge to be left on the soil beneath the stockpile then is applied to the rest of the area. If sewage sludge is stockpiled several times on the same location, the soil may not be able to assimilate the additional waste components and pollution may occur. Therefore, the proposed rules require that long term stockpiles not be located at the same area for two or more consecutive years. This will ensure that the storage area is cropped at least every other year and thus utilize added sludge nitrogen and allow the soil at least a twelve month period to assimilate waste components.

6 MCAR § 4.6111 B.2-B.5

6 MCAR § 4.6121 C.2.c, D.2.a-D.2.b

The proposed rules require certain conditions which will minimize the potential for disease transmission as a result of the pathogenic organisms in sewage sludge. The proposed rules require that the sewage sludge must either be further treated to reduce pathogens or the landspreading operation must be managed so that pathogens cannot contact a host.

Processes to further reduce pathogens (PFRP) are specified in 6 MCAR § 4.6136 and involve the treatment of sewage sludge so that it is essentially free of pathogenic organisms. A PFRP is required if access to the operation is not controlled, or if livestock will be grazing within one month of sewage sludge application, or crops for direct human consumption are grown on the sewage sludge application area. If the sewage sludge is not treated by a PFRP, the proposed rules specify various activities that the area may not be used for until certain time periods have passed. The requirements in the proposed rules regarding PFRP and land uses for pathogen control are adopted from the EPA criteria for the classification of solid waste disposal facilities (40 CFR Part 257).

Additional measures to reduce contact with pathogens have been included in the proposed rules. The proposed rules specify that sewage sludge may only be applied to forage crops when foliage is minimal. Sewage sludge will adhere to vegetation and increased levels of metals, synthetic organic compounds and pathogens may be added to the animal diet if sewage sludge is applied to foliage. By limiting the time period after cutting forage, the proposed rules ensure that the minimum leaf area will be exposed and new plant growth will not be affected by the application of sewage sludge.

6 MCAR § 4.6111 G.9, K.4

6 MCAR § 4.6121 C.2.b

Liquid sewage sludge applications are limited in the proposed rules so that sewage sludge does not remain on the soil surface for long periods of time

where it can produce nuisance conditions and also increase the potential for direct contact with pathogens or disease transmission through vectors such as flies and domestic animals. The maximum gallon rates that are specified for sites are based on the soil texture. Coarse soils are more permeable than fine textured soils, therefore, more liquid can be applied without ponding on the surface. The maximum application rates are specified for sites because it would be time consuming and burdensome for treatment plant operators to determine site specific application rates based on sewage sludge and soil characteristics at the time of sewage sludge application. Operators of facilities which may receive repeated applications of liquid sewage sludge must determine the appropriate application rates according to the specific characteristics of the soil and the sewage sludge, so that the sewage sludge applied will infiltrate into the soil in a day.

An additional provision of the proposed rules requires that sewage sludge not be applied to ponded areas because such areas do not provide the infiltrative capacity necessary to minimize the disease and nuisance condition potential of ponded sewage sludge.

6 MCAR § 4.6111 I.1, J.1

6 MCAR § 4.6121 A.2.f

The proposed rules establish three categories of sewage sludge storage -- short term, long term and storage at a facility, which may be continuous. The time spans which are allowed are based on the various storage needs for landspreading. Short term storage is storage for as long as one month at a landspreading site. Several days may be required to deliver enough sewage sludge to a landspreading site and in some cases, landspreading may not be conducted due to equipment failure, adverse weather conditions, or scheduling conflicts. Therefore, the proposed rules stipulate that sewage sludge must be spread as soon as conditions permit, but recognize that conditions may prevent spreading for a considerable time. Thirty days is a reasonable time span to allow the operator to either landspread the sludge or find a storage area suitable for long term storage.

Long term storage is allowed so that sludge generated during the winter or during the growing season may be stored at the intended application area until the fields are accessible. Except under certain conditions, long term storage is only allowed at the site which is to receive the sludge. Those conditions will allow a property owner who proposes to have sludge applied to several parts of his property to store the sludge at one location if all the application sites are located within a half mile radius. The restriction is intended to prevent the establishment of central storage areas containing sludge intended for use on many landspreading sites in the area. The land suitability requirements regarding sewage sludge storage are based on the assumption that a reasonable amount of sewage sludge will be stockpiled at a site and allowed to crust over. A certain amount of nuisance is inevitable from the dust, noise and odors associated with sewage sludge hauling. However, after sewage sludge is delivered, nuisance conditions should diminish. Allowing sewage sludge to be stockpiled at a central landspreading site but landspread at other sites would be an unreasonable burden for the residents in an area to accept. Also, several townships in Minnesota prohibit stockpiling of sewage sludge. Without the restriction in the proposed rules, local prohibitions may lead to the stockpiling of large quantities of sewage sludge in other townships or counties that do not have ordinances against stockpiles.

Sewage sludge may be stored on a continuous basis at landspreading facilities although the method of storage will vary according to the design of the facility. The proposed rules establish acceptable standards for liquid and

dewatered sewage sludge storage. The seepage restriction for liquid sewage sludge storage is based on a study developed by the Agency with the aid of a consulting firm which addresses the acceptable rate of seepage from municipal waste treatment ponds. Storage pads for dewatered sludge must be constructed to prevent cracking and subsequent leachate infiltration.

6 MCAR § 4.6111 K.2

The proposed rules require that the permission of the landowner be obtained before sludge is applied to the land. This is required because some aspects of sewage sludge landspreading may affect the land use for some time after the initial sewage sludge application. For example, a landowner may rent land for one year and plan to grow vegetable crops the next year. If the renter applies sewage sludge, the landowner will not be able to produce certain crops the next growing season. This requirement also provides an additional safety factor to ensure that sewage sludge is properly applied and managed by requiring permission from the person most interested in the long term care of the property.

6 MCAR § 4.6111 H.4, K.6

The proposed rules also require that the boundaries of the sewage sludge application area be clearly marked in order to prevent the inadvertant application of sewage sludge to areas which should not receive sewage sludge. It is important that sewage sludge not be applied where soil or site characteristics are unsuitable and to avoid the application of sewage sludge to adjoining property or road right-of-ways. It is not reasonable to expect that the operator of the application equipment will be able to identify unsuitable soils or unmarked property lines at the time of sewage sludge application. Therefore, the proposed rules require that such boundaries be identified prior to sewage sludge application and remain marked during the time sewage sludge is being applied.

6 MCAR § 4.6111 K.7

The putrescence of a sewage sludge is based on the level of volatile solids contained in it. Putrescence is an indication of the odors and vector attractants that will be generated at the application area. A sewage sludge which is highly putrescible will create nuisance conditions for the residents of the surrounding area. Incorporation of the sewage sludge into the soil will promote the microbial decomposition of the volatile solids and prevent odor release into the air. In most cases, increased levels of pathogen reduction will decrease the putrescence of the sewage sludge. However, this does not apply in all cases and the degree of pathogen reduction cannot be used as an index of odor potential.

6 MCAR § 4.6121 A.2.a, B.2.f

Landspreading facilities are required to have a ground water, and in some cases, a surface water monitoring program because of the potential for intensive use of the property. A program to monitor ground water is required for all facilities in order to 1) ensure that ground water quality beyond the facility boundary is not affected, 2) alleviate public concerns regarding the operation of the facility and 3) provide protection for the municipality which operates the facility in the event that an unidentified source is polluting the ground water in the area. Also, in some cases facilities will be allowed to apply sewage sludge in excess of agricultural rates, and monitoring wells will also serve to signal changes in ground water quality so that the landspreading operation can be modified or discontinued.

A reasonable minimum number and general location of the required monitoring wells is specified in the proposed rules to ensure that reliable, relevant data is obtained. Often, a single monitoring well is not able to provide consistent, accurate data. A second well at the same depth will provide a means of back-up sampling and verification of data. Upgradient and downgradient wells are required in order to establish background water quality and to determine if the facility is causing a change in water quality. Two wells located within the landspreading area will provide early warning of changes in ground water quality.

Although the frequency of sampling and the parameters which must be analyzed must be established before facility operation, it is not reasonable to establish the monitoring program requirements in the proposed rules. Facilities will vary a great deal in operation, soil characteristics and sewage sludge composition and the same monitoring program will not apply to all situations. However, the factors which will be considered by the Director in developing a monitoring plan have been included in the proposed rules. This degree of discretion is necessary in order to provide more stringent controls for facilities with a high potential without requiring the same level of monitoring for a facility which, due to its location and operation, presents very little potential for contamination. An applicant for a landspreading facility permit will be able to estimate the facility's monitoring needs based on the information provided in the proposed rules and the information obtained from the site investigation. For example, an applicant for a facility which is located over a widely used, shallow aquifer and which will be receiving high levels of nitrogen will know that frequent analyses for nitrate will be required. An applicant for a facility which will be operated according to all the requirements for a landspreading site will know that he will probably not be required to conduct more than a very basic monitoring program.

Surface water monitoring may be required if there is a discharge of drainage or runoff water to surface water. As was discussed with ground water monitoring, the parameters and frequency of monitoring are not specified in the proposed rules. However, the factors which the Director will consider in establishing a monitoring program are listed in the proposed rules to enable the applicant to estimate monitoring needs.

C. Reasonableness of Record-keeping and Annual Reporting

6 MCAR § 4.6112

6 MCAR § 4.6122

In order for a political subdivision to determine if it is applying the appropriate quantity of sewage sludge to a site or facility, accurate records must be kept and regularly updated. If a record-keeping system is not maintained, excessive quantities of nitrogen, zinc, lead, nickel, copper, and/or cadmium may be applied.

Since a landspreading approval or permit may be in effect for a period of five years, a regular reporting of important information is needed to determine compliance with the proposed rules. The information in an annual report will be stored at the Agency to ensure that no parcel of land in Minnesota will receive quantities of metals in excess of limitations. This is especially important since sites may, over many years, be used by more than one treatment plant.

D. Reasonableness of Appendices

Appendices have been included in the proposed rules to provide more detailed information relating to certain aspects of the proposed rules in an accessible form. It is necessary to provide information regarding standard procedures for sampling and analyzing the various parameters required by the proposed rules in

order to ensure that the data obtained is reliable and to provide an information base other than Agency staff for treatment plant personnel to refer to. The appendices also provide an easily understood procedure for determining the amount of sewage sludge that can be applied to a crop, because this determination is basic for any sort of landspreading operation. A description of the treatment plant processes which reduce and further reduce pathogen levels are necessary to establish operating standards for the process in a relevant and understandable manner.

6 MCAR §§ 4.6131 - 4.6134

These appendices provide information on standard sample collection procedures and where to obtain information for detailed analytical methods. Collection and sample storage and preparation procedures which are commonly used and scientifically acceptable have been detailed in the proposed rules. The actual analytical techniques used to measure the various required parameters are much more complex and in most cases, several options are available. Economic or time constraints and laboratory availability may be factors in determining the type of analyses conducted. Therefore, the proposed rules provide for alternative analytical procedures which will still provide reliable, relevant data. The references provided in the appendices for analytical procedures are generally available and obtaining them will not present an unreasonable burden for analytical laboratories or treatment plant personnel.

6 MCAR § 4.6135

The crop nitrogen requirements are usually the basis for determining sewage sludge application rates. The laboratory determination of total nitrogen which is submitted with the landspreading proposal must be converted to show the amount of crop available nitrogen in the sludge. A formula for determining the available nitrogen per ton of sewage sludge has been developed through research on nitrogen mineralization rates and ammonia volatilization. The formula in the proposed rules is recommended by the EPA and has been used successfully in landspreading programs in Minnesota conducted under the quidelines and the Temporary Sewage Sludge Disposal Standards (6 MCAR § 4.8050).

6 MCAR § 4.6136

Several requirements within the proposed rules refer to the degree of pathogen reduction in the sewage sludge. The actual process standards necessary to produce the acceptable levels of pathogen reduction are specified in this appendix. The operating procedures for most of the commonly used treatment processes are specified and are the same as the standards required for pathogen reduction in the EPA criteria for the classification of solid waste disposal facilities (40 CFR Part 257). These standards represent the methods which must be used to produce a ten-fold reduction in pathogen levels (PSRP) or to produce a sewage sludge which is essentially pathogen free (PFRP). However, many treatment plants in Minnesota use pathogen reduction processes which do not fit within the standards specified but which are effective to reduce pathogens. Processes which do not meet the standards provided in the proposed rules must be evaluated by the Director. It is reasonable to consider other factors in addition to the actual treatment process when making a determination of the potential for disease transmission from the land application of the sewage sludge. The factors which will be considered in the Director's decision are specified in the proposed rules and all relate to the degree of risk which a proposal may present.

V. ESTIMATED TOTAL COST TO LOCAL PUBLIC BODIES TO IMPLEMENT THE PROPOSED RULES.

A. Introduction

There are two major cost categories that must be addressed when determining the expense of the proposed sewage sludge management rules. The first major cost is that which would be expended to get a landspreading site approved by the MPCA. After discussion with individuals that are currently involved in getting site approval, Table 1 was formulated. Table 1 lists each task that must be undertaken to obtain and operate a landspreading site along with the average time necessary to perform each task. Additional costs for the borings required at long-term storage sites are also included in Table 1. Since the proposed rules do not require that landspreading facilities be established, these costs are not included in the assessment.

TABLE 1

Tasks and estimated costs for obtaining a landspreading site.

A. Man hours involved		
Finding willing landowner.		1 hour
Explaining sludge landspreading program.		1 hour
Collecting and evaluating site information.		4 hours
Boundaries	USGS Maps	
Legal Description	Soil Maps	
Separation Distances		
Taking soil sample and ship to lab.		2 hours
Filling out application form .		1 hour
Staking site boundaries.		1 hour
Updating and maintaining site records.		1 hour
B. Costs		
11 Man hours @ $10/hour		$110
1 Soil sample @ $10/sample		10
		$120
C. Additional costs for long-term storage site.		
Three man hours for soil boring @ $10/hour		$30

The second major cost is that for sampling and analyzing sewage sludge. All publicly owned treatment works (POTW's) will have to analyze their sewage sludge at a frequency determined by POTW design flow. A total sewage sludge analysis cost approximately $220.00 for the parameters listed in Table 2. In addition to the total sewage sludge analytical costs, certain municipalities will be required to analyze for specific metals at a frequency greater than the minimum. From past experience, it is doubtful that any municipality will have to analyze for PCBs at a frequency greater than the minimum since most sewage sludges contain levels less than 5mg/kg. Analytical costs for a single metal is typically $20.00.

Table 2

Parameters included in a total sewage sludge analysis.

pH	zinc
total solids	copper
volatile solids	lead
kjeldahl nitrogen	nickel
ammonia nitrogen	cadmium
polychlorinated biphenyls	chromium
	mercury

Tables 3 and 4 summarize the cost analysis which is discussed in the remainder of this section. The cost analysis does not take into consideration that certain costs and responsibilities are required under Federal regulations (40 CFR Part 257). These costs include sewage sludge analysis for cadmium and PCBs, protection of surface and ground waters, sewage sludge treatment for the reduction of pathogens, soil analysis for pH and cation exchange capacity, and public access control. Because of these cost and responsibilities required by Federal regulations, the costs added by the proposed sludge rules will be much less than that estimated in Tables 3 and 4. Also, the municipalities that will

be affected by the proposed rules are currently regulated by the temporary rules governing sewage sludge disposal (6 MCAR 4.8050). The costs imposed by the temporary rule are of similar magnitude as the ones estimated in Tables 3 and 4 for the proposed rules. Therefore, municipalities should not notice a substantial increase in sewage sludge management costs after the proposed rules are adopted.

TABLE 3

Estimated total cost to local public bodies to implement the proposed rules.

1. Site Costs	
830 Landspreading sites @ $120/site	$99,600.00
70 Long term storage sites @ $30/site	2,100.00
2. Sludge Analysis Costs	
304 total analyses @ $220/sample	$66,880.00
874 additional metal analyses @ $20/sample	17,480.00
3. Estimated Total Cost	$186,060.00

TABLE 4

Breakdown of annual and initial costs to local public bodies to implement the proposed rules.

1. Annual Costs	
Total sludge analyses	$66,880
Additional sludge analyses	17,480
830 soil samples (2 hours x $10 + $10/sample)	24,900
830 site record updating (1 hour x $10)	8,300
	$117,560
2. Initial Costs	
830 landspreading sites (minus soil sampling and record keeping)	$66,400
70 long term storage sites	2,100
3. Estimated Total Costs	$186,060

B. Costs to POTW's with Design Flow more than 20 mgd

Only two treatment facilities in Minnesota fall within this category--Metropolitan Waste Control Commission (MWCC) and Western Lake Superior Sanitary District (WLSSD)-- therefore, the economic analysis can more specifically relate to the two sludge programs.

1. Costs to MWCC

It is assumed that 50% of the yearly production of MWCC sewage sludge will be landspread. This is a dewatered sewage sludge and some storage at sites is anticipated. One-half of the annual sewage sludge production is approximately 90,000 dry tons. An average application rate is 20 tons per acre, therefore a minimum of 225 forty acre landspreading sites are required. In addition to the sewage sludge produced at the main plant, several satellite plants produce sewage sludge that is, or may be landspread. It is assumed that a total of 2600 acres (65 sites) will be required for these plants. It is also assumed that long-term storage will take place at 50 of the 225 landspreading sites.

The minimum sewage sludge analytical frequency for the main plant is four times a year. According to current analyses, it appears that nickel will have to be analyzed eight times per year, and cadmium twelve times per year.

Based on their design flow, the satellite plants that may landspread sewage sludge--Anoka, Cottage Grove, Hastings, Blue Lake, and Stillwater, Bayport and Rosemount-- would need a minimum of 13 sludge analyses per year. Assuming each plant had one metal that would have to be analyzed more frequently due to higher concentrations, 13 additional metal analyses would be required.

TABLE 5

Estimated Total Cost to MWCC

1. Site Costs	
290 landspreading sites @ $120/site	$34,800.00
50 long-term storage sites @ $30/site	1,500.00
2. Sludge Analysis Costs	
17 total analyses @ $220/sample	$3,740.00
25 additional metal analyses @ $20/sample	500.00
3. Estimated Total Cost to MWCC	$40,540.00

2. Costs to WLSSD

All of WLSSD's sewage sludge production is currently landspread. This amounts to approximately 15,000 dry tons per year. At an average application rate of 10 tons per acre, about 40 forty acre sites would be required to landspread this amount of sewage sludge. It is assumed that half of these sites will have long-term sewage sludge storage. The minimum sewage sludge analytical frequency is four times per year. Based on the current sewage sludge composition, no additional metal analyses would be required.

TABLE 6

Estimated Total Costs to WLSSD

1. Site Costs	
40 Landspreading sites @ $120/site	$4,800.00
20 long-term storage sites @ $30/site	600.00
2. Sludge Analysis Costs	
4 total analyses @ $220/sample	$880.00
3. Estimated Total Cost to WLSSD	$6,280.00

C. Costs to POTW's with Design Flow of 1 to 20 mgd

In Minnesota there are 33 wastewater treatment facilities within this category. Four of these have a design flow between 10 and 20 mgd, four have a design flow between 5 and 10 mgd, and 25 between 1 and 5 mgd. For every 1 mgd of flow it is assumed that one dry ton of sewage sludge is produced (365 dry tons per year). Utilizing these figures, approximately 50,000 dry tons of sewage sludge per year are produced by the 33 treatment facilities in this category. At an average application rate of five tons per acre, approximately 300 forty acre land-spreading sites are needed for sewage sludge disposal.

The minimum sewage sludge analytical frequency for this category is twice per year (66 analyses). Assuming each treatment facility must analyze for one metal at two times the mimimum frequency and for another metal at three times the minimum frequency, an additional 198 metal analyses will be required for these facilities.

TABLE 7

Estimated total costs for POTW's with design flows of 1 to 20 mgd.

1. Site Costs	
300 landspreading sites @ $120/site	$36,000.00
2. Sludge Analysis Costs	
66 total analyses @ $220/sample	$14,520.00
198 additional metal analyses @ $20/sample	3,960.00
3. Estimated Total Costs for This Category	$54,480.00

D. Costs to POTW's with Design Flow less than 1 mgd

In Minnesota there are 217 wastewater treatment facilities within this category. Assuming an average design flow 0.5 mgd for these facilities and one dry

ton of sewage sludge produced per mgd, approximately 40,000 dry tons of sewage sludge would be generated by the 217 facilities in one year. At an application rate of five dry tons per acre, 200 forty acre landspreading sites are necessary.

The minimum sewage sludge analytical frequency for this category is once per year (217 analyses). Assuming each treatment facility must analyze for one metal at twice the minimum frequency and for another metal at three times the minimum frequency, an additional 651 metal analyses will be required.

TABLE 8

Estimated Total Costs for POTW's with design flows of less than 1 mgd.

1. Site Costs	
200 Landspreading sites @ $120/site	$24,000.00
2. Sludge Analysis Costs	
217 total analyses @ $220/sample	$47,740.00
651 additional metal analyses @ $20/sample	$13,020.00
3. Estimated Total Costs for This Category	$84,760.00

VI. EXHIBITS

The following references were utilized in the development of the proposed rules.

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