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DRAFT RELATED ACTIONS ENVIRONMENTAL IMPACT STATEMENT

PENZ FARMS COMPANY
DARWIN SCHROEDER
HILLTOP PORK PRODUCERS
CONFINED SWINE FACILITIES

MAY 1979

PREPARED BY

Minnesota Pollution Control Agency

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LIST OF ABBREVIATIONS

ADT	average daily traffic
cfs	cubic feet per second
cfm	cubic feet per minute
CTF	Consultant Task Force
EAW	Environmental Assessment Worksheet
EIS	Environmental Impact Statement
FDA	Federal Drug Administration
fps	feet per second
FWPCA	Federal Water Pollution Control Administration
gpd	gallons per day
hp	horsepower
kwh	kilowatt hours
MDNR	Minnesota Department of Natural Resources
MEQB	Minnesota Environmental Quality Board
mg/l	milligram per liter
ml	milliliter
MPCA	Minnesota Pollution Control Agency
MSPA	Minnesota State Planning Agency
m/sec	meters per second
NAC	Noise Area Classification
NPDES	National Pollutant Discharge Elimination System
NWS	National Weather Service
ppm	parts per million
TSP	total suspended particulates
TWP	technical working paper

1. EXECUTIVE SUMMARY

1.1 Introduction

The Minnesota Pollution Control Agency (MPCA) has received permit applications for the construction and operation of three independently proposed confined swine facilities in southeastern Minnesota. Each proposed project would involve construction and operation of a farrow-to-finish swine complex and manure application on adjacent or nearby cropland. The facilities would be independently owned and operated by Penz Farms Company, Darwin Schroeder, and Hilltop Pork Producers.

In response to a citizens' petition regarding the Penz Farms Company and Darwin Schroeder proposals, the Minnesota Environmental Quality Board (MEQB) resolved on April 11, 1977 that an Environmental Assessment Worksheet (EAW) would be prepared for each of these projects. The MPCA was designated as the Responsible Agency for the preparation of these documents. On the basis of information compiled in the EAWs, the MPCA board resolved on July 26, 1977 that a Related Actions Environmental Impact Statement (EIS) would be prepared that considered the individual and cumulative impacts of these two proposals.

A citizens' petition regarding the Hilltop Pork Producers application was submitted to MEQB on October 18, 1977. Although no EAW was prepared for this proposal, Mr. Donald Kunde (owner of Hilltop Pork Producers), in a letter to the MEQB dated November 4, 1977, agreed to have an EIS prepared. On November 8, 1977, MEQB ruled that the proposal constituted a major action with the potential for significant environmental effects and that an EIS was required. MPCA was designated as the Responsible Agency.

In January 1979, a Consultant Task Force was retained by MPCA to provide assistance in the preparation of the EIS and related background documents. Using the best available information, MPCA and its consultants prepared this EIS.

1.2 Proposed Action

The proposed action involves construction and operation of three large confined swine facilities. The Penz Farms Company and Darwin Schroeder confinement buildings and manure storage facilities would be located in Haverhill and Farmington Townships, respectively, in Olmsted County. The Hilltop Pork Producers facilities would be located in Wanamingo Township, Goodhue County. The three proposed projects would have a combined capacity of 12,645 swine and would produce approximately 25,300 market hogs per year. Manure generated during operation would be stored in plastic-lined earthen basins (Penz Farms Company and Darwin Schroeder) or above-ground tanks (Hilltop Pork Producers) and would be applied to cropland by injection or spray irrigation.

Construction of the proposed facilities would begin in May 1980 and proceed for approximately five months. The economic life of the proposed operations has been identified by the applicants to be between 15 and 25 years.

1.3 Environmental Impacts

Public concern over the proposed action has focused on the following issues: odors, groundwater and surface water contamination, public health, and local socioeconomic conditions. Anaerobic storage of swine manure releases odorants to the atmosphere and may, depending on waste management, meteorological, and geographic variables, constitute a public or private nuisance. The potential for water contamination associated with manure storage and application is an important local concern. Large areas of southeastern Minnesota are susceptible to groundwater contamination because of the presence of "karstified" carbonate bedrock. Public health issues are related to the potential for disease transmission from high intensity swine confinement, manure storage, and land application of swine manure. Finally, concern has been expressed over the potential economic effects of the proposed large-scale operations on local family farms and adjacent property values.

Air Quality

The effects of normal operations of the proposed facilities on any federal or state ambient air quality standard would be negligible. Therefore, the principal air quality related issue is the potential for the facility to generate community odor levels that may constitute a public or private nuisance. Community odor levels induced by the proposed facilities were quantified based on predicted emissions and concentrations of a single representative odorant: hydrogen sulfide. Assuming that most of the odorants would be released during the "warm season" (mid-April through mid-October, or approximately the period between the biannual land applications), community odor predictions were made for "worst-case" and "typical-case" meteorological conditions (under routine operating conditions).

The results indicate that swine odors would be perceptible at residences within approximately 1.5 miles of the Penz Farms Company and Darwin Schroeder facilities for about 2% to 3% of the time during the warm season, with about 40 residences in the vicinity of each of these facilities affected. Residents within 0.75 miles may be subject to "worst-case" odors several times the threshold level. In the Hilltop Pork Producers study region, chronic swine odors should not be a problem, although short-term "worst-case" odors could affect residences within a mile or so of the proposed facilities (about 13 houses). It should be noted that all of these predictions are for routine facility operations, and the potential exists for more severe community odor impacts during manure withdrawal for land application, although such impacts would be of short duration.

It is possible to implement mitigation measures that would substantially reduce community odor impacts during routine and nonroutine operations. Measures that appear to offer the most promise include mechanical aeration of storage basins and the use of masking agents or deodorants during settling basin or storage basin agitation associated with manure withdrawal for fertilization.

Water Quality

Normal operation of the proposed facilities are not predicted to result in adverse water quality impacts. Minor beneficial impacts may be realized by improving soil properties that limit direct run-off and by routing run-off from an existing feedlot to a proposed manure storage basin.

The proposed manure storage systems are designed to minimize seepage; however, rupture of the basin liners (Penz Farms Company and Darwin Schroeder) could release potential contaminants to groundwater. Construction of concrete pumping bays in each earthen storage basin would minimize the potential for rupture of the liners.

Release of stored manure in the event of sinkhole development could result in adverse effects on water quality. Available geological information indicates that the sinkhole potential at the

Penz Farms Company and Darwin Schroeder facilities sites is low. Although the potential for sinkhole development at the Hilltop Pork Producers site is not well known, the possibility of release of manure to the environment is considered remote because of the structural integrity of the proposed manure storage facilities.

Public Health

Numerous pathogens and toxins are capable of causing disease in both swine and humans. If diseases of swine pose any threat to humans, it is most likely to be to their handlers and caretakers. Because these people are generally in good health, the zoonotic disease transmission potential from swine to humans is probably low.

Pathogen survival in wastes applied to the soil is short and rarely constitutes a health hazard if proper management practices are used.

For pathogens or toxins from the swine to cause human disease in the community surrounding the proposed farms, there would need to be unusual circumstances, poor sanitary practices, or some highly improbable mechanical or biological vector.

The greatest impact resulting from the use of antibacterials in animal feeds is the formation of multiple drug-resistant organisms. Drug-resistant pathogens may cause problems in both humans and animals since the use of some antibacterials will not be effective against these organisms.

Socioeconomics

The proposed operations would be among the largest in the project region, and because of economies of scale would have lower hog production costs than the majority of local hog producers. However, it is not likely that the proposed action would have a major economic impact on the hog market in the area. While these operations would increase regional total hog production and decrease available hog slaughtering capacity, other factors that affect pricing and

marketing, such as long-term economic trends, seasonal variations, and product quality, would not be influenced. The proposed action may have a long-term impact by setting a precedent for accelerated development of similar large-scale swine facilities. However, this factor would be only one of many influences on the future of livestock operations in the area.

Any changes in the value of property surrounding the proposed facilities sites would be caused by the effect of odor produced during operation. Since the proposed operations would not interfere with any of the factors that contribute to the value of adjacent agricultural land, it is highly unlikely that these values would be affected. However, it is possible that the value of the farm residences adjacent to or near the facilities sites would decline.

The three operations would employ 13 workers, with a combined annual payroll of approximately $149,000. Additionally, the proposed operations would increase the market value of the three facilities sites and, thus, would increase the gross property tax received by Olmsted and Goodhue Counties.

Geology and Hydrology

The proposed use of manure as fertilizer is not projected to have adverse effects on soil properties and may improve soil fertility and enhance soil structure.

All three proposed facilities sites are underlain, at various depths, by dolomite and limestone (carbonate) rocks. Depending upon the thickness and type of overlying geologic materials, carbonate formations in southeastern Minnesota may contain solution-enlarged fractures or caverns, and the surface topography may contain karst features such as sinkholes or disappearing streams. Because of the lack of filtering capacity normally associated with groundwater flow, "karstified" carbonate rocks are susceptible to contamination. The sinkhole potential and the susceptibility to groundwater contamination associated with each proposed facilities site are related to the thickness and type of geologic materials overlying these carbonate

formations. On the basis of site-specific shallow soil borings and deep test holes in the vicinity of each project, the sinkhole potential at the Penz Farms Company and Darwin Schroeder facilities sites is considered low. Additional soil borings, driven to a minimum of 40 feet, would be useful in further defining the sinkhole potential at these sites. Soil borings have not been conducted at the proposed Hilltop Pork Producers facilities site, and such investigations would be necessary to adequately determine sinkhole potential. However, the probability of karst-related land subsidence of sufficient magnitude to threaten the structural integrity of the proposed storage tanks is considered low.

Land Use

The Penz Farms Company and Darwin Schroeder proposals have been judged to be in compliance with county and local plans and ordinances. The proposed residence associated with the Hilltop Pork Producers operation would not be in compliance with sections of the Goodhue County Zoning Ordinance, which require that a farm dwelling within an agricultural district be associated with a minimum of 40-acre farm unit.

No significant transportation impacts are expected during construction or operation. Additionally, land use impacts related to cultural resources or visual aesthetic character are not anticipated.

Ecology

Impacts to terrestrial and aquatic ecology associated with construction and operation of the proposed facilities are expected to be insignificant. Construction and normal operation of the proposed facilities would not significantly affect wildlife habitat or populations. Accidental release of stored manure could adversely effect aquatic environments; however, the probability of such an occurrence is considered low. Detailed data regarding the role of

wildlife as a potential disease transmission vector associated with swine facilities and land application of manure are unavailable. However, this potential is estimated to be low, provided that good management practices are observed.

Noise

Predicted noise levels during the construction and operational phases of the proposed action would not exceed MPCA daytime noise standards. The projects are considered to produce some minor degree of noise impact for brief periods of time during construction and possibly during hot weather nights.

1.4 Alternatives

No Action

The no-action alternative involves continuation of the current use of the project sites. The proposed facilities sites would continue to be devoted to crop production, and the proposed manure application parcels would receive chemical fertilizer and minor amounts of livestock manure.

This alternative would eliminate all adverse and beneficial effects associated with construction and operation of the proposed confined swine facilities. Environmental impacts of the proposed action are summarized in Section 1.3.

Reduced Operation

The reduced operation alternative consists of two 150-sow farrow-to-finish confined swine facilities and one 510-sow confined feeder-pig operation. The primary differences between this alternative and the proposed action are related to the number of swine kept and produced, and the total quantity of swine manure generated. The confinement and waste management facilities would essentially be located, designed, and operated as described for the proposed action, but would have reduced swine population and manure storage capacities.

Because of the attendant reduction in swine capacity and manure quantities, the reduced operation alternative would result in decreased transportation requirements and noise effects; a decrease in the total acreage required for manure application; and, most importantly, a decrease in the total area (and total number of residences) subject to odor effects. The range of odor perception for both the worst-case and typical-case meteorological conditions would be reduced by approximately 50% at each of the three proposed sites. The possibility of accidental release of manure to the environment and the remote potential for disease transmission associated with the proposed action would not be significantly reduced by this alternative.

Alternative Manure Application Areas

Each applicant has identified land areas proposed for application of swine manure as well as other land areas available for this purpose. These additional parcels are considered as alternative manure application areas.

Available manure application parcels are compared with respect to (1) roadway distance to the facilities site, (2) the number of adjacent residences, and (3) run-off characteristics. Use of alternate manure application parcels would generally involve increased roadway transportation of manure and an increase in the number of residences adjacent to application sites. Additionally, alternate and proposed parcels are similar with respect to run-off characteristics. Thus, no environmental benefits would be associated with the use of alternate manure application parcels.

Alternative Waste Management Systems

Reasonable alternatives to the proposed waste management systems were identified using two screening criteria: (1) technological feasibility and (2) cost versus environmental benefit. Alternatives considered include deep pit storage and oxidation ditches.

Penz Farms Company and Darwin Schroeder

The alternatives for these operations are deep pit storage (such as above-ground tanks) and oxidation ditches. Deep pit storage would decrease the emission of volatile compounds during normal operation (and thus decrease odor effects) and decrease nitrogen losses (resulting in economic benefits to the operator). If above-ground tanks were used, the potential for seepage or leakage of stored manure would be minimized because of the structural integrity of such systems. The major disadvantage of this alternative is the additional capital costs required.

The major advantage associated with the oxidation ditch alternative is odor control. Oxygenation of the raw manure minimizes

the formation of odor-causing anaerobic bacteria. However, this alternative would involve increased capital and operating costs and may require an elaborate management program to avoid operational problems.

Penz Farms Company proposes both injection and spray irrigation application techniques. The alternative of injecting all manure would promote nitrogen conservation, control odors during application, and reduce the potential for aerosol transmission. The primary disadvantage of this alternative is that injection involves greater energy requirements than spray irrigation.

Hilltop Pork Producers

Since the Hilltop Pork Producers proposed action is a deep pit (tank) storage system, the primary alternative is an in-building oxidation ditch. This system would essentially involve the same advantages and disadvantages as decribed for the other facilities, however, the net reduction in odor effects would be less owing to the lower odorant emissions of the proposed (tank) system.

2. INTRODUCTION

2.1 Background

MPCA has received permit applications for the construction and operation of three confined swine facilities in Olmsted and Goodhue Counties in southeastern Minnesota. Each proposed project would involve a large farrow-to-finish confinement complex, onsite manure storage, and utilization of manure as fertilizer on adjacent or nearby cropland. The facilities would be independently owned and operated by Penz Farms Company, Mr. Darwin Schroeder, and Hilltop Pork Producers.

Citizens' petitions concerning each of the proposed projects have been submitted to the MEQB. Additionally, citizen groups and individuals have expressed their concern over the proposed projects at public meetings and in numerous letters to state agencies and offices, including MPCA. Public concern has focused on the following issues: odors, groundwater and surface water contamination, public health, and local socioeconomic conditions. Anaerobic storage of swine manure releases odorants to the atmosphere and may, depending on waste management, meteorological, and geographic variables, constitute a public or private nuisance. The potential for water contamination associated with manure storage and application is an important local concern. Large areas of southeastern Minnesota are susceptible to groundwater contamination because of the presence of "karstified" carbonate bedrock. Public health issues are related to the potential for disease transmission from high intensity swine confinement, manure storage, and land application of swine manure. Finally, concern has been expressed over the potential economic effects of the proposed large-scale operations on local family farms and adjacent property values.

In response to the citizens' petition regarding the Penz Farms Company and Darwin Schroeder proposals, MEQB resolved on April 11, 1977 that an EAW would be prepared for each of these projects. The MPCA was designated as the Responsible Agency for the preparation of these documents. On the basis of information compiled in the EAWs,

the MPCA Board resolved on July 26, 1977 that a Related Actions EIS would be prepared that considered the individual and cumulative impacts of these two proposals.

A citizens' petition regarding the Hilltop Pork Producers application was submitted to MEQB on October 18, 1977. Although no EAW was prepared for this proposal, Mr. Donald Kunde (owner of Hilltop Pork Producers), in a letter to the MEQB dated November 4, 1977, agreed to have an EIS prepared. On November 8, 1977, MEQB ruled that the proposal constituted a major action and that an EIS was required. The MPCA was designated as the Responsible Agency.

In January 1979, a Consultant Task Force (CTF) was retained by MPCA to provide assistance in the preparation of the EIS and related background documents. Using best available information, the CTF prepared a series of technical working papers (TWPs) describing the proposed action, alternatives, environmental setting, and potential impacts of the proposed action. These TWPs, as listed below, provide the informational and technical basis for this draft EIS.

1: Description of the Proposed Action
2: Description of Alternatives
3: Air Quality
4: Water Quality
5: Public Health
6: Socioeconomics
7: Geology and Hydrology
8: Land Use
9: Ecology
10: Noise

2.2 Environmental Impact Statement Process

Under the provisions of the 1973 Minnesota Environmental Policy Act, (Minn. Stat. Chapter 116D) an environmental assessment is performed when a citizens' petition containing 500 or more signatures requesting an EIS for a proposed action is presented to MEQB. This environmental assessment may involve preparing an EAW or conducting public meetings. Determination of the need for an EIS is generally made on the basis of the EAWs or information gathered at public meetings; however, in cases where the magnitude and potential environmental impact of a project indicate that an EIS is needed, the requirement of an EAW or public meeting may be waived.

The purpose and scope of an EIS is governed by the 1973 Minnesota Environmental Policy Act (Minn. Stat Chapter 116D) and MEQB rules (MEQC 1977).

> The purpose of an Environmental Impact Statement is to provide information for agencies and private persons to evaluate proposed actions which have the potential for significant environmental effects, to consider alternatives to the proposed actions, and to institute methods for reducing adverse environmental effects. An Environmental Impact Statement is not a document to justify an action, nor shall indications of adverse environmental effects necessarily require that an action be disapproved. It is to be utilized as a guide in issuing, amending, and denying permits and carrying out the other responsibilities of public agencies to avoid or minimize adverse environmental effects and to restore or enhance environmental quality consistent with the Act (MEQC 1977).

MEQB, the principal agency responsible for administration of the Environmental Policy Act, has established regulations for determining whether an EIS is necessary. An EIS is generally required whenever it is determined that an action is major and has the potential to create significant environmental effects. When two or more actions are related, they are considered as a single action and their cumulative potential effects on the environment are considered in determining whether an EIS is required. Actions are related if:

- they are of a similar type, and are planned or will occur at the same time, and will affect the same geographic area; or
- they are interdependent and not independently viable stages or segments of development of the same project and would not be undertaken if subsequent stages or segments would not also occur; or
- it can be determined, based on a comprehensive plan or on the precedent that would be established by a public agency's undertaking or approving an action, that one of the actions will induce other actions of the same type or affecting the same geographic area (MEQC 1977).

As prescribed by the rules of the MEQB, a draft EIS contains the following information:

1) Summary. A summary sheet that describes the action, major environmental impacts (adverse and beneficial), reasonable alternatives, and the federal, state, and local permits outstanding shall be included. Also, federal, state, or local agencies, other organizations and private individuals consulted in the preparation of the EIS shall be identified.
2) Description. A description of the action, including type, size and location, and the environmental setting of the action. A regional and site-specific map should be included to assist in identification of the project.
3) Environmental impact of the proposed action. All phases of an action shall be considered when evaluating an action: planning, acquisition, construction, implementation, development, operation, and conclusion of operation. Special consideration shall be given to pollution, impairment, or destruction of the air, water, land, or other natural resources located within the State resulting from the proposed action, without limitation by the definitions of "action" and "environment" in these Rules. This discussions shall also include a description of all resources in the area and how they will be affected by the action, with emphasis placed on resources that are rare or unique to the region or that possess important historical, cultural, natural, ecological, or aesthetic values, without limitation by the definitions of "action" and "environment" in these Rules.

4) Any direct or indirect environmental, economic, energy, and employment effects that cannot be avoided if the proposed actions is implemented. This discussion shall describe the adverse and beneficial environmental, economic, energy, and employment effects that will result directly from the action, as well as the effects that may be reasonably expected to result from the action. Mitigation measures that have been or may be incorporated into the action to reduce or minimize significant adverse environmental, economic, energy, and employment effects shall be discussed.

5) Any irreversible and irretrievable commitments of resources that would be involved in the proposed action if it is implemented. This discussion shall include the proposed use of non-renewable resources, long term or irreversible commitments of resources to a particular use and any irreversible and irretrievable damage that may result from the action.

6) The relationship between local short term uses of the environment and the maintenance and enhancement of long term productivity, including the environmental impact of predictable increased future development of an area if the action is implemented. This discussion shall include the extent that the proposed action involves trade-offs between short term environmental gains or losses versus long term gains or losses, including potential risks to health and safety, and the extent that the proposed action forecloses future options. The impact of predictable increased future development in the area that may be stimulated, directly or indirectly, by the proposed action shall be discussed.

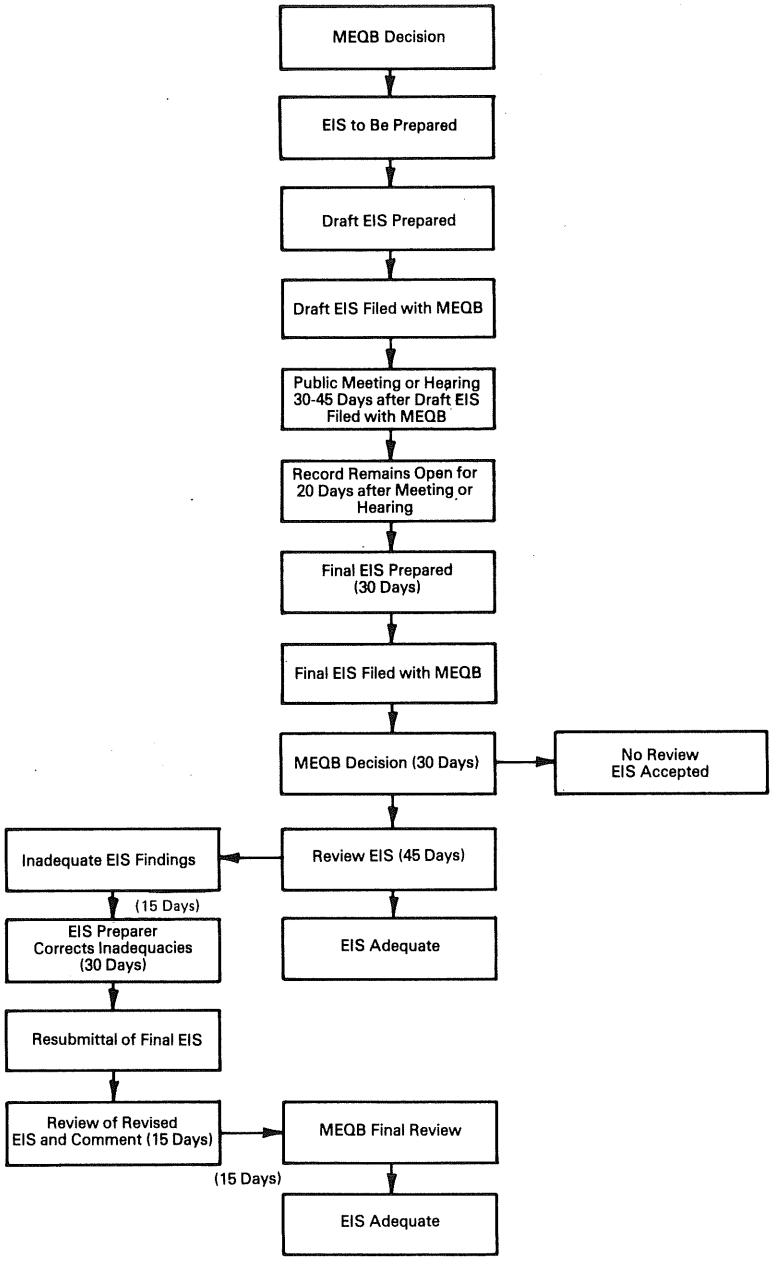
7) Alternatives of the proposed action. An objective evaluation of all reasonable alternatives to the action and the environmental impact of each and the reasons for their rejection in favor of the recommended choice shall be made. Reasonable modifications of the proposed action that may avoid or reduce adverse environmental effects shall be discussed, including the expected benefits, costs, and effects of the objective of the proposed action.

8) The impact on state government of any federal controls associated with the proposed action. Federal actions pending which may affect the final outcome of the project should be discussed, including those actions which may result in the expenditure of additional state funds.

9) The multi-state responsibilities associated with the proposed action. Impacts of the proposed action upon multi-state responsibilities shall be discussed, including the environmental effects of the action upon adjacent states (MEQC 1977).

The EIS process is shown in simplified form in Figure 2.2-1. Between 30 and 45 days after the draft EIS is filed, public hearings are scheduled. A transcript of the hearings is made and the public record remains open for 20 days after the last day of hearings to allow the submission of additional information. The Responsible Agency has 30 days from the close of the public record to prepare and file the final EIS.* The final EIS consists of the draft EIS, comments or summaries of comments received during public hearings and reviews, and MPCA responses to the comments. MEQB may review the final EIS to ensure that its EIS rules have been complied with. If MEQB determines that the final EIS is inadequate, the Responsible Agency has 30 days to undertake required revisions, with an additional 15-day review period. Once the MEQB has determined that the EIS is adequate, the EIS process is concluded.

*MEQB may extend the time limitation upon written request showing good cause.



MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 2.2-1
Environmental Impact State-
ment Process

707052

2.3 Permitting Process

Minnesota standards and permitting procedures (Minn. Regs. SW 51-61) have been established for the control of wastes from livestock feedlots. The general conditions of these regulations require that livestock feedlots and other animal lots be located and operated in a manner that precludes potential pollution hazards to the land, air, or waters of the state except where corrective and protective measures approved by MPCA are taken. Pursuant to Minnesota Regulations SW 56-61, any Minnesota county may assume responsibility for processing animal feedlot permits. Olmsted and Goodhue Counties have not done so to date, thus, MPCA is responsible for the issuance or denial of animal feedlot permits for the proposed facilities.

New rules have been proposed for the control of pollution from animal feedlots (proposed Minn. Regs. AW 1 and 2). These proposed regulations are currently in the public comment phase. Final approval is anticipated in the fall of 1979, at which time these rules will supercede and replace Minnesota Regulations SW 51-61. Thus, if the final determination regarding the proposed facilities is made after the effective date of these new rules, the applicable permitting procedures and requirements shall be those specified by Minnesota Regulations AW 1 and 2.

Animal feedlots may be required to obtain a permit under the National Pollutant Discharge Elimination System (NPDES) pursuant to the Federal Water Pollution Control Act Amendments of 1972. The MPCA administers the NPDES permitting program in Minnesota. Operations that consist of 2,500 swine weighing over 55 pounds and that have a potential for discharge resulting from a 25-year 24-hour storm may be required to obtain an NPDES permit. Information contained in this EIS will, in part, provide the basis for MPCA's determination regarding NPDES permits for the proposed operations.

2.4 References

Laws of 1973, Minnesota Statutes Chapter 116.

MEQC 1977. Minnesota Code of Agency Rules. Section 3.021 Environmental Review Program. Minnesota Environmental Quality Council.

Minnesota Regulations AW 1 and 2. Rules for the Control of Pollution from Animal Feedlots.

Minnesota Regulations SW 51-55. Regulations for the Control of Wastes from Livestock Feedlots, Poultry Lots and Other Animal Lots. Minnesota Pollution Control Agency Division of Solid Waste.

Minnesota Regulations SW 56-61. Regulations for the Processing of Feedlot Permits by the Counties and the Minnesota Pollution Control Agency. Minnesota Pollution Control Agency Division of Solid Waste.

3. DESCRIPTION OF THE PROPOSED ACTION

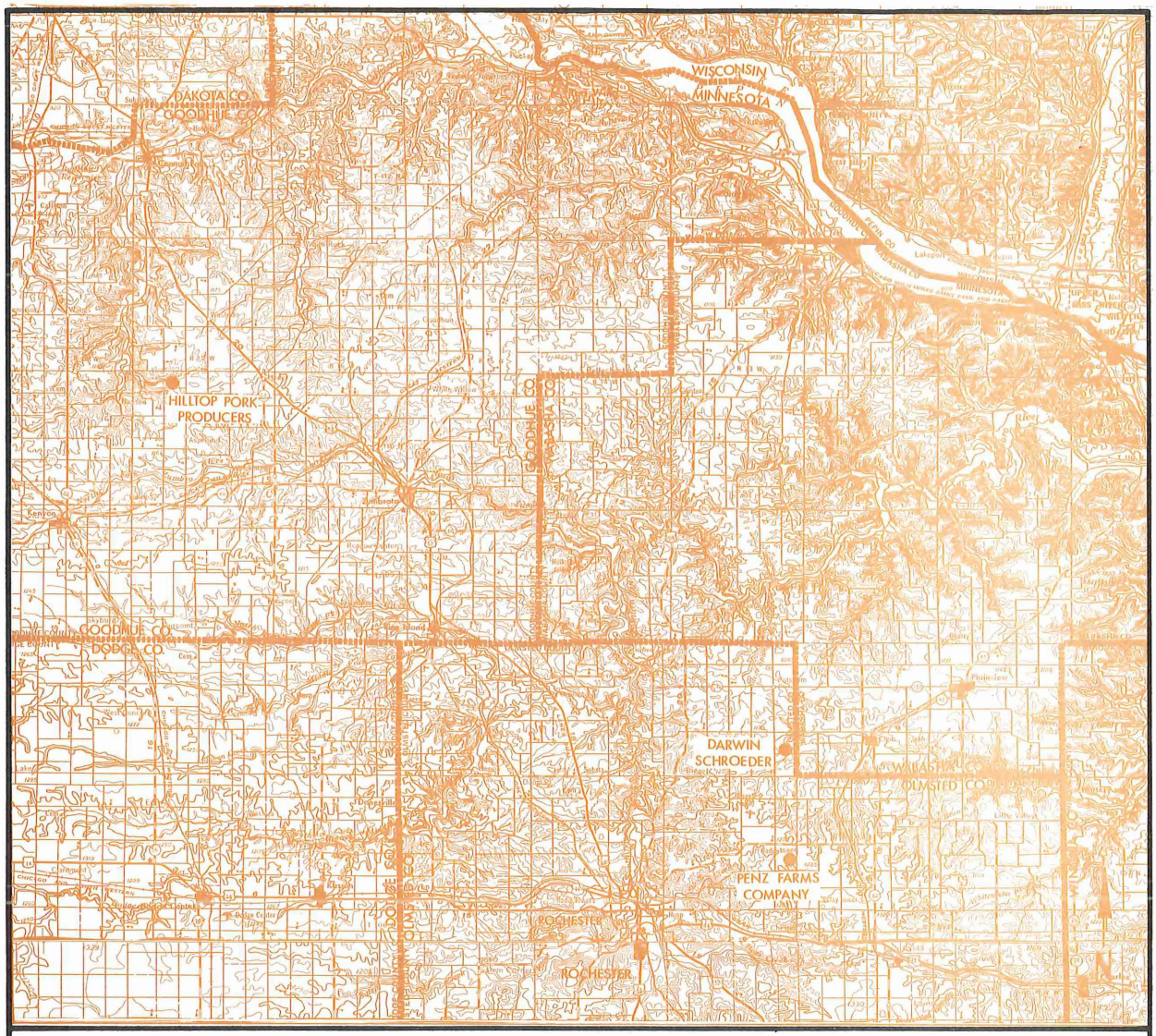
3.1 Introduction

Specific geographic areas relevant to the proposed action are referred to in this EIS according to the following designations. The "study area" is the approximate 2,500-square-mile area containing all three proposed facilities. Within the study area are two 100-square-mile "project regions," one containing the Penz Farms Company and Darwin Schroeder proposed locations, and the other containing the Hilltop Pork Producers location. The "project site" for each operation is defined as that area containing the confinement facilities and cropland available for manure application. Finally, the "facilities sites" are the 4- to 5-acre areas containing the actual swine confinement and manure storage facilities.

The Penz Farms Company and Darwin Schroeder facilities sites would be located approximately 5 miles apart in Haverhill and Farmington Townships, respectively, in Olmsted County. The Hilltop Pork Producers facilities site would be located approximately 30 miles to the northwest, in Wanamingo Township, Goodhue County. Figure 3.1-1 shows the location of each of the three confined swine facilities within the project study area.

Each proposed operation would use a modern building complex with totally confined facilities for breeding and gestation, farrowing and pre-nursery, nursery, and finishing of swine. Figures 3.1-2, 3.1-3, and 3.1-4 show the proposed facilities sites for the three proposals, including the layout and dimensions of confinement buildings and manure management facilities.

Each project applicant has identified land areas proposed for application of swine manure as fertilizer as well as other land areas available for this purpose. Proposed and other available manure application parcels are shown on Figures 3.1-5 and 3.1-6. Data regarding the size of application areas and proposed application methods are summarized in Table 3.1-1. Darwin Schroeder and Hilltop

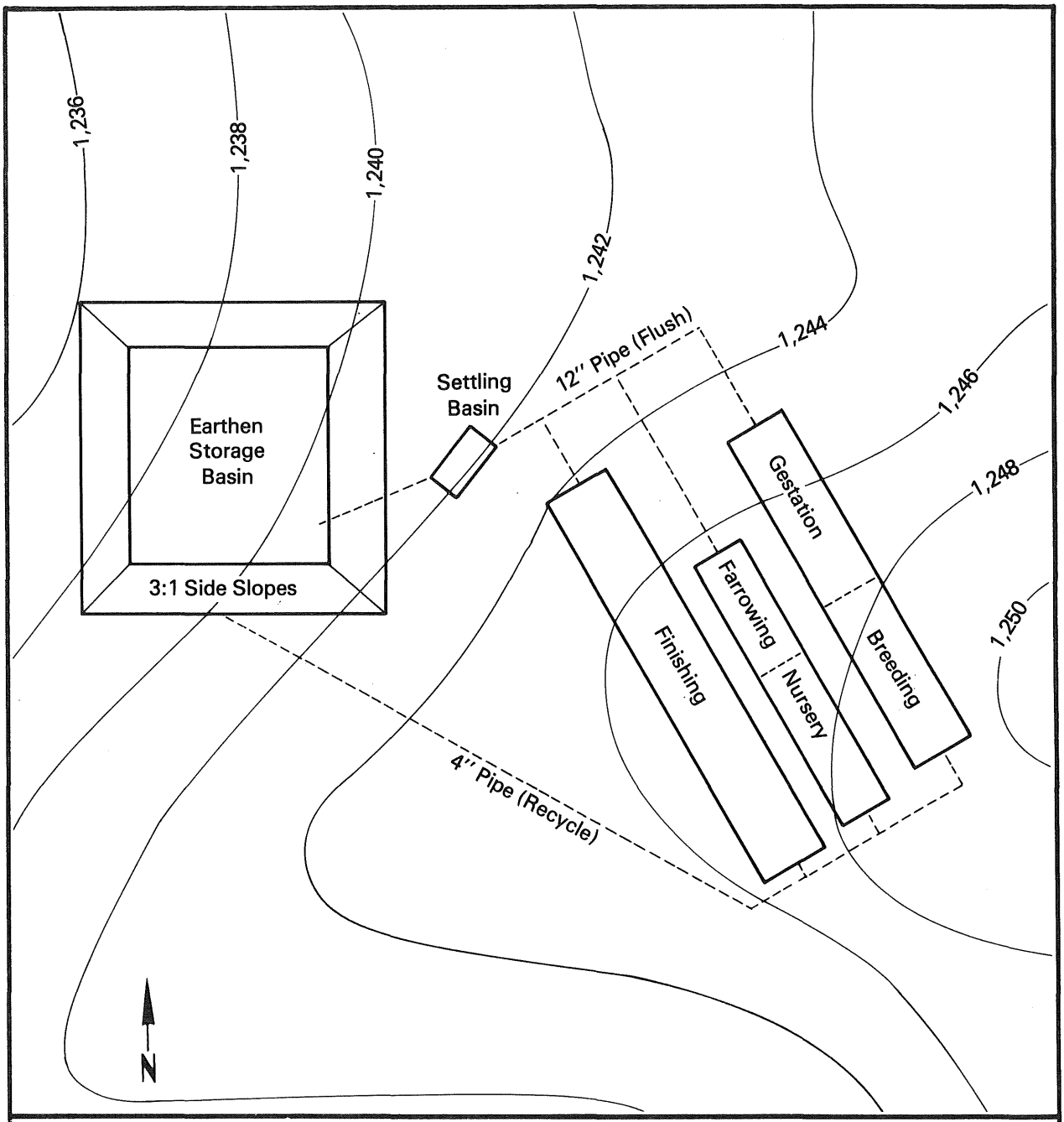


MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 3.1-1
Project Study Area

Contour Interval 50 Feet

547-1 7904264



PENZ FARMS COMPANY

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

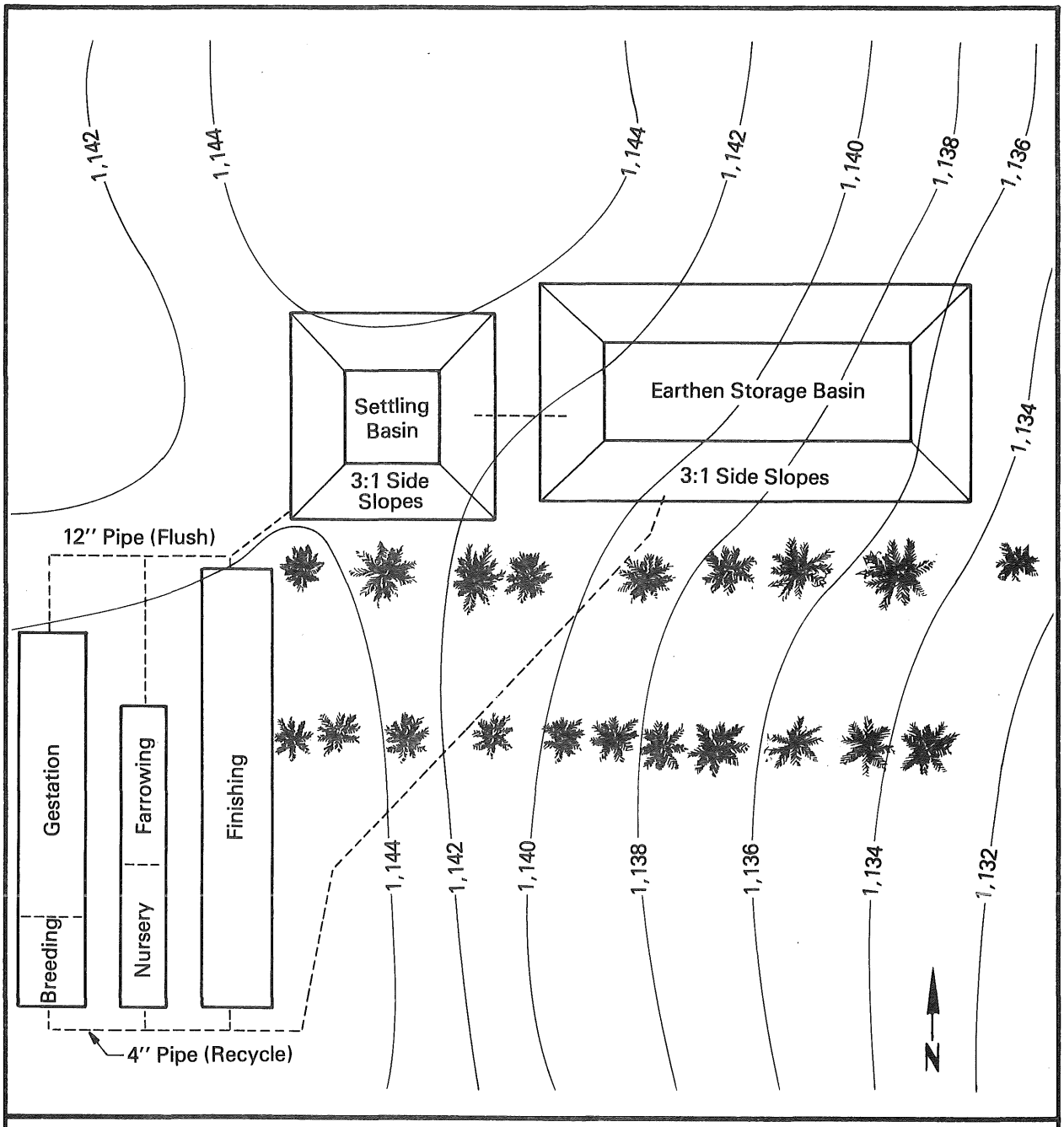
LEGEND

1,240 Elevation Contour

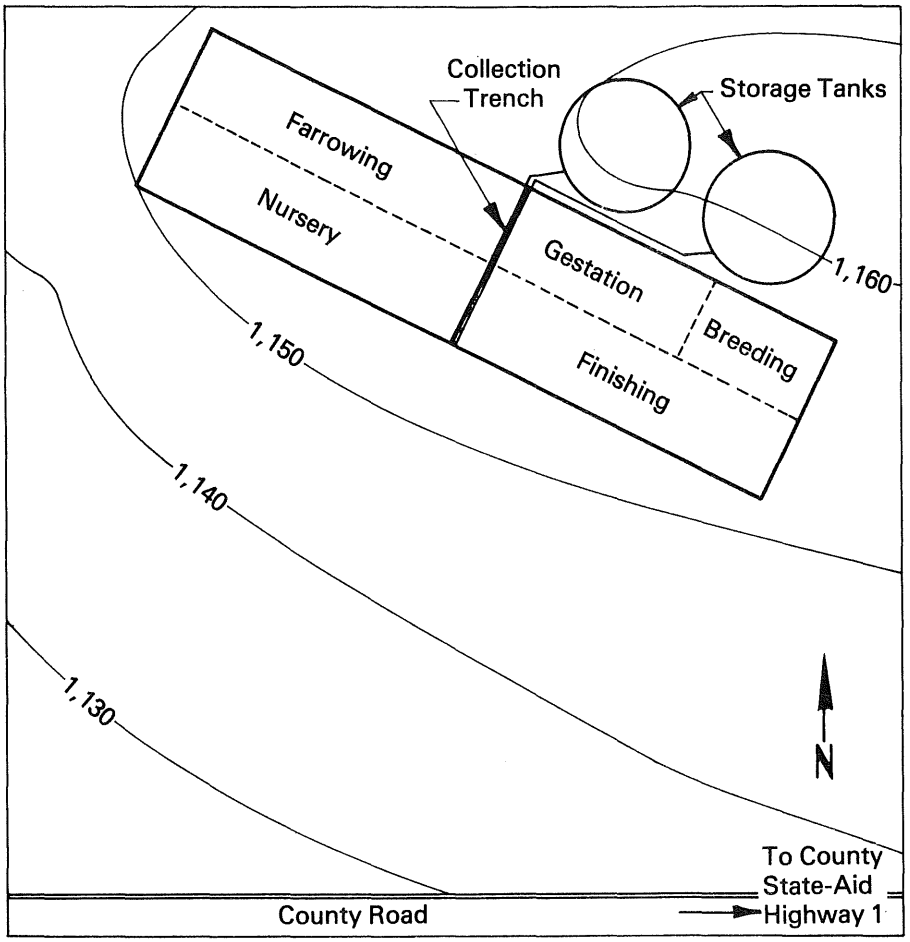
Contour Interval = 2 Feet

Figure 3.1-2
Penz Farms Company Facilities Site

79041111


1,142
1,144
1,144
1,142
1,140
1,138
1,136
1,134
Settling Basin
3:1 Side Slopes
Earthen Storage Basin
3:1 Side Slopes
12" Pipe (Flush)
Gestation
Breeding
Farrowing
Nursery
Finishing
1,144
1,142
1,140
1,138
1,136
1,134
1,132
4" Pipe (Recycle)
N
0 50 100 150 Feet
DARWIN SCHROEDER
LEGEND
1,144 Elevation Contour
Contour Interval = 2 Feet
MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES
Figure 3.1-3
Darwin Schroeder Facilities Site

7904110



0 50 100 150 feet

HILLTOP PORK PRODUCERS

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

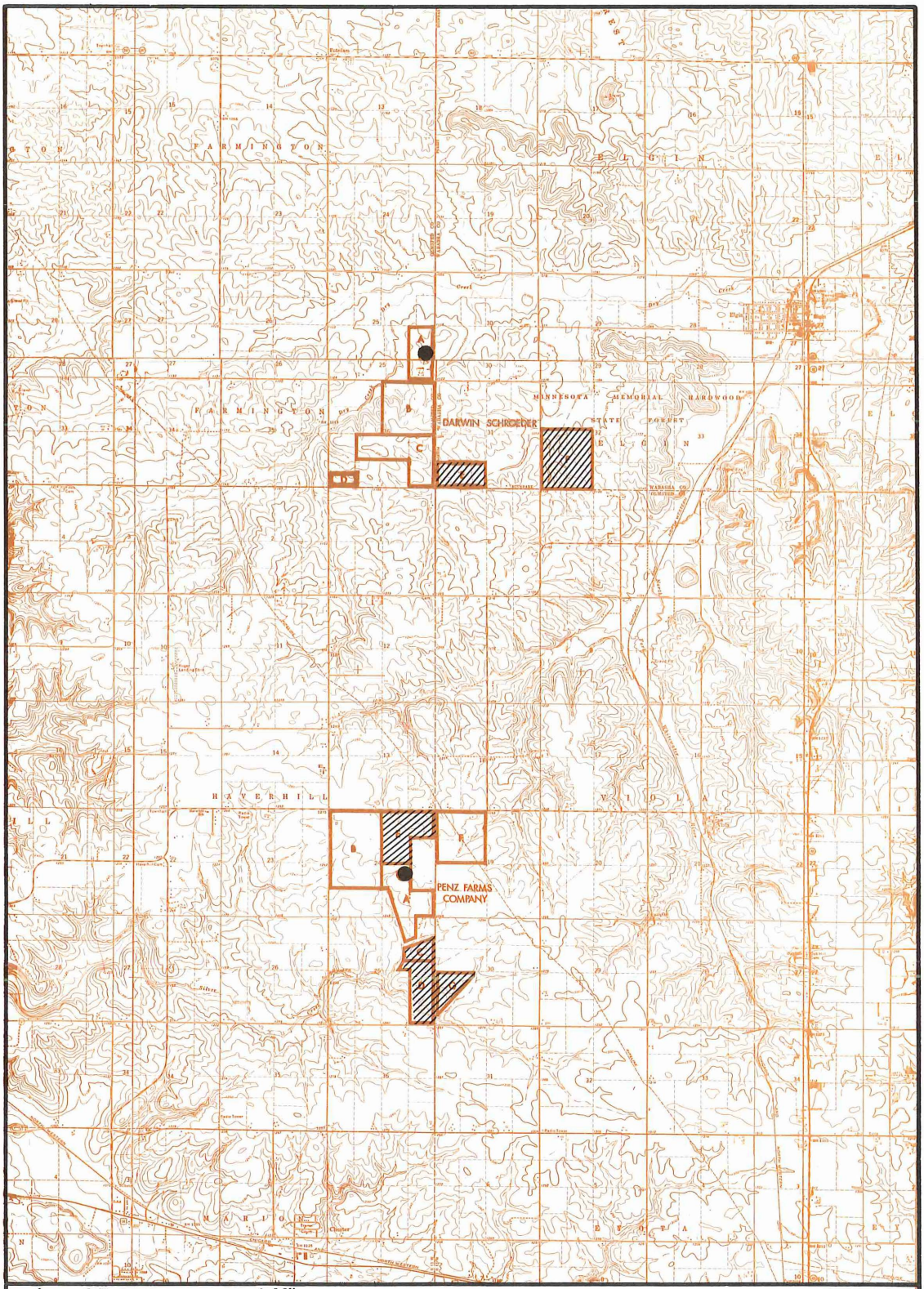
LEGEND

1,150 Elevation Contour

Contour Interval = 10 Feet

Figure 3.1-4
Hilltop Pork Producers Facilities Site

7904112



PENZ FARMS COMPANY

LEGEND

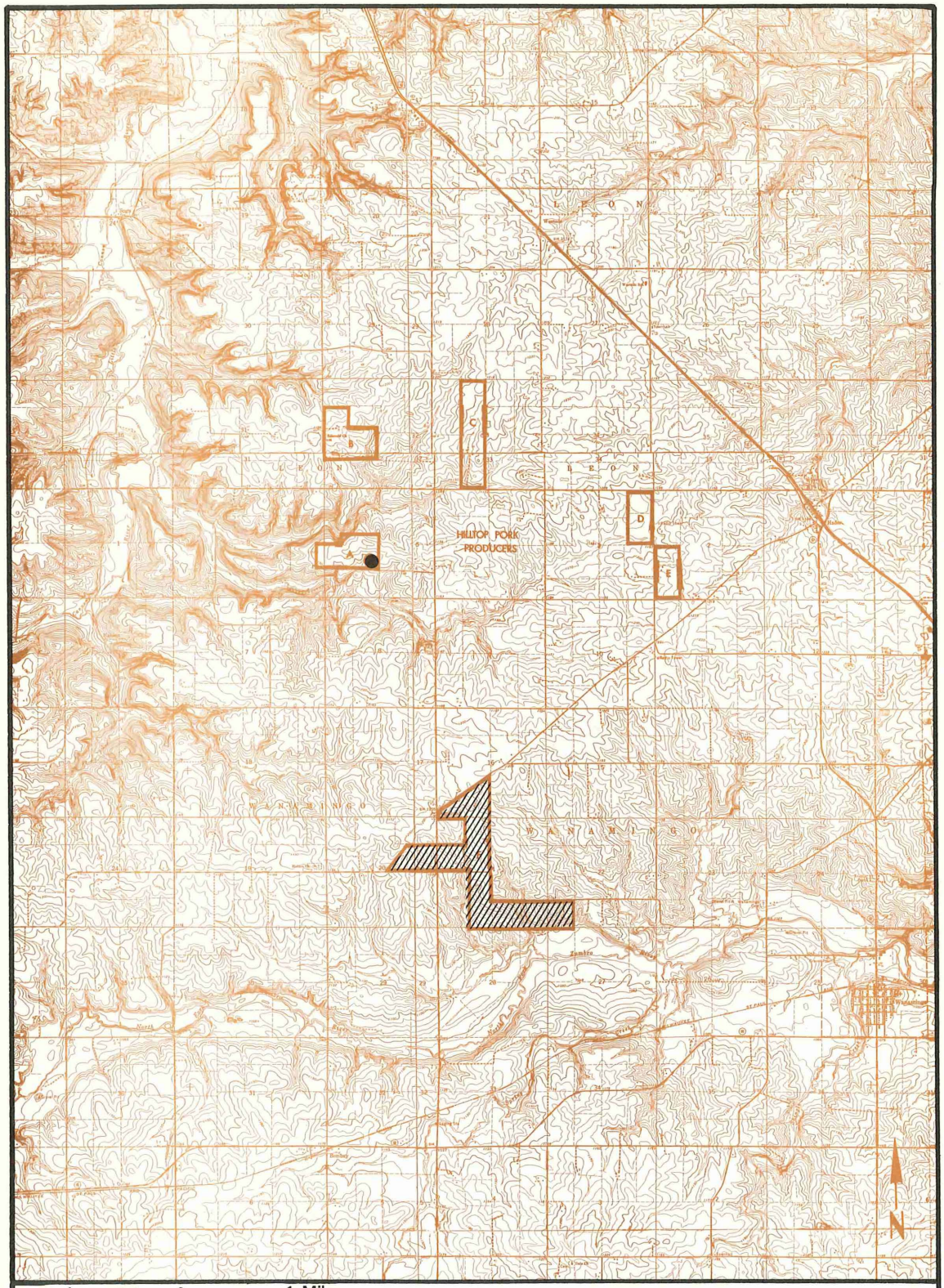
- Facilities Site
- A — Proposed Application Parcel
- E — Other Available Application Parcel

Contour Interval 20 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 3.1-5
Facilities Sites and Manure Application Parcels for Penz Farms Company and Darwin Schroeder

556-2 7904092 7904150



1 0.5 0 1 Mile

HILLTOP PORK PRODUCERS

LEGEND

- ● Facilities Site
- [A] Proposed Application Parcel
- [F] Other Available Application Parcel

Contour Interval 10 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 3.1-6
Facilities Site and Manure Application Parcels for Hilltop Pork Producers

469-4 7904109 7904155

TABLE 3.1-1

LAND AREAS AVAILABLE FOR APPLICATION OF SWINE MANURE

Parcel	Application Technique	Total Acres	Tillable Acres
	Penz Farms Company		
Proposed			
A	Spray Irrigation	120	90
B	Spray Irrigation	240	220
F	Injection	160	80
Subtotal			390
Other Available			
C	Spray Irrigation*	35	20
D	Spray Irrigation*	100	80
E	Spray Irrigation*	120	80
G	Injection	60	60
Subtotal			240
Total			630
	Darwin Schroeder		
Proposed			
A	Injection	80	60
B	Injection	160	147
C	Injection	160	154
D	Injection	20	17
Subtotal			378
Other Available			
E	Injection	80	70
F	Injection	180	160
Subtotal			230
Total			608
	Hilltop Pork Producers		
Proposed			
A	Injection	120	110
B	Injection	130	90
C	Injection	160	120
D	Injection	80	75
E	Injection	80	70
Subtotal			465
Parcel	Application Technique	Total Acres	Tillable Acres
Other Available			
F	Injection	340	300
Subtotal			300
Total			765

*October weather conditions permitting, Penz Farms Company parcels A and B only would receive spray irrigation. In the event of generally wet conditions, more acreage would be required and spraying would occur on one or more of the other parcels with parcel C being the highest priority (after A and B) and parcel E the lowest.

Pork Producers have proposed to inject manure into available cropland using liquid manure tank wagons. The manure would be applied two times a year for approximately two-week periods: in late April to early May and in late October. Penz Farms Company has proposed both injection and spray irrigation application techniques. Injection would occur three times a year: in late April, early August, and late October to early November. Spray irrigation would be used once a year during the month of October.

3.2 Site Description

3.2.1 Facilities Sites

As shown in Figure 3.2-1, the Penz Farms Company proposed facilities site is located approximately 1,500 feet west of 80th Avenue Northeast, along the northeast border of parcel A. The 5-acre site is presently put to straight-row corn crops, producing between 100 and 140 bushels per acre per year. The site presently receives chemical fertilizer only, which is spread and incorporated once a year.

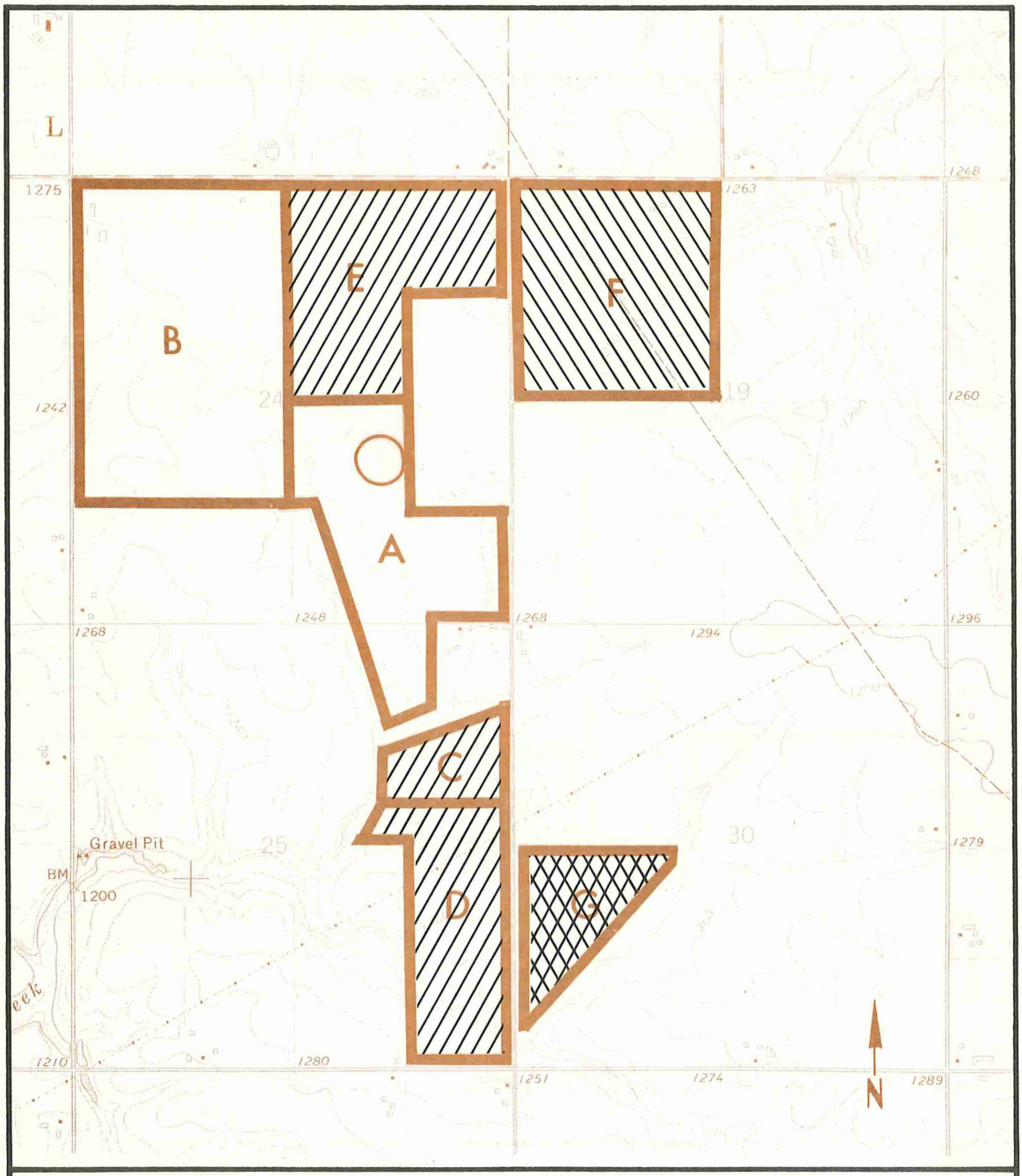
The facilities site proposed by Darwin Schroeder is located approximately 300 feet west of 80th Avenue Northeast and 500 feet northeast of Mr. Schroeder's residence (see Figure 3.2-2). The approximate 4-acre site is presently used for straight-row corn production, with average yields of 180 bushels per acre per year. Chemical fertilizer and cattle manure are both applied to the site by spreading and incorporation.

Figures 3.2-3 and 3.2-4 show the location of the Hilltop Pork Producers facility site and available manure application parcels. The proposed 5-acre facilities site is located just north of an unnamed county road and approximately 0.5 miles west of County State Aid Highway 1. Corn and hay are currently produced on this site at yields of 125 bushels per acre per year and 4 tons per acre per year, respectively. Chemical fertilizer is spread and incorporated once a year on acres put to corn. Hog manure is spread on hay ground once a year at a rate of approximately 11 tons per acre.

3.2.2 Manure Application Parcels

Penz Farms Company

Figure 3.2-1 shows available areas for application of swine manure from the proposed Penz Farms Company operation. Parcels A and B (310 tillable acres) would be spray irrigated. Parcels C, D,



PENZ FARMS COMPANY

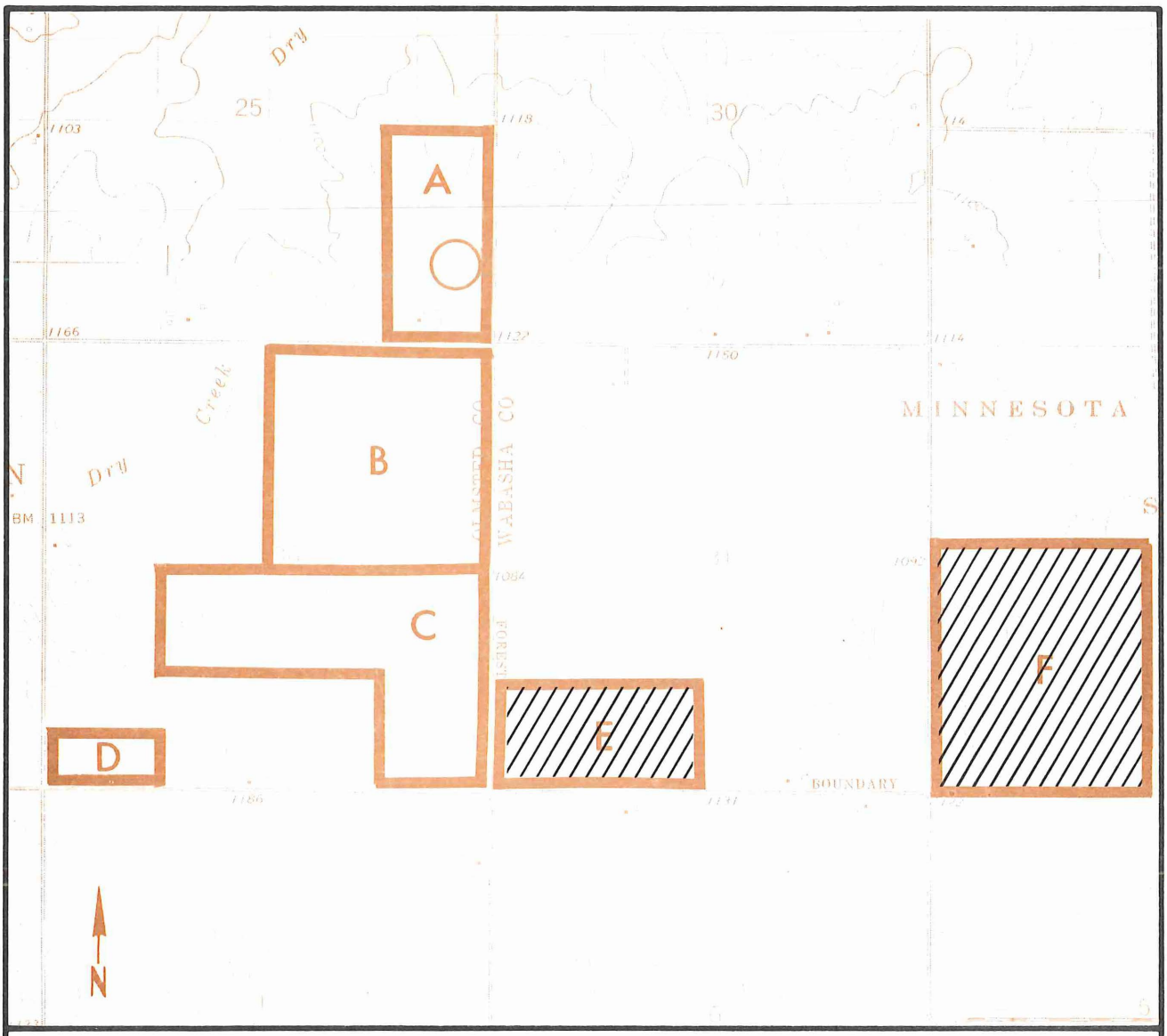
LEGEND

- Facilities Site
- Manure Application Parcels
  - A — Proposed for Spray Irrigation
  - D — Other Available for Spray Irrigation
  - F — Proposed for Injection
  - G — Other Available for Injection

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 3.2-1
Penz Farms Company Project Site

7904031 7904032 7904108



DARWIN SCHROEDER

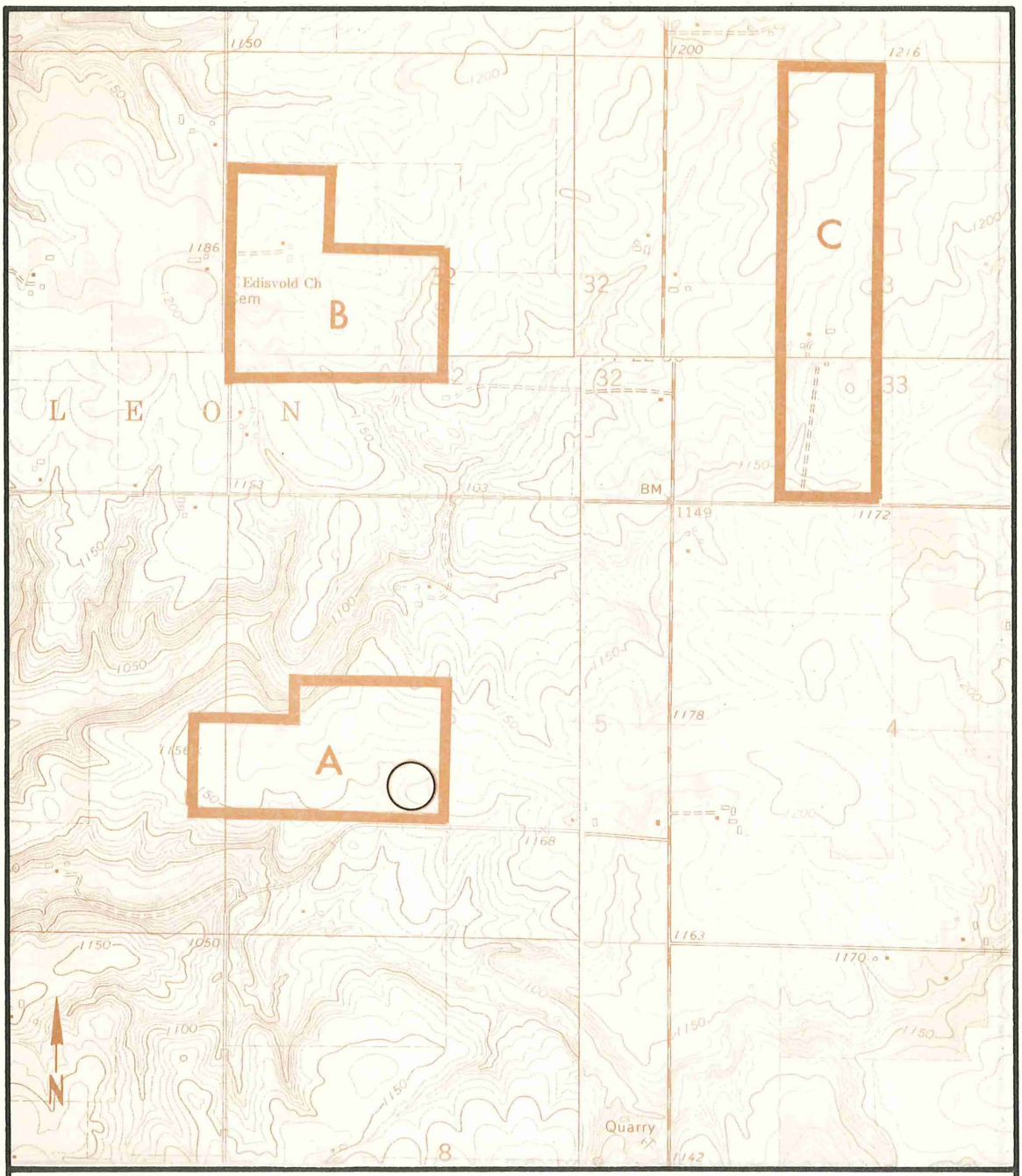
MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

LEGEND

- Facilities Site
- Manure Application Parcels
  - A — Proposed
  - E — Other Available

Figure 3.2-2
Darwin Schroeder Project Site

7904033 7904034 7904101



HILLTOP PORK PRODUCERS

LEGEND

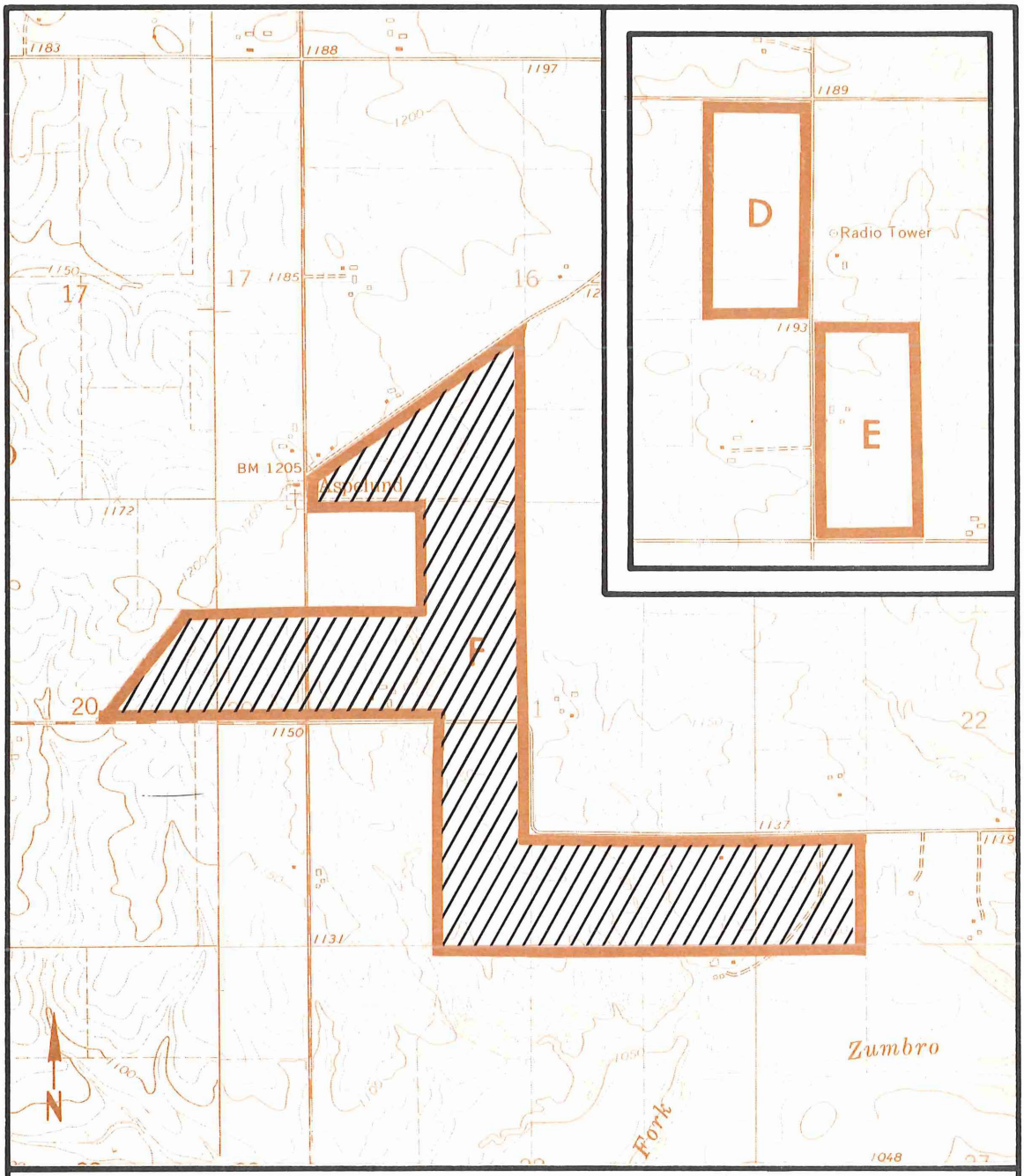
Facilities Site

A Proposed Manure Application Parcels

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 3.2-3
Hilltop Pork Producers Project
Site (a)

7904029 7904030 7904107



HILLTOP PORK PRODUCERS

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

LEGEND

Manure Application Parcels

D — Proposed

F — Other Available

Figure 3.2-4
Hilltop Pork Producers Project
Site (b)

7904027 7904028 7904102

and E (180 tillable acres) are also available to receive spray irrigation in the event of wet conditions during irrigation (in which case additional acreage would be required) or as alternatives to parcels A and B. The 80 tillable acres on parcel F are proposed for injection of manure. Parcel G (60 tillable acres) is available as an alternative to parcel F for injection of manure.

Parcels A through G are all currently put to straight-row crop production, generally using a four-year crop rotation of two years of corn, one year of soybeans, and one year of oats. It is estimated that in any given year 50% of the total tillable acreage of each parcel is put to corn production, with the remainder split evenly between soybeans and oats. Current crop yields average 115 to 140 bushels per acre per year of corn, 40 bushels per acre per year of soybeans, and 80 to 90 bushels per acre per year of oats.

All of the identified manure application parcels, with the exception of parcel B, currently receive chemical fertilizer only, which is spread and incorporated once a year. Parcel B receives swine manure by spray irrigation, supplemented by chemical fertilizer. Soil samples are periodically tested at a local private testing laboratory to determine soil nutrient needs. Current fertilizer application rates are highly variable and are adjusted on the basis of the soils tests; however, the applicant has estimated current annual application rates to be 100 to 140 pounds of nitrogen, 40 to 60 pounds of phosphoric acid, and 150 to 200 pounds of potash per acre.

Darwin Schroeder

Parcels available for the application of swine manure generated by the Darwin Schroeder operation are shown on Figure 3.2-2. Darwin Schroeder has proposed to inject manure into parcels A, B, C, and D (a total of 378 tillable acres) and has identified parcels E and F (230 tillable acres) as other parcels available for this purpose.

Parcels A, B, C, and D currently produce corn and alfalfa, with a crop rotation of three to five years of corn followed by one year of

alfalfa. It is estimated that in any given year, 80% of the tillable acreage of each of these parcels is put to corn production, with the remaining 20% producing alfalfa. A five-year rotation of three years of corn, one year of alfalfa, and one year of soybeans is currently used on parcels E and F. It is estimated that 60% of the tillable acreage within these parcels produces corn each year, with the remainder split evenly between alfalfa and soybeans. Average crop yields are approximately 170 to 180 bushels per acre per year of corn, 7 tons per acre per year of alfalfa, and 40 bushels per acre per year of soybeans. Straight-row farming is used on all manure application parcels with the exception of parcel E, which is contoured.

Parcel A is currently fertilized with chemical fertilizer and cattle manure, both of which are spread and incorporated into the ground. Parcels B through F receive chemical fertilizer only. Each year, fertilizer application rates are determined on the basis of the results of soils testing. The applicant has estimated average annual application rates of 180 pounds of nitrogen, 40 to 60 pounds of phosphoric acid, and 150 pounds of potash per acre.

Hilltop Pork Producers

Land parcels available for application of swine manure from the Hilltop Pork Producers operation are shown on Figures 3.2-3 and 3.2-4. Parcels A through E (a total of 465 tillable acres proposed for injection of manure) is comprised of 50% corn, 40% soybeans, and 10% hay. Parcel F rotates corn (two years), soybeans (one year), and hay (two years). It is estimated that on any given year 40% of the tillable acreage within parcel F is put to corn production, 40% to hay production, and 20% to soybeans. Annual crop yields are approximately 110 bushels of corn, 30 bushels of soybeans, and 4 tons of hay per acre.

On parcel A, chemical fertilizer is spread and incorporated once a year on acres put to corn. Swine manure is currently spread on hay ground once a year at a rate of approximately 11 tons per acre.

Parcels B through F all receive chemical fertilizer once a year, which is spread and incorporated. The extent to which livestock manure is used on these parcels is unknown. The applicant has estimated the average annual nutrient application rate for all parcels (A to F) to be approximately 100 pounds nitrogen, 40 to 60 pounds of phosphoric acid, and 150 pounds of potash per acre.

3.2.3 Existing Livestock Operations

This section briefly describes existing livestock operations that are owned and operated by the project applicants and that are located on or near the proposed facilities sites.

Penz Farms Company owns and operates a confined swine finishing operation in the northwest corner of parcel B, approximately 1.5 miles northwest of the proposed facilities site. The average swine population is approximately 1,200; manure is stored in an earthen storage basin. Swine manure is spray irrigated once a year on cropland west of the existing facility and on proposed manure application parcel B. Application of manure from this existing facility on parcel B would be discontinued if the proposed operation is implemented.

Darwin Schroeder owns and operates a cattle feedlot approximately 100 feet south of the proposed facilities site. This operation contains 100 head of cows, calves, and cattle, with an average weight of approximately 1,000 pounds. Cattle manure is currently spread on adjacent cropland, including proposed manure application parcel A. If the proposed action is implemented, spreading of cattle manure on parcel B would be discontinued. Additionally, the earthen storage basin associated with the proposed confined swine operation would be designed to receive run-off routed from the existing 1-acre cattle feedlot area. Run-off from this area is currently uncontrolled.

Hilltop Pork Producers owns and operates a swine finishing operation approximately 0.7 miles east of the proposed facilities

site. During the winter, 1,200 pigs are kept in a confinement building. During the remainder of the year, the swine population increases to approximately 1,500, with the additional pigs kept outdoors. Swine manure is stored in two concrete pits and spread twice a year on cropland other than those parcels identified as application parcels for the proposed operation.

3.3 Facilities Description

3.3.1 Swine Confinement Buildings

Penz Farms Company and Darwin Schroeder

The swine confinement buildings proposed by Penz Farms Company and Darwin Schroeder are identical, thus the following description applies to both proposed operations. Each proposed complex would consist of three buildings for breeding and gestation, farrowing and nursery, and finishing of swine. All buildings would be constructed of wood frame with aluminum roofing and siding.

The breeding and gestation building would be approximately 235 feet long, 40 feet wide, and 14 feet tall. The maximum holding capacity is 25 boars and 400 sows. The building would be walled off into separate rooms for each hog production phase: breeding, postbreeding, and gestation. A negative-pressure ventilation system would be used; that is, air circulation by ceiling intake and wall exhaust. Variable-speed exhaust fans would be placed approximately 20 feet apart along side walls. Exhaust fans are placed at pit level (below the floor level of swine penning). Five one-quarter horsepower (hp) and 14 one-half hp fan motors would be used to provide a maximum ventilation capacity of 350 cubic feet per minute (cfm) per sow or boar in summer and a minimum capacity of 10 cfm per sow or boar in winter. A stand-by generator would be available to supply power to the ventilation system in the event of electric outages.

The farrowing and nursery building would be 185 feet long, 32 feet wide, and 14 feet tall. The farrowing room would contain 80 individual farrowing crates and would thus have a maximum capacity of 80 sows and litters. The maximum capacity of the nursery would be 1,080 pigs. The ventilation system would be designed to provide a minimum capacity of 20 cfm and a maximum capacity of 450 cfm per sow and litter in the farrowing room and a minimum of 3 cfm and maximum of 32 cfm per nursery pig in the nursery room. It is estimated that 38 one-quarter hp exhaust fans would be required.

The proposed finishing building would be 280 feet long, 46 feet wide, and approximately 14 feet tall, with a maximum holding capacity of 1,920 pigs. The ventilation system would use 4 one-half hp fans and 24 one-quarter hp fans to provide a minimum capacity of 6 cfm per pig and maximum capacity of 75 cfm per pig.

Hilltop Pork Producers

The Hilltop Pork Producers confinement facilities would consist of one building separated into four major rooms for breeding and gestation, farrowing, nursery, and finishing of swine. The proposed building would be 380 feet long and 90 feet wide with 8-foot sidewalls and a maximum height of approximately 20 feet. Wood frame construction and aluminum sidewalls and roofing would be used. The maximum capacity of the building would be 4,275 swine of various sizes, from birth to 350 pounds.

The confinement building would use a negative-pressure ventilation system. The exact specifications of this system have not been identified to date. However, the applicant has estimated that the system would have the capacity to completely replace the air within the building 1.5 times per minute. Such a system would require a total fan capacity of approximately 700,000 cfm. A stand-by generator would be available to power fans in the event of an electricity outage.

3.3.2 Waste Management Facilities

Penz Farms Company and Darwin Schroeder would use similar handling, treatment, and storage facilities. The proposed systems include liquid handling by flushing, solids separation, and anaerobic storage. Hilltop Pork Producers would use slurry collection by scraping and anaerobic storage in commercially available tanks.

Handling and Collection

The collection systems for both Penz Farms Company and Darwin Schroeder would consist of slatted floors and shallow concrete pits. One 12-inch deep by 24-inch wide concrete channel would be located beneath each of the breeding, nursery, and finishing buildings. The entire system would be flushed every 4.5 hours using 350 gallons of holding basin recycle per flush. The system would be a siphon design that automatically fills and releases at the designated frequency. This flush volume and frequency would provide a flushing velocity of 4 feet per second (fps) to maintain all manure solids in suspension.

Manure at the Hilltop Pork Producers facility would be transferred to a small containment pit by a scraper system operated on a timer. There would be no flushing. The manure would be transferred from the pit to a holding area by a pump, and pumped underground into the storage tank from the bottom. The frequency of transfer would depend on the size of the containment pit.

Settling Basins

Pit manure from the Penz Farms Company and Darwin Schroeder facilities would be flushed to settling basins. The characteristics of these facilities are shown in Table 3.3-1. These data show that the Darwin Schroeder settling basin would be designed for long-term storage capacity as well as settling efficiency.

No facilities are proposed specifically for the purpose of solids separation at the Hilltop Pork Producers site. The proposed commercially available storage tanks are discussed in the following section.

Storage Basins

Both the Penz Farm Company and Darwin Schroeder facilities would include long-term anaerobic storage following their settling basins. The characteristics of these basins are shown in Table 3.3-2. The

TABLE 3.3-1

DESIGN CHARACTERISTICS OF SETTLING BASINS AT
PENZ FARMS COMPANY AND DARWIN SCHROEDER FACILITIES

Characteristics	Penz Farms Company	Darwin Schroeder
Volume Capacity (cubic feet)	8,000	90,000
Size (length, width, height in feet)	20 x 40 x 10	120 x 120 x 10
Side Slope	Vertical	3:1
Material	Concrete	Earth with plastic liner
Detention Time (days)	5.8	95*
Solid Removal (percent)	85	60

*Based on average waste flow plus wash water and flushing water; flow = 7,120 gallons per day.

TABLE 3.3-2

DESIGN CHARACTERISTICS OF STORAGE BASINS AT
PENZ FARMS COMPANY AND DARWIN SCHROEDER FACILITIES

Characteristics	Penz Farms Company	Darwin Schroeder
Approximate Volume Capacity (cubic feet)	298,000	282,000
Size (length, width, height in feet)	200 x 200 x 10	140 x 250 x 12
Side Slope	3:1	3:1
Material	Earth with plastic liner	Earth with plastic liner
Storage Capacity (days)*	305	295

*Based on average flow (waste plus wash water), 10 inches of direct rainfall on surface area and 1-foot freeboard.

facilities are basically the same design, with neither proposing ancillary systems to maintain aerobic conditions. Each facility would use plastic liners to inhibit seepage of manure. An approximate 1-foot thick layer of soil would be placed over each liner.

At the Hilltop Pork Producers operation, manure slurry, scraped from collection pits, would be pumped into two commercially available storage tanks. These tanks are open-topped, glass-fused steel constructed on concrete pads. Each contains a usable volume of 93,600 cubic feet (72 foot diameter by 23 foot height). A single pump system would transport wastes from the building to the storage tanks.

For consistency, the detention time for the Hilltop Pork Producers facilities is estimated based on average daily flow. Therefore, including wash water, the "design" storage capacity would be 330 days. No mixing, agitation, aeration, or other ancillary systems are proposed for the Hilltop Pork Producers storage tanks.

3.4 Proposed Construction Activities

Construction activities associated with each proposed swine complex would be restricted to the proposed 4- to 5-acre facilities sites and would entail excavation and grading of the site as well as construction of an access road, swine confinement and ancillary structures, and waste storage facilities. The total cost of construction is approximately $2,485,000 (see Table 3.4-1).

3.4.1 Schedules and Labor Force

Construction of the proposed facilities would begin in May 1980 and proceed for a period of 5 to 5-1/2 months. A total of 25 construction workers would be employed over this period, and the total construction payroll is estimated to be approximately $200,000. Data regarding construction payroll and other construction costs for each of the three proposed operations are presented in Table 3.4-1. Construction activities at the Penz Farms Company and Darwin Schroeder facilities sites would take place Monday through Saturday from 7:00 A.M. to 6:00 P.M. over the course of the construction period. Construction activities at the Hilltop Pork Producers facilities site would take place Monday through Friday from approximately 7:00 A.M. to 5:00 P.M. All workers would commute daily from unknown origins.

3.4.2 Equipment and Materials

An estimated total of 60 truckloads of materials and supplies (20 to each facilities site) would be delivered over the 5 to 5-1/2 month construction period. Heavy equipment used during construction would consist of bulldozers, backhoes, and cement trucks. It is estimated that each of the three proposed facilities sites would require one bulldozer for a two-week period to excavate and grade the site and entrance road, one backhoe for two weeks to dig foundations, and one cement truck for two weeks to deliver concrete. Construction debris would be hauled away and disposed of at unknown sites.

TABLE 3.4-1

SUMMARY OF CONSTRUCTION EMPLOYMENT AND EXPENDITURES

Site	Average Number of Construction Workers	Estimated Construction Payroll*	Other Construction Costs	Total Cost of Construction**
Penz Farms Company	8	$ 60,320	$ 789,680	$ 850,000
Darwin Schroeder	6	45,240	789,760	835,000
Hilltop Pork Producers	11	91,234	708,766	800,000
TOTAL	25	$196,794	$2,288,206	$2,485,000

*Based on estimates of average monthly wage for construction labor contained in 1978 Minnesota Wage Data by Industry and Size of Firm (Minnesota Department of Economic Security).

**Data supplied by applicants.

Preparation of the Darwin Schroeder facilities site would require approximately 9,000 cubic yards of fill material to be transported to the site from an unknown source. The nearest borrow pits are approximately 3 miles away to the northeast and east, in Elgin Township. No offsite transportation of excavated materials would be required during construction of the Penz Farms Company and Hilltop Pork Producers sites. At the Penz Farms Company facilities site, approximately 10,000 cubic yards of earth would be moved during excavation. All cut and fill would be disposed of and originate on site. Preparation of the Hilltop Pork Producers site would involve grading of an approximately 63,000-square-foot building construction pad, requiring an undetermined amount of earth to be excavated. All cut and fill would be distributed and obtained on site.

3.5 Proposed Operational Activities

3.5.1 Swine Management

The maximum capacity of the proposed confined swine facilities is given in Table 3.5-1. The three projects would have a combined maximum capacity of 12,645 swine, with an average weight of approximately 140 pounds. A total of 25,300 market hogs weighing between 215 and 235 pounds would be produced per year. The Penz Farms Company and Darwin Schroeder operations would each have a maximum capacity of 480 sows, 25 boars, and 3,680 pigs, with each producing approximately 8,300 market hogs per year. Maximum capacity of the Hilltop Pork Producers operation would be 510 sows, 25 boars, and 3,740 pigs, with approximately 8,700 market hogs produced per year.

Operation of high-intensity confined swine systems generally follows a strict schedule of management activities. Table 3.5-2 presents a management calendar for a typical high-intensity confined swine operation. Disease prevention and treatment programs would be developed through veterinary consultation. Normal procedures for disease prevention would include: maximum isolation from all rodents, cats, dogs, humans, and new herd additions; cleansing of sows before entering the farrowing facility; and regular cleaning and sanitizing of facilities.

Labor requirements for operation of high-intensity, farrow-to-finish confined swine facilities vary from 15 to 22 hours per sow unit per year (AES undated). Aside from indirect labor spent in planning, records-keeping, and maintaining the farmstead, each of the facilities would require from three to five full-time employees during operation.

Market hogs would be transported by truck to packing plants in Austin and Albert Lea, Minnesota. Penz Farms Company and Darwin Schroeder would each require one truck hauling approximately 160 market hogs per week. Hilltop Pork Producers would deliver three truckloads per week, each containing approximately 55 market hogs.

TABLE 3.5-1

MAXIMUM SWINE CAPACITY OF PROPOSED
CONFINEMENT FACILITIES

Project	Sows	Boars	Pigs	Market Hogs Produced per Year
Penz Farms Company	480	25	3,680	8,300
Darwin Schroeder	480	25	3,680	8,300
Hilltop Pork Producers	510	25	3,740	8,700
TOTAL	1,470	75	11,100	25,300

TABLE 3.5-2

MANAGEMENT CALENDAR FOR A TYPICAL HIGH-INTENSITY CONFINED SWINE OPERATION

Stage	Days from Breeding	Management Practices
Pre-breeding	-30	Co-mingle gilts with sows or provide for fence-line contact; also provide new boars fence-line contact with sows.
	-28 to -14	Vaccinate sows for lepto; also vaccinate for erysipelas, if a problem.
	-14 to -7	Increase feed intake for gilts to 6 to 7 pounds per gilt per day for one to two weeks prior to breeding.
	-2	Spray for lice and mange.
Gestation	0	Breed, rotating boars daily.
	21 to 24	Remove boars.
	35 to 60	Pregnancy check, and sell any open females.
	90	Vaccinate sows for erysipelas, if a problem.
	105	Worm sows with a broad-spectrum wormer. Clean the farrowing house.
	108 to 110	Wash sows with warm water and soap, spray for lice and mange, and move to farrowing house; isolate farrowing house from all visitors.
		Start hand-feeding 3 to 4 pounds per sow per day of a farrowing ration containing 20% wheat bran (or other bulky ingredients) and continue until two to three days after farrowing.
	112	Prepare auxiliary heat for pigs.
	Days after Farrowing	
Farrowing-nursery	0 to 1	Dip navel cord in mild iodine solution.
		Clip needle teeth.
		Cut off tails.

TABLE 3.5-2 (Continued)

Stage	Days after Farrowing	Management Practices
		Ear notch gilts from good litters of 9 or more pigs.
		Complete the farrowing records, including date, number pigs farrowed, etc.
		Observe sows for MMA (mastitis, metritis, agalactia).
	1 to 3	Transfer pigs to equalize litters.
		Give iron shots.
	3 to 14	Castrate males.
	7 to 10	Provide creep feed for pigs.
	14 to 21	Give second iron shot, if needed.
	28 to 42	Wean pigs, group by size, and move to nursery.
Growing-finishing	42	Worm pigs with a broad-spectrum wormer, and spray for lice and mange.
	56	Vaccinate pigs for erysipelas, if a problem.
	72	Worm pigs with a wormer other than the one used at 42 days.
	150	Select replacement gilts from those ear-notched at birth.
	150 to 200	Observe withdrawal regulations for feed additives, and market the hogs at 215 to 235 pounds.

Source: AES undated.

Replacement sows would be chosen out of the herd. Each operation would require one truck delivery per year containing five to ten replacement boars.

Each operation would require approximately 80,000 to 100,000 bushels of feed per year. Penz Farms Company would use corn and oats, grown on adjacent cropland, and a commercial pre-mix feed as a supplement. Pre-mix would be trucked to the site approximately three times per week. Darwin Schroeder would use corn grown on adjacent cropland and a commercial pre-mix supplement. Approximately 700 tons of pre-mix would be purchased annually and would be delivered by truck approximately every two weeks.

The swine ration used by Hilltop Pork Producers would consist of approximately 80% corn, 15% soybean meal, and 5% commercial pre-mix. Corn would be purchased locally, either directly from farmers or from grain dealers. Soybean meal and pre-mix would be trucked in from Minneapolis, Minnesota, and Quincy, Illinois, respectively. Approximately 1.5 truckloads per week would be required for delivery of the various swine-ration components to the facilities site.

The Penz Farms Company and Hilltop Pork Producers have proposed to dispose of waste animals by onsite incineration. The Darwin Schroeder operation would use a local rendering service with dead animals picked up daily, if necessary.

3.5.2 Energy and Water Requirements

Penz Farms Company and Darwin Schroeder would each have an annual energy requirement of approximately 6,000 gallons of propane and 125,000 kilowatt-hours (kwh) of electricity. The annual energy requirements of the Hilltop Pork Producers operation have not been identified; however, it is estimated that annual usage would be similar to those of the other two operations. The energy required for all operations would be supplied locally.

The water requirements of each operation would be supplied by on-site wells. Penz Farms Company proposes to drill a new well at the facilities site and withdraw approximately 6,000 gallons per day (gpd). This well would supply the start-up water for the proposed

flushing system. During normal operation, most of the 6,000 gpd withdrawal would be consumed by swine, with a minor portion put to sow washing and pen sanitation. Darwin Schroeder would use an existing well approximately 200 feet southwest of the facilities site with estimated daily water consumption at 3,600 to 4,000 gallons. Hilltop Pork Producers would construct a well at the facilities site and pump approximately 5,500 gpd. The total water demand for the three projects is approximately 15,500 gpd.

3.5.3 Crop Production on Proposed Manure Application Parcels

During facilities operation, each applicant would continue the same crop production and farming practices currently applied to identified manure application parcels. Current crop production is discussed in Section 3.2.2. Data regarding crop production on parcels proposed to receive swine manure are summarized in Table 3.5-3. Penz Farms Company parcels proposed for application of swine manure would grow corn, soybeans, and oats. All of the oats and some of corn produced would be used as swine feed, with the remaining crops marketed locally. Darwin Schroeder would grow corn and alfalfa on cropland receiving swine manure with a portion of the corn production used as swine feed. Land used for the application of manure generated by the Hilltop Pork Producers facilities would produce corn, soybeans, and hay, with all crops marketed locally.

3.5.4 Manure Management

Raw Manure Characteristics

The characteristics of raw swine manure depends mainly on the size of the animals involved and the feed ration. Quantity estimates are based on total live weight as shown in Table 3.5-4. The basic unit of measure for these calculations is 1.0 cubic foot of waste per day for every 1,000 pounds of animal confined.

TABLE 3.5-3

CROP PRODUCTION ON PROPOSED MANURE APPLICATION PARCELS

Parcel	Size of Parcel (tillable acres)	Proposed Crops	Land Area Put to Each Crop (acres)	Projected Annual Yield*	Proposed Crop Use**
Penz Farms Company					
A	90	Corn	45	115 to 140	F/M
		Soybeans	22.5	40	M
		Oats	22.5	80 to 90	F
B	220	Corn	110	115 to 140	F/M
		Soybeans	55	40	M
		Oats	55	80 to 90	F
F	80	Corn	40	115 to 140	F/M
		Soybeans	20	40	M
		Oats	20	80 to 90	F
Darwin Schroeder					
A	60	Corn	48	170 to 180	F/M
		Alfalfa	12	7 tons/acre/year	M
B	147	Corn	118	170 to 180	F/M
		Alfalfa	29	7 tons/acre/year	M
C	154	Corn	123	170 to 180	F/M
		Alfalfa	31	7 tons/acre/year	M
D	17	Corn	14	170 to 180	F/M
		Alfalfa	3	7 tons/acre/year	M
Hilltop Pork Producers					
A	110	Corn	55	110	M
		Hay	55	4 tons/acre/year	M
B	90	Corn	45	110	M
		Soybeans	45	30	M
C	120	Corn	60	110	M
		Soybeans	60	30	M
D	75	Corn	37.5	110	M
		Soybeans	37.5	30	M
E	70	Corn	35	110	M
		Soybeans	35	30	M

*Bushels per acre unless otherwise noted.

**F = used as swine-feed; M = marketed locally.

TABLE 3.5-4

QUANTITY OF RAW SWINE MANURE GENERATED
AT THE PROPOSED FACILITIES

Number of Animals (maximum capacity)	Average Animal Weight (pounds)	Total Animal Weight (pounds)	Manure Generated* cubic feet per day (gpd)
Penz Farms Company			
460 sows	400	184,000	
3,680 pigs	110	404,800	
	Total	588,800	589 (4,418)
Darwin Schroeder			
460 sows	400	184,000	
3,680 pigs	110	404,800	
	Total	588,800	589 (4,418)
Hilltop Pork Producers			
510 sows	350	178,500	
25 boars	350	8,750	
510 pigs	10	5,100	
1,020 pigs	35	35,700	
680 pigs	75	51,000	
680 pigs	125	85,000	
850 pigs	280	238,000	
	Total	602,050	602 (4,515)

*Unit volume = 1 cubic foot of manure per day per 1,000 pounds of animal weight.

The most important components of the raw manure are solids and nutrients. The data listed in Table 3.5-5 are based on information received from the applicants and generally agrees with literature data. As mentioned above, the variability depends on animal mix and feed rations. Additional manure components are shown in Table 3.5-6 and are derived from the cited literature. These data include micronutrients, trace metals, and general characteristics.

Treated Waste Characteristics

Water and Solids Balances

A daily water and solids balance for the three facilities is shown in Figure 3.5-1. The Penz Farms Company and Darwin Schroeder balances assumed 1,800 gallons of flushing water recycled from the storage basins 1,100 gallons of wash water. Solids remaining in the settling basins are dry weights and are based on removal efficiencies shown in Table 3.3-1. All other solids values are also dry weights. The percentages in parentheses are average percent solids on a weight basis.

Nutrients

The major nutrients of interest are nitrogen, phosphorus, and potassium. Of the three, only nitrogen would be lost from the system. For phosphorus and potassium, some conversions between soluble and particulate fractions may occur but no system losses would be encountered. Nitrogen, however, can be lost from the system by the volatilization of ammonia gas.

To estimate nitrogen losses, a 65% annual loss value (Vanderholm 1975; Koelliker and Miner 1973) has been applied to the Penz Farms Company and Darwin Schroeder facilities and the 25% value (Sutton, Vanderholm, and Melvin undated) to the Hilltop Pork Producers facility as shown in Table 3.5-7. The total annual nitrogen generation values are based on 365 days of operation and the data in Table 3.5-5.

TABLE 3.5-5

SOLIDS AND NUTRIENT COMPOSITION OF RAW SWINE MANURE FROM THE PROPOSED FACILITIES

Characteristics	Penz Farms Company	Darwin Schroeder	Hilltop Pork Producers
Flow (gpd)	4,420	4,420	4,520
Total Solids*	8.4 (3,375)	8.4 (3,375)	8.5 (3,485)
Volatile Solids**	80 (2,700)	80 (2,700)	80 (2,790)
Nitrogen**	7.6 (257)	7.6 (257)	6.0 (210)
Phosphorus**	2.2 (74)	2.2 (74)	3.6 (124)
Potassium**	5.4 (182)	5.4 (182)	5.4 (188)

Source: Total percent solids from Pierce (1975).

*Percent weight (pounds per day).

**Percent of total solids (pounds per day).

TABLE 3.5-6

MICRONUTRIENTS, TRACE METALS, AND GENERAL CHARACTERISTICS OF RAW SWINE MANURE

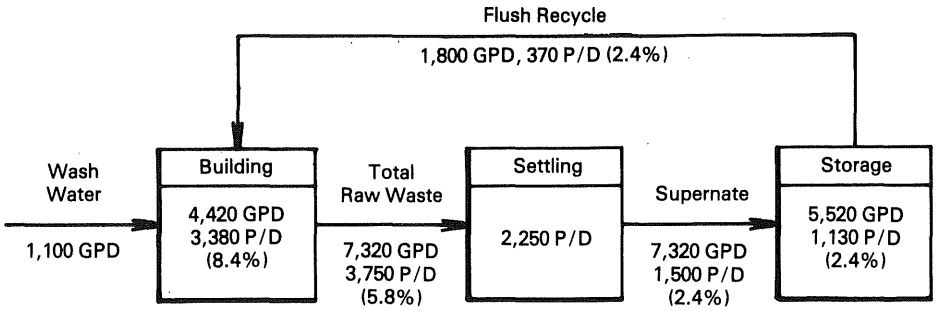
Characteristics	Quantity
Micronutrients*	
Calcium	3.2
Magnesium	0.8
Sulfur	0.3
Trace Metals**	
Copper	250
Zinc	530
Iron	1,940
Aluminum	540
Manganese	340
Cobalt	6
Molybdenum	0.3
Cadmium	1
Lead	12
General Characteristics	
Fat (Ether Soluble)*	6.6
Protein*	19
Thermal†	7,800

Source: Pierce 1975.

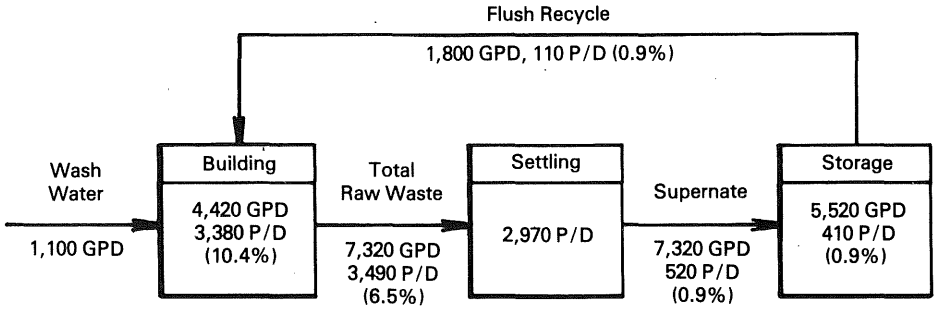
*Percent of total solids.

**mg/kg.

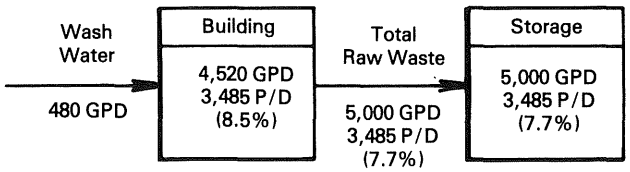
†Btu per pound (dry).



DARWIN SCHROEDER



PENZ FARMS COMPANY



HILLTOP PORK PRODUCERS

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 3.5-1
Water and Solids Balances

7905051

TABLE 3.5-7

ANNUAL NITROGEN LOSSES FROM PROPOSED SWINE FACILITIES

Source	Penz Farms Company	Darwin Schroeder	Hilltop Pork Producers
Total annual nitrogen in waste, lb as nitrogen	94,000	94,000	77,000
Total annual nitrogen lost, lb as nitrogen	61,000	61,000	19,000
Total annual nitrogen lost, lb as ammonia	74,000	74,000	23,000

Sources: Koelliker and Miner 1973; Vanderholm 1975; Sutton, Vanderholm, and Melvin undated.

Although calculated on an annual basis, most losses occur between March and November. During this period, atmospheric ammonia vapor pressures in the vicinity of the storage basins can be expected to range between 1 and 2 x 10^{-6} atmospheres (0.55 and 1.1 micrograms per liter as nitrogen) (Koelliker and Miner 1973).

Manure Application

All three facilities propose land application of all generated swine manure. The Penz Farms Company and Darwin Schroeder facilities would have to apply both a solid fraction from the settling basins and a liquid fraction from their storage basins. The Hilltop Pork Producers facilities would apply a single waste stream pumped from the two commercial storage tanks.

Solids from the Penz Farms Company settling basin would be transported to the application site in a tank wagon and injected. Liquid from the storage basin would be spray irrigated using a traveling rain gun. Separate fields would be used for the solids and liquid waste streams, as identified in Section 3.2.2.

Solids from the Darwin Schroeder settling basin would be transported to the application site in leak-proof containers. The proposed application technique is injection. Stored liquid (from the storage basin) would be transported and applied in a similar manner.

Wastes from the Hilltop Pork Producers storage tanks would be transported to the application sites in leak-proof containers on trucks or hauled by tractors. Application would be by injection.

Nutrient Utilization

The Penz Farms Company facilities would use separate parcels for the application of solids from the settling basin and liquid supernate from the storage lagoon. In addition, solids would be injected while the liquids would be spray irrigated and incorporated. To separate utilization for these two systems, total excreted nutrients must be separated into soluble and particulate fractions.

Approximately 50% of the nitrogen in fresh manure can be assumed to be in the ammonia form (Vanderholm 1975). The remaining nitrogen is organic, and is assumed in this analysis to be subject to removal by settling. In addition, nitrogen is lost to the system by ammonia volatilization. For simplicity, ammonia losses (on a percent basis) are assumed equal for both the settling system and the storage. The resulting nitrogen "balance" is shown in Table 3.5-8. Phosphorus removal in the settling tank is assumed to be approximately 50% (Sutton, Vanderholm, and Melvin undated). No data are available for potassium, but it is assumed to follow the same removal characteristics as phosphorus.

Annual nutrient needs of proposed manure application parcels are summarized in Table 3.5-9. A comparison of nutrients in the manure versus nutrients required for crop growth is given in Table 3.5-10. Calculated quantities of manure nutrients for the Penz Farms Company operation are based on the above assumptions regarding nutrient separation between the settling basin and storage basin. Values for the Darwin Schroeder and Hilltop Pork Producers facilities are based on assumed nutrient losses shown in Table 3.5-7. As shown in Table 3.5-10, the amount of nitrogen in the swine manure is generally less than the nitrogen crop-uptake on proposed application parcels, whereas phosphorous and potassium levels are generally greater than that necessary for crop growth.

Land Application Loading Rates

Calculated loading rates are based on the following factors:

- the utilization/availability comparisons in Table 3.5-10,
- additional nitrogen losses during application, and
- an assessment of nitrogen availability in manure versus nitrogen actually available to crops (since not all manure nutrients are readily available to crops in the year of application).

TABLE 3.5-8

ANNUAL NITROGEN BALANCE FOR PENZ FARMS COMPANY
TREATMENT SYSTEM

Source	Quantity (pounds)
Total nitrogen excreted	94,000
as inorganic nitrogen	47,000
as organic nitrogen	47,000
Nitrogen potentially retained in settling basin*	37,950
Nitrogen lost as ammonia release**	25,900
Nitrogen in settled solids	14,050
Nitrogen potentially in storage basin	54,050
Nitrogen lost as ammonia release	35,100
Nitrogen in storage	18,950

Note: All nitrogen values are dry weight.

*85% of organic nitrogen

**65% of total

TABLE 3.5-9

NUTRIENT UTILIZATION FOR YIELDS EXPECTED FROM PROPOSED MANURE APPLICATION PARCELS

Facility	Crop	Expected Yield (unit/acre/year)	Nutrient Utilization* (pound/acre/year)		
			Nitrogen	Phosphoric Acid	Potash
Penz Farms Company	Corn	130 bushels	175	72	177
	Soybeans	40 bushels	180	45	80
	Oats	85 bushels	94	40	109
Darwin Schroeder	Corn	175 bushels	230	97	235
	Alfalfa	7 tons	383	70	405
Hilltop Pork Producers	Corn	110 bushels	165	64	139
	Hay	4 tons	150	55	250
	Soybeans	30 bushels	123	32	52

Source: ERT 1979.

*Source: Sutton, Vanderholm, and Melvin undated

TABLE 3.5-10

COMPARISON OF NUTRIENTS IN MANURE VERSUS REQUIRED NUTRIENTS FOR CROP GROWTH
(pounds per dry weight)

Project	Nutrients in Manure	Nutrients Required
Penz Farms Company		
Settling Basin Solids		
Nitrogen	14,050	12,480*
Phosphorous	13,505	2,015*
Potassium	33,215	9,014*
Storage Basin		
Nitrogen	18,950	48,360**
Phosphorous	13,505	8,070**
Potassium	33,215	35,772**
Darwin Schroeder		
Nitrogen	32,900	98,415
Phosphorous	27,010	6,556
Potassium	66,430	46,314
Hilltop Pork Producers		
Nitrogen	58,000	68,400
Phosphorous	42,000	4,462
Potassium	69,000	40,587

Source: ERT 1979

*Nutrients required for crop growth on parcel F.

**Nutrients required for crop growth on parcels A and B.

The resulting loading rates for nitrogen are given in Table 3.5-11. These data include two loading rates: pounds per year at available nitrogen and pounds per acre per year of total nitrogen. As shown, the total acreage required to utilize the available nitrogen in the manure is significantly less than the acreage proposed for application (see Table 3.5-3). It is important to note, however, that this acreage requirement would increase each year since a portion of the total nitrogen applied each year becomes available to crops in succeeding years. The data shown in Table 3.5-11 are estimates and actual loading rates would be determined each year on the basis of laboratory testing of manure and soils.

TABLE 3.5-11

NITROGEN LOADING RATES

Project	Pounds/Year Available Nitrogen	Pounds/Acre/Year Total Nitrogen	Acres*
Penz Farms Company			
Parcel A and B			
Corn	6,040	307	34.5
Soybeans	3,105	316	17.25
Oats	1,620	165	17.25
Parcel F			
Corn	3,760	368	21.5
Soybeans	1,845	379	10.25
Oats	960	197	10.25
Darwin Schroeder			
Corn	16,560	323	72
Alfalfa	6,890	538	18
Hilltop Pork Producers			
Corn	23,100	232	140
Hay	5,250	210	35
Soybeans	12,912	173	105

Source: ERT 1979

Note: All nitrogen values are dry weight.

*Acreage required in the first year to apply manure at nitrogen-based agronomic rates.

3.6 References

AES undated. Pork Production Systems with Business Analyses. Pork Industry Handbook PIH-15. Agricultural Extension Service. St. Paul: University of Minnesota.

ERT 1979. Description of the Proposed Action: Related Actions EIS on Confined Swine Facilities. TWP 1, Document P-3634-500. Environmental Research & Technology, Inc., Concord, MA.

Koelliker, J. K. and J. R. Miner 1973. Description of Ammonia for Anaerobic Lagoons. Transactions of the ASAE, pp. 148-151.

Minnesota Department of Economic Security. 1978 Minnesota Wage Data by Industry and Size of Firm. Research and Statistical Services Office.

Pierce G. R. 1975. The Inclusion of Pig Manure in Ruminant Diets. Managing Livestock Wastes. Third International Symposium, American Society of Agricultural Engineers.

Sutton, A. L., D. H. Vanderholm, and S. W. Melvin undated. Fertilizer Value of Swine Manure. Pork Industry Handbook. Agricultural Extension Service. St. Paul: University of Minnesota.

Vanderholm, D. H. 1975. Nutrient Losses from Livestock Waste During Storage, Treatment, and Disposal. Managing Livestock Wastes. Third International Symposium, American Society of Agricultural Engineers.

4. DESCRIPTION OF THE ENVIRONMENT

4.1 Air Quality

4.1.1 Climatology of Study Area

The study area is situated within the Southeast Climatological Division of Minnesota (Kuehnast 1972). This region is characterized by higher mean temperatures year-round than the rest of the state, and prolonged hot spells during the summer months are not uncommon. The most significant meteorological parameters for the key air quality issues associated with livestock operations are wind speed, wind direction, atmospheric stability, and ambient temperature. The first three define the advection and diffusion of odorant gases, particulates, and aerosols from the source to receptors in the impact area. Ambient temperature governs such factors as the types and amounts of odorant emissions,* swine building ventilation (exhaust) rates, and probable (indoor versus outdoor) activities of persons (sensitive receptors) in the area.

Tables 4.1-1 and 4.1-2 present summaries of temperature and wind data, respectively, compiled by the National Weather Service (NWS) at the Rochester, Minnesota, municipal airport station over a 30-year period. Table 4.1-1 shows that, on the average, the maximum temperature exceeds 32°F (freezing) on only 28% of the days in December through February, with an average daily maximum of 25°F for these three months. In March, the mean daily maximum is only 4.5°F above freezing, although maximums above 32°F can be expected to occur on an average of 21 days. No maximums below 32°F normally

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*Temperature influences emissions through its interaction with pH levels and the chemical processes involved in anaerobic decomposition of manure.

TABLE 4.1-1

TEMPERATURE SUMMARY FOR ROCHESTER, MINNESOTA (1941-1970)

Month	Temperature Averages (°F)			Temperature Frequencies (Mean Number of Days of Occurrence)		
	Daily Maximum	Daily Minimum	Monthly Mean	Maximum Above 89°F	Maximum Above 32°F	Minimum Above 32°F
January	21.9	3.9	12.9	0	7	0
February	26.4	7.4	16.9	0	9	0
March	36.5	19.1	27.8	0	21	4
April	54.9	34.1	44.5	0	30	16
May	67.1	45.3	56.2	-	31	29
June	76.4	55.5	66.0	2	30	30
July	80.7	59.5	70.1	2	31	31
August	79.4	57.7	68.6	1	31	31
September	70.2	48.3	59.3	-	30	29
October	60.4	38.7	49.6	0	31	23
November	40.9	24.2	32.6	0	24	7
December	26.9	10.9	18.9	0	9	1
Annual	53.5	33.7	43.6	6	284	202

Source: NOAA 1975

TABLE 4.1-2

WIND SPEED AND DIRECTION SUMMARY FOR ROCHESTER, MINNESOTA
(1941-1970)

Month	Mean Wind Speed (mph)	Prevailing Direction	Frequency of Occurrence of Low Wind Speeds(%)	
			1 to 3.5 mph	Calms
January	14.1	NW	0.96	0.73
February	13.5	NW	1.25	1.70
March	13.6	NW	1.78	1.45
April	14.5	NW	0.33	1.42
May	13.4	S	1.29	1.29
June	11.8	S	1.41	1.42
July	10.5	S	0.97	1.21
August	10.4	S	1.54	1.61
September	11.3	S	1.66	2.17
October	12.9	S	0.96	0.65
November	13.0	S	1.33	1.00
December	13.3	NW	2.09	0.89
Annual	12.7	S	1.30	1.29

Source: NOAA 1975

occur during April through October. Mean temperature for this period is about 59°F, and the average daily maximum is 70°F. For June, July, and August, the average daily mean and maximum are 68°F and 79°F, respectively. The warmest month is July, with a daily mean of 70°F and an average daily maximum of about 81°F. On the average, there are about six days per year when the maximum temperature equals or exceeds 90°F.

Wind data at Rochester (Table 4.1-2) indicate an average annual wind speed of 12.7 mph, with lowest speeds (10 to 11 mph) in the summer months. Prevailing winds are from the northwest in winter and early spring, southerly the rest of the year. Of particular interest in determining the potential for episodes of high ambient odor levels is the frequency of calm or light winds, particularly during periods of neutral or stable atmospheric conditions. The last two columns of Table 4.1-2 present estimates of the joint frequencies of occurrence for seven wind speed (including calms) and seven atmospheric stability classes in each of the 16 cardinal wind directions. The figures in the last two columns of Table 4.1-2 represent the monthly frequencies under all stability conditions (from five-year records) of the two lowest speed classes: 1 to 3.5 mph and calm (less than one mph). It is evident that the highest probability of occurrence for calm winds can be expected in September (2.17% of the time), while the lowest frequency (0.65%) occurs in October. The mean frequency of occurrence of calms for the April through September period is 1.52%; that is, above the annual average of 1.29%. The mean frequency of occurrence for light or calm winds (all winds 0 to 3.5 mph) for this six-month period is 2.72%, slightly above the annual average of 2.59%.

Because the simultaneous occurrence of calm or light winds and stable atmospheric conditions in the warmer months of the year is of special interest in evaluating the potential for high community odor levels, a summary of the joint stability and wind speed frequencies estimated for Rochester is presented in Table 4.1-3 for April through October and for each of the 16 cardinal wind directions. Within this seven-month period, stable atmospheric conditions and low wind speeds are more frequently associated with winds from the west (0.25% of the

TABLE 4.1-3

MEAN FREQUENCY OF OCCURRENCE OF STABLE ATMOSPHERIC CONDITIONS WITH LOW WIND SPEEDS IN ROCHESTER, MINNESOTA (APRIL-OCTOBER 1969-1973)

Wind Direction	Percentage of Observations - Light or Calm Winds* and Stable Conditions							
	April	May	June	July	Aug.	Sept.	Oct.	7-Month Average
North	0.20	0.04	0.17	0.31	0.04	0.23	0.20	0.17
North-Northeast	0.13	0.07	0.14	0.04	0.12	0.07	0.03	0.09
Northeast	0.06	0.10	0.04	0.01	0.24	0.06	0.04	0.08
East-Northeast	0.02	0.04	0.05	0.03	0.10	0.14	0.14	0.07
East	0.06	0.20	0.05	0.20	0.10	0.21	0.08	0.13
East-Southeast	0.06	0.01	0.11	0.03	0.16	0.07	0.02	0.07
Southeast	0.03	0.01	0.12	0.02	0.15	0.13	0.20	0.09
South-Southeast	0.02	0.04	0.18	0.08	0.07	0.14	0.11	0.09
South	0.15	0.06	0.18	0.09	0.26	0.25	0.09	0.15
South-Southwest	0.02	0.01	0.02	0.05	0.04	0.12	0.00**	0.04
Southwest	0.05	0.12	0.01	0.05	0.06	0.13	0.10	0.07
West-Southwest	0.06	0.03	0.03	0.08	0.06	0.06	0.02	0.05
West	0.22	0.07	0.14	0.10	0.14	0.86	0.23	0.25
West-Northwest	0.13	0.18	0.28	0.14	0.12	0.28	0.12	0.18
Northwest	0.13	0.10	0.13	0.02	0.16	0.16	0.03	0.10
North-Northwest	0.22	0.03	0.12	0.12	0.21	0.33	0.03	0.15
Total - All Wind Directions	1.50	1.13	1.75	1.37	2.01	3.25	1.45	1.78

Source: NOAA 1975

*0 to 3.5 mph

**Less than 0.005%

time), north (0.17% of the time), and the west-northwest (0.18% of the time). Based on these observations, the single most adverse meteorological situation would be represented by westerly winds in September (that is, residences situated directly east of a source) when "worst-case" wind/stability conditions can be expected to occur 0.86% of the time. Worst-case conditions for perceived odor impact, however, will more likely occur during the mid-summer period (when odor emissions are enhanced by hot weather and people are more likely to be outdoors) or for brief periods in mid-spring or mid-autumn, during manure withdrawal.

4.1.2 Existing Ambient Air Quality Data

The only permanent air monitors within the three-county study area are located in Rochester (total suspended particulates (TSP), sulfur dioxide, nitrogen dioxide, and carbon monoxide) and Redwing (TSP only). Summary data, including numbers of violations of state primary standards, are presented in Table 4.1-4 for TSP, sulfur dioxide, and nitrogen dioxide (MPCA 1977; MPCA 1978). Carbon monoxide is omitted from this table because the only carbon monoxide monitor (MPCA No. 5076) is located in downtown Rochester and, hence, is totally unrepresentative of the study areas. Even the data provided are of limited use because of the nonrural character of the zones of influence for these monitoring stations.

In general, it is probable that baseline ambient concentrations of sulfur dioxide and nitrogen dioxide in the study area are considerably below the levels reported in Rochester and Redwing. Carbon monoxide levels should approximate rural background (that is, only a few parts per million even under worst case meteorological conditions). Observed TSP levels, on the other hand, are often higher in rural areas than in urban areas largely because of wind erosion and dust entrainment associated with normal agricultural activities. The Clean Air Act Amendments of 1977 recognize that particulate emissions from such activities are unavoidable and has, therefore, exempted the "native soil" component of TSP from determination of whether a

TABLE 4.1-4

SUMMARY OF AIR MONITORING DATA
IN OLMSTED AND GOODHUE COUNTIES, MINNESOTA

Pollutants	Rochester (Olmsted County)	Redwing (Goodhue County)
Total Suspended Particulates ($\mu g/m^3$) (1977)		
Annual (average of all stations)*	54	67
24-Hour		
Highest	207	217
2nd Highest	148	204
Number of Violations†Δ	0	0
Sulfur Dioxide (ppm) (1976)		
Annual**	0.013	-
24-Hour		
Maximum	0.14	-
2nd Highest	0.14	-
Number of ViolationsΔ	52	-
3-Hour		
Maximum	0.33	-
2nd Highest	0.32	-
Number of ViolationsΔ	6	-
Nitrogen Dioxide (ppm) (1976)		
Annual**	0.024	-

*Geometric mean.

**Arithmetic mean.

†Average of all five stations in Rochester.

ΔOf Minnesota primary standards.

particular locality violates the TSP standards for ambient air quality or significant deterioration. Most rural areas of Minnesota and, in fact, the United States are, therefore, classified as "attainment" (meeting the standards) for TSP.

4.1.3 Existing Land Use and Community Odor Sources

As described in Section 4.6, the land within a 3-mile radius of each facilities site is almost exclusively under active agricultural use, with feedlots (primarily cattle and swine) interspersed among rural residences throughout the area. Livestock operations and fertilizer applications constitute the principal existing odor sources in virtually all of rural southeastern Minnesota. In 1977, there were a total of about 54,000 swine raised in Olmsted County, 67,000 in Wabasha County, and 49,000 in Goodhue County (Minnesota Crop and Livestock Reporting Service 1978).

It is assumed that virtually all of the swine wastes generated in these three counties are used as fertilizer on adjacent parcels of land, although there is no available information on the methods of application commonly practiced. Detailed inventory data on baseline swine population and distribution of farms according to size of swine operation is presented in Section 4.4.

Existing livestock operations owned and operated by the applicants are described in Section 3. These include a 1,200-head confined swine facility located about 1.5 miles northwest of the proposed Penz Farms Company, a 100-head cattle feedlot approximately 100 feet south of the proposed Darwin Schroeder operation, and a 1,200 to 1,500 confined/outdoor swine finishing operation approximately 0.7 miles east of the proposed Hilltop Pork Producers site. Earthen storage basins are used to store the wastes associated with the existing operations, with the exception of Hilltop Pork Producers, which uses concrete pits.

Sensitive Receptors

Air quality effects and community odor levels can normally be expected to decrease with distance from the facility. Currently, there are about 120 residences within a 3-mile radius of either the proposed Penz Farms Company or Darwin Schroeder facility and over 140 residences within 3 miles of the proposed Hilltop Pork Producers operation. The community of Elgin (population approximately 600) is just beyond the 3-mile radius of the Darwin Schroeder proposed operation. Numbers of residences within various distance zones are given in Section 4.6.

4.1.4 Minnesota Laws and Regulations Pertaining to Odor

Air Pollution Control Regulations

Minnesota Rule APC 9 regulates odor emissions, ambient odor levels, and odor testing associated with various sources, including, stacks, chimneys, vents, windows, openings, lagoons, basins, catch basins, ponds, open tanks, storage tanks, storage piles, organic or inorganic discharges, and/or applications of materials that emit odorous gas, gases, or particulates. However, Minnesota Rule APC 9(f) exempts agribusiness activities from the standards promulgated in other sections of Minnesota Rule APC 9:

> (f) Agri-business Exception. The odor of growing vegetation shall not be considered odorous air pollution. The odor of domestic (organic) fertilizer, industrial (inorganic) fertilizer, and pesticides shall not be considered odorous air pollution if such substances are used effectively according to their intended purposes and application. The open storage (piling) of such materials shall be accomplished in a nuisance-free manner and in compliance with the regulations of federal, state and local government and with other regulatory agencies.

This exception establishes a separate standard for the open storage of domestic (organic) fertilizer, industrial (inorganic) fertilizer, and

pesticides, namely, that these substances shall be stored in a nuisance-free manner.

Minnesota Rule APC 10 specifies procedures for controlling odors resulting from processing animal matter. However, this rule is clearly not intended to apply to various phases of a hog raising operation. Therefore, no part of Minnesota Rule APC 10 is relevant to the proposed facilities.

Concept of Nuisance

Minnesota has statutory prohibitions against both public and private nuisances. Minnesota Statute §561.01 (1978) grants individuals a private cause of action against a nuisance and defines a nuisance as follows.

> Anything which is injurious to health, or indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property, is a nuisance. An action may be brought by any person whose property is injuriously affected or whose personal enjoyment is lessened by the nuisance, and by the judgement the nuisance may be enjoyed or abated as well as damages recovered.

Minnesota Statute §609.74 (1978) defines what constitutes a public nuisance and provides for sanctions against the commission of such an act:

> Whoever by his act or failure to perform a legal duty intentionally does any of the following is guilty of maintaining a public nuisance, which is a misdemeanor:
>
> (1) Maintains or permits a condition which unreasonably annoys, injures or endangers the safety, health, morals, comfort, or response of any considerable number of members of the public; or
>
> (2) Interferes with, obstructs, or renders dangerous for passage, any public highway or right of way, or waters used by the public, or
>
> (3) Is guilty of any other act or omission declared by law to be a public nuisance and for which no sentence is specifically provided.

The determination of whether a nuisance actually exists in a given situation is difficult. Many factors have been used by courts in evaluating whether or not there is a nuisance, and no one factor seems conclusive. In each case, the court must evaluate the extent of the harm to the plaintiff and the propriety of the defendant's conduct. Some of the factors that have been considered by the sources in evaluating the existence of a nuisance include:

- the nature of the locality: that is, is the area predominantly rural or residential;
- the pre-existence of the offending facility;
- whether the accused party has taken all reasonable precuations to minimize odorous air pollution emissions;
- whether the plaintiff is an individual with "ordinary and normal sensibilities" with respect to odor;
- the proximity of the activity to those complaining;
- the value of the service being provided by the defendant;
- the motive of the defendant; and
- the number of people complaining.

Each court may grant greater weight to one of the above-described factors over another factor or may find still additional extenuating circumstances on which to base its findings. Therefore, the presence of a nuisance condition is situational and must be determined on a case by case basis.

Minnesota Environmental Rights Act

Minnesota Statute Chapter 116B (1978), the Minnesota Environmental Rights Act, was enacted to allow for a cause of action against persons who cause pollution, impairment, or destruction of natural resources. However, the definition of "person" excludes family farms, family farm corporations, and/or bona fide farmer corporations. Additionally, the definition of "pollution, impairment, and destruction" does not include conduct that violates or is likely

to violate any environmental quality standard, limitation, regulation, rule, order, license, stipulation, agreement, or permit solely because of the introduction of odor into the air.

4.1.5 Ambient Air Quality Standards

National Ambient Air Quality Standards

National Ambient Air Quality Standards were established for six major pollutants by the 1970 Clean Air Act. These pollutants are: TSP, sulfur dioxide, carbon monoxide, nonmethane hydrocarbons, nitrogen dioxide, and photochemical oxidants. Roadway vehicles constitute a significant source of carbon monoxide, nonmethane hydrocarbons, and nitrogen oxides and can be indirectly responsible for high ambient concentrations of photochemical oxidants, which result from the photochemical interaction of nitrogen dioxide and nomethane hydrocarbons. Sulfur oxides and particulates are emitted primarily from stationary sources; that is, industrial stacks, power plants, incinerators, and space heating. Table 4.1-5 shows the air quality standards for the six major pollutants. The standards specify exposure periods for each pollutant based on studies of health effects. All of the pollutants listed directly affect the human physiological system except for hydrocarbons, the nonmethane component of which contributes indirectly to photochemical smog through a series of chemical reactions with nitrogen oxide and other substances in the atmosphere.

Minnesota Air Quality Standards

Minnesota has established ambient air quality standards with time period specifications identical to the federal standards (see Table 4.1-5). Allowable concentrations of sulfur oxides, photochemical oxides, and peak-hour carbon monoxide, however, are more stringent than the national criteria. The state's 1-hour carbon

TABLE 4.1-5

COMPARISON BETWEEN NATIONAL AND MINNESOTA AMBIENT AIR QUALITY STANDARDS

Pollutant	Time Period of Standard	Primary* Standard		Secondary** Standard	
		National	State	National	State
Total Suspended Particulates ($\mu g/m^3$)	Annual Geometric Mean	75	75	60	60
	24-hour Maximum	260	260	150	150
Sulfur Oxides (ppm)	Annual Arithmetic Mean	0.03	0.03	-	0.02
	24-hour Maximum†	0.14	0.10	-	0.10
	3-hour Maximum†	-	0.25	0.50	0.25
Carbon Monoxide (ppm)	8-hour Maximum†	9	9	9	9
	1-hour Maximum†	35	30	35	30
Photochemical Oxidants (ppm)	1-hour Maximum†	0.08	0.07	0.08	0.07
Hydrocarbons (ppm)	3-hour Maximum† (6 to 9 A.M.)	0.24	0.24	0.24	0.24
Nitrogen Oxides (ppm)	Annual Arithmetic Mean	0.05	0.05	0.05	0.05

Source: MPCA 1977

*Primary Standard: Protection of public health

**Secondary Standard: Prevention of all other adverse effects of air pollutants (for example, damage to materials, fibers, vegetation, etc.).

†Not to be exceeded more than once per year.

monoxide standard of 30 parts per million (ppm) is 5 ppm less than the federal standard. There are also significant differences for sulfur oxides, with annual and 24-hour primary standards about one-third less than the federal standard and the state's allowable 3-hour secondary standard only half of the national. Minnesota, moreover, has established a 3-hour primary standard for sulfur oxides where none exists on the federal level and has also established annual and 24-hour secondary standards.

4.2 Water Quality

4.2.1 Surface Water

Chemical Constituents

Water discharge and geology are the major controls of dissolved minerals in the rivers of southeastern Minnesota. The dominant ions in these waters are calcium, magnesium, and bicarbonate (USGS 1974, 1975a, 1975b). As the percentage of flow from surface contributions increases, the concentration of dissolved solids decreases. Consequently, dissolved solids are lowest at high flow and highest at low flow. Ions such as sodium, chloride, and nitrates, which are increased through point source waste disposal, are reduced by dilution at high flow. However, in areas of high agricultural use, the concentration of stable agricultural pollutants, such as nitrates and chloride, usually increases under storm conditions. Available data regarding surface water quality at low flow conditions in the project study area are summarized in Tables 4.2-1 and 4.2-2.

Organic and Bacterial Constituents

Throughout the study area, ambient levels of bacterial and organic contaminants are extremely variable depending on land use and point source discharges. Available data for Silver Creek and the Zumbro and Cannon Rivers are given in Table 4.2-1. As shown in this table, measured levels of coliform bacteria in Silver Creek and the North Fork Zumbro River under low flow conditions have exceeded maximum allowable levels for recreation (400 per milliliter (ml) water) recommended by the Federal Water Pollution Control Administration. In general, this level is not exceeded in major rivers in the study area, but excessive levels may occur in tributaries draining farm lands and housing developments (USGS 1974, 1975a, 1975b).

TABLE 4.2-1

SURFACE WATER QUALITY AT LOW FLOW CONDITIONS

Characteristics	Whitewater River Basin	Zumbro River Basin			Cannon River Basin
	North Fork Whitewater R. 2 miles above Elba	Silver Creek	Zumbro R. below Rochester	North Fork Zumbro R. 6 miles below Zumbrota	Little Cannon R.
Anions (percent)					
Bicarbonate	87	-	67	77	80
Sulfate	7	-	12	14	17
Chloride & Nitrate	6	-	21	9	3
Nitrate (mg/l)*	11	-	2.1	4.4	3.7
Total Phosphorus (mg/l)	0.20	-	1.30	0.24	-
Cations (percent)					
Calcium	60	-	56	59	56
Magnesium	35	-	27	34	38
Sodium & Potassium	5	-	17	7	6
Hardness & calcium carbonate (mg/l)	290	-	310	310	-
Fecal Coliforms (#/100 ml)		400-1,000	<400	>1,000	<400
Dissolved Solids (mg/l)	320	320	400	345	310
Total contribution to Basin's dissolved solids (percent)	28	<5	29	<13	6.1
Biochemical Oxygen Demand (mg/l)	-	<3	3-10	<3	-

Source: USGS 1974, 1975a, 1976b.

Note: During low flow conditions, most of the stream flow is derived from groundwater outflow.

*mg/l = milligrams per liter.

TABLE 4.2-2

MIDSUMMER FLOW, TEMPERATURE, AND WATER CHEMISTRY OF WHITEWATER RIVER BASIN

Characteristics	Below Carley State Park Wabasha Co.	Below Junction of Logan Branch and North Branch of North Fork Whitewater Olmsted Co.	Approx 3 miles west of Elba, Winona Co.	Approx 1 mile west of Elba, Winona Co.	Beaver Creek, South Fork Whitewater River, Trout Creek, and Whitewater River, primarily Winona Co.	
					Average	Range
Volume (cfs)	5.1	16.1	21.4	31.1	39	2.1 to 122.0
Temperature (^{o}F)	76	73	69	72	68.6	62 to 78
Sulfate (mg/l)	4.0	6.0	-	7.0	8.5	1.0 to 13.0
Total phosphorus (mg/l)	0.426	0.332	-	0.137	0.244	0.068 to 0.852
Soluble phosphorus (mg/l)	0.217	0.212	-	0.64	0.126	0.025 to 0.600
Chloride (mg/l)	40.0	32.5	-	25.8	29.38	15.3 to 91.0
Nitrogen						
Ammonia (mg/l)	0.020	0.020	-	0.020	0.036	0.020 to 0.054
Nitrite (mg/l)	0.0321	0.0112	-	0.0112	0.088	0.0033 to 0.0451
Nitrate (mg/l)	2.353	0.989	-	0.724	1.39	0.346 to 3.120
Total Kjeldahl (mg/l)	1.680	-	-	0.718	1.144	0.592 to 1.50
pH	8.35	8.42	-	8.35	8.19	8.05 to 8.32
Total Alkalinity (mg/l)	252.5	252.5	-	252.5	251.1	242.5 to 252.5

Source: MDNR 1977.

Patterns of phosphorus discharge for stream samples do not correlate with those of water discharge during the years of parallel data (USGS 1975a). This suggests that municipal waste discharge is the principal control of phosphorus discharge at Rochester.

The following sections summarize available data for specific streams and rivers in the study area.

North Branch Whitewater River

The North Branch Whitewater River originates on rolling uplands, drops into a narrow, rugged valley, and joins the Middle Branch Whitewater River in a sandy bottomed, broad valley. Fisheries biologists determined that one section in the lower reach (6.7 miles) was suitable for trout management, while the remaining three sections (16.8 miles) were not (MDFG 1977).

Field surveys have indicated that the river remained turbid for a long period of time after run-off (MDFG 1977). Water quality analyses (Tables 4.2-1, 4.2-2) indicate very fertile water, probably resulting from agricultural activities on the upper watershed (MDFG 1977). Phosphorus and nitrogen concentrations generally agree with ambient levels in waters draining agricultural areas (Table 4.2-3). Apparently, the present level of nutrients is compensated for by high oxygen levels and low temperature, resulting in a nutrient-enriched stream that can still support trout (MDFG 1977).

Silver Creek

In a recent survey, the Minnesota Division of Fish and Wildlife (MDFG 1978) stated that Silver Creek contains high levels of suspended solids and that game fish only reside near the mouth. United States Geological Survey data (USGS 1975a) for Silver Creek indicate high levels of dissolved solids and coliform bacteria during low flow conditions (see Table 4.2-1).

TABLE 4.2-3

PHOSPHORUS AND NITROGEN VARIABILITY FOR STREAMS DRAINING DIFFERENT LAND USE CATEGORIES

Land Use	Mean Total Phosphorus and Total Nitrogen Concentration (mg/l)		Mean Total Phosphorus and Total Nitrogen Export ($kg/km^2/yr$)	
	Phosphorus	Nitrogen	Phosphorus	Nitrogen
Forest	0.014	0.850	8.3	440.1
Mostly Forest	0.035	0.885	17.4	449.4
Mixed	0.040	1.282	18.4	552.4
Mostly Urban	0.066	1.286	30.1	788.6
Mostly Agricultural	0.066	1.812	22.7	630.5
Agricultural	0.135	4.170	30.8	982.3

Source: EPA 1975a

Cannon River

Water quality investigations in the Cannon River Watershed (Colman and Kopach 1972) indicate that the major pollution problems are derived from agricultural activities and from feedlots located close to rivers and streams. Nitrate values from tile lines draining a fertilized corn field ranged from 3.46 mg/l on August 9, 1972 to 3.0 mg/l on August 11, 1972 following heavy midsummer rains. The study suggested that crop field tile line systems are a major source of pollution in the watershed.

Little Cannon River

The Little Cannon River flows through a flat prairie terrain comprised of 70% agricultural lands and 30% deciduous trees (MDFG 1971). Water quality data collected during low flow are summarized in Table 4.2-1. Field observations (MDFG 1971) indicate that this river is not suitable for trout because of temperature and siltation conditions.

Belle Creek

Water quality data are unavailable for Belle Creek. Field surveys (MDFG 1977) have indicated that this creek contains high levels of suspended solids and had no game fish value.

Stream Classifications and Water Quality Criteria

All streams on or adjacent to the project sites are classified 2B, with the exception of Dry Creek, which is classified 2C. The designated use for these waters is fisheries and recreation. Minnesota criteria for intrastate waters state that the quality of 2B waters should be sufficient to support sport or commercial fishes and be suitable for aquatic recreation. Waters classified as 2C should support fish species common under natural conditions and should be suitable for noncontact aquatic recreation.

4.2.2 Groundwater Quality

Large portions of southeastern Minnesota are highly sensitive to groundwater contamination (SIGMA Associates, Inc. 1979). As described in Section 4.5, the study area is underlain at various depths by carbonate formations. Accelerated chemical and physical weathering of these limestone and dolomite formations, particularly along joints and faults, has resulted in the development of karst features (sinkholes, caves, and underground drainage) throughout southeastern Minnesota. Carbonate formations in karst regions may rapidly transmit groundwater through joints and solution-enlarged cavities without the filtering capacity normally associated with groundwater flow. As discussed in Section 4.5, those locations within the study area that contain thin or nonexistent surficial deposits overlying carbonate rocks have the greatest potential for groundwater contamination.

Surficial Deposits

Surficial deposits cover most of the project region, but only in the western and southern parts is there a sufficient thickness of saturated sand and gravel to be widely used as aquifers. Water from glacial deposits in the study area is a calcium bicarbonate type. In general, the dissolved solids content is less than 500 mg/l (USGS 1974, 1975a, 1975b).

Water obtained from aquifers in unconsolidated deposits in the study area is generally of acceptable quality for domestic use; however, it may contain high nitrate concentrations, reflecting the general susceptibility of these aquifers to pollution (USGS 1975b).

Bedrock Aquifers

Water in bedrock aquifers present in the study area is generally of acceptable quality for domestic use, but has a wide range of suitabilities for other uses. The principal objections are excessive hardness and resultant carbonate encrustation in water heaters (USGS 1975a).

Water from the bedrock formations of the study area is a calcium bicarbonate type. The water generally contains less than 500 mg/l of dissolved solids and less than 30 mg/l of sulfate (Table 4.2-4). The dominant ions in water from these aquifers are calcium, magnesium, and bicarbonate. Temporary (carbonate) hardness concentrations generally exceed 180 mg/l (as calcium carbonate). Iron concentrations are generally higher than the 0.3 mg/l recommended by the U.S. Environmental Protection Agency (EPA 1976). High clorine and nitrate concentrations have been recorded in water from shallow bedrock aquifers in the study area, and are indicative of pollution from surface sources (USGS 1974).

TABLE 4.2-4

GROUNDWATER QUALITY OF BEDROCK AQUIFERS

	Whitewater River		Zumbro River				Cannon River	
Aquifer	East of Eyota south fork Whitewater Jordan Sandstone	East of Dover south fork Whitewater Prairie du Chien Group	South of Atlanta Jordan Sandstone	Zumbro River at Rochester Ironton and Galesville Sandstone	Upper Rochester area Ironton and Galesville Sandstone	Bear Creek drainage St Peter Sandstone	Little Cannon River near Cannon Falls Jordan Sandstone	Prairie Creek near Nerstrand Prairie du Chien Group
Anions								
Bicarbonate (%)	92	71	89	90	91	91	89	88
Sulfate (%)	4	16	3	8	4	4	9	8
Chloride and Nitrate (%)	4	13	8	2	5	5	2	4
Nitrate (mg/l)	-	33	11	0.5	0.5	6.4	1.0	0.0
Iron (mg/l)	0.12	0.01	0.18	0.21	0.37	0.0	0.19	0.03
Cations								
Calcium (%)	54	57	55	63	62	74	63	62
Magnesium (%)	41	17	40	35	33	21	33	32
Sodium and Potassium (%)	5	26	4	2	5	4	4	6
Hardness as calcium carbonate	250	270	250	270	270	250		
Dissolved Solids	265	420	265	290	280	265	310	300

Source: USGS 1974, 1975a, 1975b.

4.3 Public Health

4.3.1 Swine Health Maintenance Procedures

Since the purpose of a confined swine facility is to raise pigs to a marketable size and weight, it is in the best interests of the owner/operator to maintain swine health. It is therefore assumed that standard swine maintenance procedures, as described below, would be implemented by the project applicants.

One of the major drawbacks to the confinement operation is the density of the swine, which increases the potential for disease transmission within the swine herd. Proper management practices during gestation, farrowing, and lactation are necessary to maintain the health of sows and newborn pigs. Standard practices include deworming sows prior to farrowing, spraying and disinfecting sows before and after farrowing, and carefully maintaining building temperatures.

Pigs are born with a very small quantity of stored iron and the sows' milk is not sufficient to supply the necessary iron requirement. To prevent anemia, the baby pigs are normally given injections of iron.

Good ventilation and sanitation procedures minimize the development of a favorable environment for the growth and reproduction of pathogenic organisms. When swine are removed from an area, the area should be cleaned with high pressure water. Young pigs are very sensitive to chilling; therefore, the temperature should be kept warm, cold drafts should be eliminated, and a low humidity maintained to minimize conditions condusive to infection.

All three applicants are aware of the potential health problems associated with confined swine facilities and each would prohibit public access to the swine confinement buildings, thereby preventing exposure of the swine to possible human and animal pathogens. All authorized persons would be required to shower both before and after entrance to all buildings. Additionally, no birds or rodents would be allowed in the buildings. Each applicant has proposed regular veterinary consultation to assist in the development and maintenance of a swine health program.

Even under optimum conditions, some losses of breeders, finishers, and especially baby and nursery pigs can be expected. The mortality rate would vary; at an average, 3 to 5 adult pigs would die per month along with 30 to 50 small pigs at each operation. Both Penz Farms Company and Hilltop Pork Producers propose to use an onsite incinerator for disposal of the dead animals. The incinerator would be used as the need arises. Darwin Schroeder would have dead animals picked up, daily if necessary, by a local rendering service. Efficient disposal practices are necessary since carcasses would attract both scavengers and bacterial decayers.

4.3.2 Zoonotic Diseases

Disease causing organisms that may be transmitted from animals to man (zoonotic pathogens) are summarized in Table 4.3-1. Those zoonotic diseases of possible significance to the proposed action are discussed below.

Brucellosis

Brucellosis can infect all domestic and semidomestic species of animals and humans. In man the disease can produce a clinical spectrum of symptoms, ranging from mild and transient to severe and debilitating with substantial tissue destruction and necrosis. Young- to middle-age adults (20 to 40 years) are most commonly affected. Brucella suis organisms enter the human body by inhalation or ingestion.

Swine in the United States are probably the primary source of infection to humans, although 99% of the swine herds are free from brucellosis (Hubbert, McCulloch, and Schnurrenberger 1975). The risk of infection in humans depends on several factors: (1) control and eradication procedures in swine populations, (2) contact between swine and man, and (3) slaughter practices. Veterinarians, farmers, abattoir (slaughter-house) employees, rendering plant workers, and other livestock handlers are high risk roups. Attack rates in the

TABLE 4.3-1

HAZARDS OF ZOONOTIC PATHOGENS AND CHEMICAL ADDITIVES
ASSOCIATED WITH CONFINED SWINE FACILITIES

Zoonotic Pathogen or Toxin (between swine and humans)	Hazard	
	Occupational: Direct Swine-Human Contact Required for Transmission	Community: Transmission of Disease from Swine to Humans by Possible Biological or Mechanical Vectors
Brucellosis	Yes, but the organisms is rare in swine.	No
Colibacillosis	Yes	Vectors are unlikely to transmit an infective dose.
Salmonella	Yes	Biologicalvectors are possible; mechanical vectors are highly improbable because the organism has low survival in manure slurry.
Pasteurellosis	No	No
Anthrax	No, the organism is extremely uncommon.	No
Tetanus	No, the organism is uncommon in confined swine.	No
Erysipeloid	Yes, but disease is rare in humans.	No
Listeriosis	No	No
Staphylococcosis	No	No
Streptococcus	No	No
Tuberculosis	No	No
Leptospirosis	Yes	Leptospires survives in water and wastes. Rodents often endemically affected. Also depends on possible water contamination.
Ringworm	Yes	No
Trichinosis	No	No

TABLE 4.3-1 (Continued)

Zoonotic Pathogen or Toxin (between swine and humans)	Hazard	
	Occupational: Direct Swine-Human Contact Required for Transmission	Community: Transmission of Disease from Swine to Humans by Possible Biological or Mechanical Vectors
Ascariasis (Large Roundworm)	Yes, but uncommon among swine handlers.	Food contaminated with soil containing ascarid eggs could be a vector.
Pork Tapeworm	No	No
Toxoplasmosis	No	No
Balantida	No	No
Influenza	Yes	No
Rotavirus (Reovirus)	Yes	No, virus is unlikely to survive.
Antibacterial Toxicosis or Allergy	No	No
Organophosphates Pesticide	Yes	No
Chlorinated Hydrocarbons Pesticide	Yes	No
Arsenic	No	No
Lead	No	No
Mercury	No	No
Selenium	No	No
Iron	No	No
Sulfates	No	Depends on possible water contamination.
Nitrates, Nitrites	No	Depends on possible water contamination.
Fluorides	No	No
Detergents and Disinfectants	Yes	Depends on possible water contamination.

Source: Leman 1979

United States from 1940 to 1947 per 100,000 were 562 for veterinarians, 276 for abattoir employees, and 59 for male farmers. While more recent infection rates are not similarly tabulated, there is a continuing downward trend. In 1971 there were about 200 cases of human brucellosis. The majority of all recent outbreaks are the result of direct animal contact (Hubbert, McCulloch, and Schnurrenberger 1975). Therefore, the community surrounding a swine facility is not at risk for brucellosis.

Brucellosis control measures used in the field by swine producers include sanitation, blood testing of breeding stock, and slaughter of affected animals in designated abbatoirs.

Colibacillosis

Colibacillosis is a relatively common disease condition caused by E. coli, an organism of the gastrointestinal tract of all vertebrates. Occasionally, E. coli produces a systemic or local infection, especially in the urinary tract of man.

No statistics are available on the transfer incidence of pathogenic E. coli from animals to man. Basic sanitary practices preventing contamination of human food and water supplies in this country are the controlling factors. The transfer of antibiotic E. coli organisms from animals to man has been demonstrated in farmers with livestock contact; no available evidence suggests that the community surrounding the livestock facility is at increased risk (Institute of Agricultural Medicine 1974).

Salmonellosis

Salmonellosis is a worldwide problem. Various species of Salmonella are commonly isolated from all domestic animals and man, but most of the infections are not apparent. The disease in man ranges from mild gastroenteritis (inflammation of the stomach and intestines) to a debilitating septicemia (blood poisoning), with the very young and very old most severely affected. In the United States,

approximately 20,000 cases per year are reported (70% are gastroenteritis), but it is estimated that closer to two million infections occur (Hubbert, McCulloch, and Schnurrenberger 1975). The most common species involved in man is Salmonella typhimurium; these infections usually result from contaminated animal products (Hubbert, McCulloch, and Schnurrenberger 1975).

Swine, poultry, and poultry products are the most important reservoirs of Salmonella. Transmission to man occurs through direct contact, inhalation, or ingestion. Food handlers, abattoir employees, and processing plant workers are considered high risk groups because of their exposure to contaminated raw foods. A study of farm children with animal contacts indicated that direct transmission from animal to man was rare (Hubbert, McCulloch, and Schnurrenberger 1975).

Salmonella cholera-suis is isolated from swine most frequently. In an Iowa study, 7.2% of pigs on farms were actively excreting Salmonella (Hubbert, McCulloch, and Schnurrenberger 1975). These organisms are susceptible to heat, cold, radiation, and common disinfectants.

Studies at the University of Minnesota (EPA 1975b) showed that Salmonella died in a manure slurry environment. In studies using "worst practical case" conditions, Salmonella typhimurium was transmitted from sludge to young turkeys via aerosols and Salmonella-contaminated feeds (EPA 1975b).

Research shows that salmonellosis in humans is an occupational hazard for farm workers, but the organism is unlikely to survive long enough to infect humans in the surrounding community (Institute of Agricultural Medicine 1974).

Erysipeloid

Erysipeloid usually is manifested in man as a localized, benign, self-limiting skin infection resulting from wound contamination with Erysipelothrix rhusiopathiae. Swine are the most common animal carriers. Skin injury is essential for the organism to gain

entrance. High risk groups include farmers, veterinarians, abattoir workers, food handlers, and rendering plant employees. The spread of infection to humans in the community surrounding a swine facility is highly unlikely, since humans are naturally resistant to generalized infections, and transfer from one person to another is not known to occur (Hubbert, McCulloch, and Schnurrenberger 1975).

Leptospirosis

Leptospirosis is a serious disease affecting a wide variety of hosts and producing many different clinical syndromes. The disease cycle commonly involves wild animals as well as domestic, and may include man himself. Humans are accidental hosts for the disease; transfer from one person to another rarely occurs (Hubbert, McCulloch, and Schnurrenberger 1975). Between 1960 and 1969, 827 cases of human leptospirosis were reported in the United States. Cattle and swine are the source of leptospirosis in about 26% of the human cases (Hubbert, McCulloch, and Schnurrenberger 1975). Initially the disease mimics a flu-like syndrome but progresses to cause extensive kidney damage. High risk populations include farmers, livestock handlers, abattoir workers, and veterinarians. The organism enters directly through abraded skin or mucus membranes via ingestion, or indirectly through contaminated water, mud, soil, bedding, or food.

Leptospires remain relatively stable in the environment prolonging their infectivity. In studies at the University of Minnesota (EPA 1975b), leptospires lived and multiplied in a manure slurry environment. The disease, however, was not transmitted to hampsters via aerosols or contaminated feed.

Rodents and other wildlife serve as disease reservoirs and may contaminate water and feed supplies for livestock and man. Confinement raising of swine limits their exposure to these wild reservoirs and also reduces the chances that fauna will transmit leptospirosis to humans in the community (Messina and Campbell 1975). Most swine are vaccinated for leptospirosis, thereby limiting the likelihood of Leptospira shedding from swine (Dunne and Leman 1975).

Ascariasis

Ascaris suim is the most common internal parasite of swine (Dunne and Leman 1975). This nematode may infect man under unsanitary conditions. Swine manure containing ascarid eggs applied to gardens could provide a source of disease via unwashed vegetables. The eggs are very persistent in the environment. Although no statistics on the incident of human ascarid infections from swine are available, it is believed to be small (Hubbert, McCulloch, and Schnurrenberger 1975). The occupational hazard to agricultural workers is considered to be low (Institute of Agricultural Medicine 1974).

Influenza

Influenza is a major epidemic disease of man that occurs periodically on a worldwide basis. The relationship of animals in the epidemiology of human influenza remains unresolved. Similar viral strains as well as identical antibodies have been isolated from man and swine. In 1969, it was shown that humans transmitted Hong Kong flu virus to swine, but the reverse sequence has not been documented under natural conditions (Institue of Agricultural Medicine 1974). Experimentally, man has become infected with influenza virus of swine origin. The virus isolated from the 1976 Fort Dix, New Jersey, influenza epidemic was antigenically similar to swine influenza virus, but this was not a decisive factor in the mass immunization campaign in 1976 (Seal, Spencer, and Meyer 1976). Investigation of the interspecies transmission, animal reservoirs, antigenic shifts within populations, and virus hybridizations is necessary. However, there is little evidence that swine handlers are subject to increased incidence of influenza (Hubbert, McCulloch, and Schnurrenberger 1975; Institute of Agricultural Medicine 1974).

Rotavirus

Rotavirus (previously classified as Reovirus) is ubiquitous in distribution, causing disease among an extremely wide host range (man,

mice, dogs, cats, cattle, swine, sheep, and monkeys). Most infections do not manifest themselves, but for the young or elderly, respiratory or gastrointestinal illnesses are possible (Cukor et al. 1979). Oral transmission between species has been documented and animal handlers appear to have the greatest risk of infection (Hubbert, McCulloch and Schnurrenberger 1975). The duration of pathogen survival in animal wastes is not well studied, but presumed to be short (Leman 1979).

Pseudorabies

Psuedorabies, also called mad itch, is increasingly common in swine (Leman 1979). Although it is common in warm blood species, the virus does not infect man (Dunne and Leman 1975). Although the names are similar, pseudorabies is in no way related to human and animal rabies.

4.3.3 Toxic Compounds Transmissible to Man

Toxic components of swine tissues that could possibly be transferred to man include antibacterials, organophosphates, chlorinated hydrocarbons, and heavy metals. These substances are transmissible in many ways: ingestion of contaminated tissues, contact with residues or carcasses, inhalation during feed processing, or contact during application to livestock. The hazards associated with these compounds are summarized in Table 4.3-1.

Organophosphates are commonly used as insecticides and dewormers in swine production systems. Humans most at risk from these chemicals are the farmers and livestock handlers who apply them to the animals. The relatively short biological half-lives of these compounds results in infrequent problems (Hubbert, McCulloch, and Schnurrenberger 1975).

Chlorinated hydrocarbons are also used as swine dewormers and insecticides, thus, the same risks are involved. Because these compounds are more stable, there is potential for environmental contamination. The greatest risk is to the applicator of these chemicals (Dunne and Leman 1975).

The use of poisonous heavy metals in swine operations is uncommon. One exception is organic arsenic, which may be used in swine rations to improve feed efficiency and to treat certain diseases. The chemical form and concentration typically used pose little or no toxic threat even to humans mixing the animal feed (Dunne and Leman 1975).

4.3.4 Feed Additives

Feed additives, particularly antibacterial drugs, have been used in swine feeds for over 25 years to increase the rate of weight gain, maximize the feed efficiency (weight gain per feed quantity), and to control disease.

The most commonly used antibacterial drugs in swine feed are shown in Table 4.3-2. The data were taken from a feed market study conducted by Doane Agricultural Services and other sources (FDA 1978). Two of the three applicants propose to use antibacterial feed additives. Hilltop Pork Producers proposes to use ASP (chlortetracycline, sulfamethazine, and procaine penicillin) on the growing pigs and Tylan (Tylosin) on the finishing pigs. Darwin Schroeder proposes to add antibacterials only if needed. A minimal amount of tetracycline may be used, but virtually no penicillin or sulfa drugs would be prescribed.

The use of antibacterials as feed additives is considered a subtherapeutic use. If any swine become sick, a much higher (therapeutic) dose of antibiotics would be used. As a feed additive, tetracycline would be used at up to 50 grams per ton of feed. For therapeutic use, two to four times as much tetracycline would be necessary (FDA 1978). The use of antibacterials as feed additives has been found to increase growth rates by 10% to 50% (Pelczar and Reid 1965).

In addition to antibacterials, there are other available swine feed additives. Arsenic or arsanilic acid is also used to increase weight gain and feed efficiency and to aid in prevention of infectious

TABLE 4.3-2

USE OF ANTIBACTERIALS IN SWINE FEED

Antibacterial	Percentage of Swine
ASP/CSP 250 (CTC-Sulfonamide-Pen)	40.0
Tylan (Tylosin) (Tylan 20%) (with Sulfa 8%)	28.0
Chlortet/Oxytet (CTC-OTC)	11.0
Mecadox (Carbadox)	7.6
PenStrep (Penicillin-Streptomycin)	6.2
3-Nitro/AA (Roxarsone/Arsanilic Acid)	5.9
Neo-Terra (Neomycin-OTC)	5.7
Furazolidone	2.2
Penicillin	1.9
Bacitracin	1.5
Neomycin	1.2
Stafac (Virginiamycin)	0.7

Source: FDA 1978.

Note: Values as of April 1, 1976.

and parasitic diseases (Loehr 1977). Copper has also been used, especially in Great Britain, for growth stimulation and its antibiotic effects (Loehr 1977).

Additives, other than those mentioned for growth stimulation, may be added to feed for other health related reasons. Small amounts of antifungal compounds may be added to feeds to prevent growth of fungal molds. Deworming compounds, such as Atgard (added to feed) or Tramisol (added to either feed or water) are used as needed (AES undated). The advent and refinement of confined swine production methods have minimized both the stress on the animals and their exposure to sick swine and possible pathogen contaminated animal wastes. These improved management practices may reduce the need for continual dosing of subtherapeutic antibacterial drugs (FDA 1978). This is, in fact, reflected by the applicants' proposals. Penz Farms Company does not propose to use these drugs at all and will rely on good animal management. Darwin Schroeder proposes to use drugs "only as needed."

4.3.5 Odorous and Nonodorous Gases

Odor problems at confined swine facilities result from the volatilization of reduced organic and inorganic compounds. Two types of human responses result from association with odor-causing compounds. The principal effect is annoyance or discomfort. More severe effects have been reported at higher concentrations. For example, at concentrations of 0.3 mg/l to 0.5 mg/l (400 to 700 ppm), ammonia is an irritant to the eye, nose, and throat of humans (Miner and Hazen 1969). Hydrogen sulfide concentrations in excess of 400 ppm have been toxic to man (Lillie 1970). As discussed in Section 4.1 and 5.1, these high concentrations would occur only in the immediate vicinity of stored manure.

Animal responses to these compounds are more difficult to predict. One experiment (Stombaugh, Teague, and Roller 1969) noted some physiological effects when a 66-pound pig was exposed to 280 ppm ammonia atmosphere for 36 hours. Incidents of animal death have been

reported when manure storage tanks beneath slatted floors are agitated. Hydrogen sulfide concentrations during such agitation have been measured inside the storage area in excess of 1,000 ppm (Lillie 1970).

Nonodorous gases present at confined swine facilities that can have physiological effects at very high concentrations include carbon dioxide and methane. Additionally, methane is explosive at high concentrations. Normal ventilation of confinement facilities and manure storage facilities prevents the occurrence of deleterious concentrations of such gases.

4.4 Socioeconomics

4.4.1 General Population Trends

The proposed project sites are located in Olmsted, Goodhue, and Wabasha Counties, which are part of the Region 10 Regional Development Area. The region increased its population by 26% from 1940 to 1970. Olmsted County, which historically has had the largest population in the region, accounted for approximately 52% of this growth (ERT 1979a). The populations of Olmsted and Goodhue Counties are expected to continue growing at a fast rate through the year 2000, while Wabasha County is expected to continue a trend of very slow growth.

The population of the townships that are most likely to be affected by the proposed actions are presented in Table 4.4-1. Haverhill and Viola Townships, where the Penz Farms Company operations would be located, have grown very slowly. However, the townships adjacent to the area have grown rapidly. Farmington Township in Olmsted County and Elgin Township in Wabasha County (the location of the project site proposed by Darwin Schroeder) both increased their populations 27% from 1960 to 1976. Most of the other areas, including Wanamingo where the Hilltop Pork Producers operation would be, have populations that have not changed significantly since 1960.

4.4.2 Demographic Characteristics of Population

The characteristics examined in this section indicate the basic nature of the population as well as its social and economic stability. The following discussion focuses on the county level and is based on the 1970 census, which is reasonably representative of current conditions. It is assumed that the county data approximates the characteristics found at the township level.

The demographic profiles of Goodhue, Olmsted, and Wabasha Counties were nearly identical in 1970. Approximately half of the population in each county was in the labor force age group (20 to 64), while 31% of the population was in the school age group (5 to 19). In Goodhue and Wabasha Counties, there were slightly more people 65 years

TABLE 4.4-1

TOTAL POPULATION BY TOWNSHIP (1960-1976)

Location	1960*	1970*	1976**	Percent Change 1960 to 1976
Olmsted County				
Haverhill	842	1,019	876	4
Viola	669	678	692	3
Eyota	558	639	657	18
Marion	4,650	5,998	6,265	35
Farmington	569	649	725	27
Goodhue County				
Wanamingo	546	498	545	0
Leon	713	683	736	3
Holden	540	466	499	-8
Warsaw	568	659	712	25
Wabasha County				
Elgin	528	487	671	27

*Source: USDC 1971

**Source: USDC 1976

old and over (14%) than under 5 (8%). Olmsted County had an equal number of individuals in these categories. In each county the population was almost entirely white with a high percentage of residents who were native to Minnesota. The predominant ethnic background of other residents was Swedish, German, or Canadian. Most of the population lived in the same house from 1965 to 1970. The median school years completed ranged from 10.8 in Goodhue County to 12.6 in Olmsted County.

In Goodhue and Wabasha Counties, the majority of workers were engaged in white collar or blue collar occupations in 1970. A high percentage were employed in farm-related jobs. Olmsted County had a large proportion of employed persons with professional, white collar or technical occupations (58%). In contrast to Goodhue and Wabasha Counties, the percentage of persons in farm-related work was low (5%). (This is probably because of the influence of the city of Rochester, which serves as a regional retail and service center.) The average family income in 1970 ranged from $9,234 in Wabasha County to $12,033 in Olmsted County.

4.4.3 Economy of Three-County Area

This section briefly describes the local economy of the area, focusing on the agricultural sector. The discussion is based on data from the 1974 Census of Agriculture (USDC 1975) and Minnesota Agricultural Statistics (Minnesota Crop and Livestock Reporting Service 1978).

Dominance of Agriculture

Agriculture is the mainstay of the local economy in Goodhue and Wabasha Counties and a significant portion of activity in Olmsted County. Table 4.4-2 presents the proportion of employed persons working in agriculture. Since 1970, Wabasha County has had a higher percentage of agricultural workers than the other two counties. Olmsted County, which contains the Rochester Standard Metropolitan

TABLE 4.4-2

AGRICULTURAL EMPLOYMENT BY COUNTY (1970-1975)

Year	Goodhue			Olmsted			Wabasha		
	Total Employed Persons*	Agric. Employment**	Percent	Total Employed Persons*	Agric. Employment**	Percent	Total Employed Persons*	Agric. Employment**	Percent
1970	14,329	2,287	16	86,224	2,238	6	7,033	2,287	33
1975	15,684	2,359	15	42,080	2,326	6	7,911	2,359	30
1978	17,209	2,383	14	48,578	2,348	5	9,070	2,383	26

*Source: Labor Market Information Center 1979

**Source: Purrington 1979

Statistical Area, has a larger work force and a lower percentage of agricultural workers than the other two counties. Although the absolute number of persons working in agriculture increased between 1970 and 1978, the proportion of farm workers in the labor force has dropped. However, this does not necessarily reflect a decrease in farm activity since current farming technology is more mechanized and does not require as much labor.

Another indication of farming dominance is that the capital investments related to farming in these counties almost doubled from 1969 to 1974, and the farms in the area received almost $200 million in total income in 1976 (ERT 1979a).

The number of farms in each county rose slightly between 1969 and 1977 (Table 4.4-3). However, the average size of farms dropped over the same period, indicating a general trend toward smaller operations. In 1974, at least 50% of the farms in Olmsted and Goodhue Counties were between 70 and 219 acres, and 56% of Wabasha County's farms were between 70 and 259 acres (ERT 1979a). In all three counties, most farm operators lived on the farms they operated (ERT 1979a).

This evidence supports the family farm image of this area. The State of Minnesota defines the family farm as "an unincorporated farming unit owned by one or more persons residing on the farm or actively engaging in farming" (Minnesota Statutes Section 500.24, Subdivision 2b). The state legislature formally stated that it was in the interests of the state to "encourage and protect the family farm as an economic unit, to insure it as the most socially desirable mode of agricultural production, and to enhance and promote the stability and well-being of rural society in Minnesota and the nuclear family" (Minnesota Statutes Section 500.24, Subdivision 1).

Unemployment Trends

Unemployment has not been a serious problem in these three counties. Since 1970, the unemployment rate in each county has been

TABLE 4.4-3

SELECTED CHARACTERISTICS OF FARMS BY COUNTY

Characteristic	Olmsted		County Goodhue		Wabasha	
	1969*	1977**	1969*	1977**	1969*	1977**
Total Number of Farms	1,710	1,740	2,070	2,215	1,187	1,240
Average Size of Farms (acres)	230	210	228	200	264	242
Proportion of Land in Farming	80%	87%	86%	92%	86%	90%

*Source: USDC 1975
**Source: Minnesota Crop and Livestock Reporting Service 1978

relatively low (ERT 1979a). In 1975, the rates increased as a result of the recession that affected all parts of the country at that time. However, the rates were lower than in more industrialized areas of the country. By 1978, the rates in Olmsted and Wabasha Counties were lower than the 1970 figures, and the unemployment rates in Goodhue County were only slightly higher (ERT 1979a).

Agricultural Property Values

Agricultural economists at the University of Minnesota have divided the state into six districts to analyze the rural real estate market. Olmsted, Goodhue, and Wabasha Counties are part of the Southeast District, which includes 20 counties. The land values in this district, along with the Northeast and East Central Districts, are considered to be strongly influenced by urban, residential, and recreational land uses.

The Southeast, Northeast, and East Central Districts also depend more on livestock agriculture than the other districts. Prior to 1972, these three districts had high annual percentage increases in agricultural property values. The increase in property values in the Southeast District was consistently lower than the increase in other districts from 1972 to 1975 (ERT 1979a). (According to agricultural economists, the dramatic rise in crop prices in 1973 was capitalized into higher farmland prices during this period in districts where cash crops dominated (Christiansen and Raup 1979).

Since 1976, there has been a general slowdown in the Minnesota rural land market, with a regional shift in activity toward the more livestock, urban, and recreationally oriented eastern districts. Although the 1978 percentage increase in estimated farmland value for the Southeast District was not high, it was greater than the increases shown for most other districts. This trend was also evident in the reported actual sales data, which shows the Southeast District with the highest average sales price (ERT 1979a).

Property Taxes

The general property tax, an ad valorem tax, is the major tax imposed by local governmental units and school districts in Minnesota. The amount of the tax is based on the market value of the property, the assessed value of the property within the taxing jurisdiction, and the property tax requirements of the taxing districts. The basic local taxing jurisdictions that apply to each site are listed, along with their mill rate, in Table 4.4-4.

There are also various credits available for agricultural land and homesteads. The agricultural credit is equal to 10 mill of the assessed value, and the credit for homesteads under 160 acres is 15 mill of the assessed value. There is an additional homestead credit of 45% of the assessed value not to exceed $325. These credits are then subtracted from the gross tax to determine the tax payment. However, the state reimburses the county for these credits so the county still receives the amount of the gross tax as its final tax revenue.

TABLE 4.4-4

TAXING JURISDICTIONS AND MILL RATE SCHEDULES

Site	Mill Rates 1978	1979
Penz Farms Company (Haverhill)		
School District	60.062	58.618
City-Township-Village	9.209	5.664
Olmsted County	23.666	22.869
Darwin Schroeder (Farmington)		
School District 806	67.010	59.970
City-Township-Village	9.209	9.085
Olmsted County	23.666	22.869
Hilltop Pork Producers (Wanamingo)		
School District 254	47.63	48.54
School District 258	53.68	52.43
City-Township-Village	11.87	9.84
Goodhue County	11.49	12.03

Sources: Possehl 1979; Gillespie 1979.

4.5 Geology and Hydrology

4.5.1 Geology

Topography and Physiography

The study area is located within the Rochester till plain, a physiographic province extending over much of southeastern Minnesota. Elevations in the study area generally range from 1,000 to 1,300 feet above sea level. As shown in Figures 3.1-5 and 3.1-6, the two project regions are characterized by gently rolling hills, with moderate to steep slopes along river drainages. The topography in each project region is mainly the result of erosion by tributaries of the Mississippi River: the Zumbro, Cannon, and Whitewater Rivers. The process of karstification has produced sinkholes and other surface karst features in the study area (see Section 4.5.2).

The Penz Farms Company and Darwin Schroeder proposed facilities sites are characterized by slopes of approximately 2%. The Hilltop Pork Producers facilities site contains slopes of up to 10%. Land areas available for the application of manure generated by each operation are generally characterized by slopes of 0% to 6%; however, areas located along the course of intermittent streams may exhibit slopes of up to 18%.

Surficial Geology

Glacial till deposition within the study area occurred during the Kansan glaciation (Wright 1972b). The thickness of the till varies across the Rochester till plain, with generally thicker deposits on the western side of the province (University of Minnesota Agricultural Experiment Station 1973). In some areas, the glacial till rests on Cretaceous or Tertiary residual deposits, which generally consist of unconsolidated clay-rich to silt-rich sand and clay (Hogberg and Gilmer 1976). Where these Cretaceous or Tertiary deposits are found, they rest directly on bedrock.

Over most of the Rochester till plain, the glacial till is overlain by loess (Wright 1972a). This loess, a fine, buff-colored silty loam, is believed to be a wind-blown deposit derived from the Mississippi River outwash during the Wisconsin (most recent) glaciation.

Penz Farms Company

A test well drilled approximately 3,500 feet west of the Penz Farms Company facilities site encountered 95 feet of unconsolidated surficial deposits overlying dolomite bedrock (Minnesota Geological Survey undated). Surficial deposits at the project site consist of glacial till overlain by loess (Hogberg and Gilmer 1976). Two shallow soil borings conducted at the proposed facilities site penetrated 20 and 28 feet of fine-grained sediments (Twin City Testing and Engineering Laboratory 1976). The results of soil borings are provided in Table 4.5-1.

Darwin Schroeder

Shallow soil borings conducted at the Darwin Schroeder facilities site encountered 15 feet of loess, sand, and glacial till (Table 4.5-1). The total thickness of unconsolidated deposits at the facilities site is estimated to be 40 to 55 feet (USDA SCS 1977). The uppermost bedrock unit at the project site is the St. Peter Sandstone.

Hilltop Pork Producers

Surficial deposits at the Hilltop Pork Producers project site consist of glacial till overlain by loess (University of Minnesota Agricultural Experiment Station 1973). No soil borings have been conducted at the proposed facilities site, thus the depth to bedrock is unknown. Records of test wells within 2 miles of the facilities site indicate that the elevation of the upper bedrock surface ranges

TABLE 4.5-1

RESULTS OF SOIL BORINGS CONDUCTED AT
PENZ FARMS COMPANY AND DARWIN SCHROEDER
FACILITIES SITES

Soil Boring No.	Depth (feet)	Geologic Materials Encountered
Penz Farms Company		
1	0-2	Silty clay soil
	2-15	Silty clay and sandy clay
	15-20	Clay
	20	Refusal*
2	0-2	Silty clay soil
	2-15	Silty clay and sandy soil
	15-29	Clay
	29	Termination
Darwin Schroeder		
1	0-8	Loess
	8-10	Sand
	10-15	Glacial till
	15	Termination
2	0-5	Loess
	5-6	Sand
	6-15	Glacial till
	15	Termination

Sources: Twin City Testing and Engineering Laboratory 1976; USDA SCS 1977.

*Obstruction encountered at 20 feet.

from 1,105 to 1,139 feet above mean sea level (Minnesota Geological Survey undated). On this basis, it is estimated that the thickness of surficial deposits at the facilities site is between 15 and 30 feet.

Bedrock Geology

The study area is underlain by vast thicknesses of sedimentary bedrock. Table 4.5-2 presents a summary of the geologic formations present in the study area. Figures 4.5-1 and 4.5-2 show the bedrock geology of the two project regions. As shown on these figures, the uppermost bedrock units within each project region consist of dolomite, limestone, shale, and sandstone.

Mineral Resources

While there are no unique mineral deposits in the study area, several of the more common geological formations are economically important. Limestone, dolomite, and sand and gravel are quarried in Goodhue, Olmsted, and Wabasha Counties (Minnesota Geological Survey 1966). In Goodhue County, clay and shale are quarried for manufacturing brick, tile, sewer pipe, and lightweight aggregate for concrete (Parham and Austin 1969). Sandstone is quarried in central Olmsted County. The western portion of Wabasha County contains deposits of post-Paleozoic iron ore (Minnesota Geological Survey 1966). There are no significant deposits of peat in any of these three counties (MDNR 1978).

Seismicity

Only two earthquakes of Intensity VII on the Modified Mercalli Scale (in 1909 and 1968) and one of Intensity VI (in 1917) have been measured in Minnesota, and their epicenters were more than 150 miles from the study area (NOAA 1973). (The Modified Mercalli Scale measures earthquake intensity based on the effects on people and structures. An Intensity VII earthquake would be felt by everyone and would result in negligible damage to well-designed structures, but considerable damage to poorly designed structures (NOAA 1973).)

TABLE 4.5-2

GENERALIZED GEOLOGIC SECTION OF SOUTHEASTERN MINNESOTA

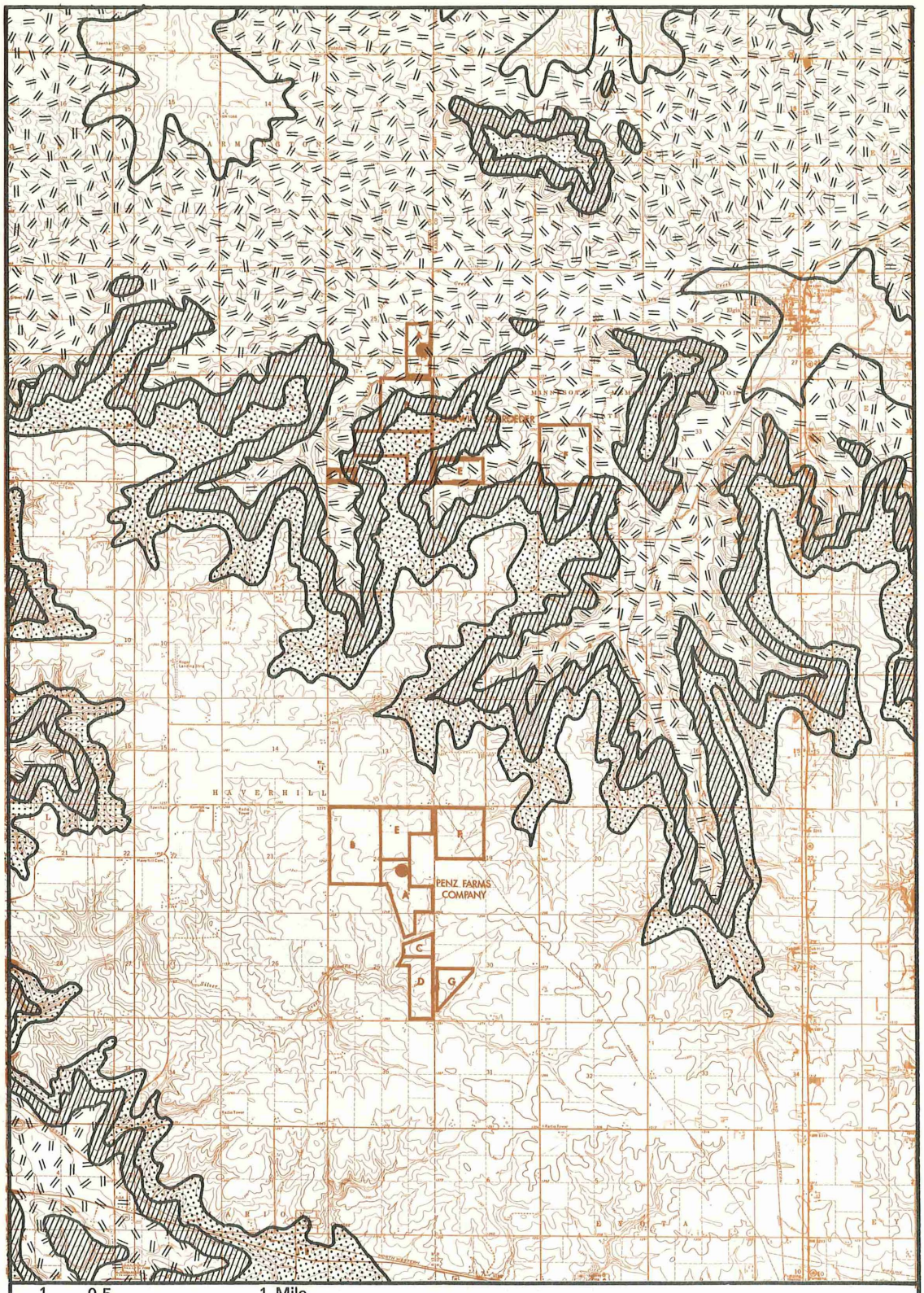
Era	Period	Formation	Member	Rock Material	Thickness (feet)	Aquifer System*
Cenozoic	Quaternary	Recent and glacial deposit	-	Loess, till, lake seds.	0-110	Upper
	Tertiary	Ostrander	-	Iron and magnesium concentrations, chert, pebbles, residuum	0-10	
Mesozoic	Cretaceous	Windrow (not present)	-			
Paleozoic	Ordovician	Maquoketa**	-	Shaly limestone	?	
		Dubuque**	-	Limestone, shale	22±	
		Galena†	Stewartville	Dolomite	65-68	
			Prosser	Dolomite and limestone	45-55	
			Cummingsville	Limestone, shale	65-70	
		Decorah	-	Shale, minor limestone	45-48	Confining bed between aquifer systems
		Platteville†	-	Dolomite and limestone	21-23	Middle
		Glenwood	-	Shale	4-11	
		St. Peter	-	Sandstone, minor siltstone	90-110	
		Prarie de Chien Group:	Willow River	Sandy dolomite	300-315	
		Shakopee†	New Richmond	Sandy dolomite and sandstone		
		Oneota		Dolomite		
	Cambrian	Jordan		Sandstone	100-110	
		St. Lawrence		Limey sandstone	65±	Confining bed between aquifer systems
		Franconia		Sandstone	190±	Lower
		Dresbach		Sandstone	630±	
Pre-Cambrian		-	-	Red seds., metamorphic igneous rocks	-	

Source: Hogberg 1973.

*See Section 4.5.2.

**Not present at the project sites.

†Formations present below the project sites (at various depths) that are known to contain karst features elsewhere in the study area.



PENZ FARMS COMPANY

LEGEND

- Galena Formation (dolomite and limestone)
- Decorah Shale (Shale and minor limestone)
- Platteville and Glenwood Formations (Platteville, dolomite and limestone; Glenwood, shale)
- St. Peter Sandstone (Sandstone and minor siltstone)

Contour Interval 20 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.5-1
Bedrock Geology of Penz Farms Company and Darwin Schroeder Project Region

Source: Minnesota Geological Survey 1966

556-2 7904092 7904241

1 0.5 0 1 Mile

HILLTOP PORK PRODUCERS

LEGEND

- Galena Formation (dolomite and limestone)
- Decorah Shale (Shale and minor limestone)
- Platteville and Glenwood Formations (Platteville, dolomite and limestone; Glenwood, shale)
- St. Peter Sandstone (Sandstone and minor siltstone)

Contour Interval 10 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.5-2
Bedrock Geology of Hilltop
Pork Producers Project Region

Source: Minnesota Geological Survey 1966

469-4 7904109 7904240

Minnesota, as well as most of the north-central United States, is classified as a Zone I earthquake risk area, which indicates that only minor earthquake damage would be expected (NOAA 1973). No active faults are known to exist in the study area.

Soils

Soils present on each of the project sites consist of silt loams and silty clay loams (USDA SCS 1965, 1976a, 1976b, 1977). Soil characteristics and the distribution of soil series on each available manure application parcel are summarized in Table 4.5-3. Predominant soils are of a high agricultural capability and are characterized by moderate infiltration rates.

The run-off characteristics of available waste application parcels were calculated on the basis of the hydrologic soil grouping of each soil present and the farming practices used on each parcel (ERT 1979b). Available manure application parcels vary only slightly with respect to run-off characteristics; that is, each produces approximately the same direct run-off in response to a given storm (ERT 1979b).

The maximum allowable application rate on parcels available for spray irrigation (Penz Farms Company only) is a function of soil properties, such as minimum infiltration rate, available water capacity, and slope. For this purpose, the maximum allowable irrigation rate is defined as that rate above which surface run-off or ponding will occur, assuming that the duration of continuous spraying at any given location does not exceed one hour. This rate depends on the soil moisture condition at the time of application and will vary from approximately 0.1 inches (when soils are thoroughly wetted) to 2 inches (when soils are relatively dry) per hour (ERT 1979b).

4.5.2 Hydrology

Surface Water

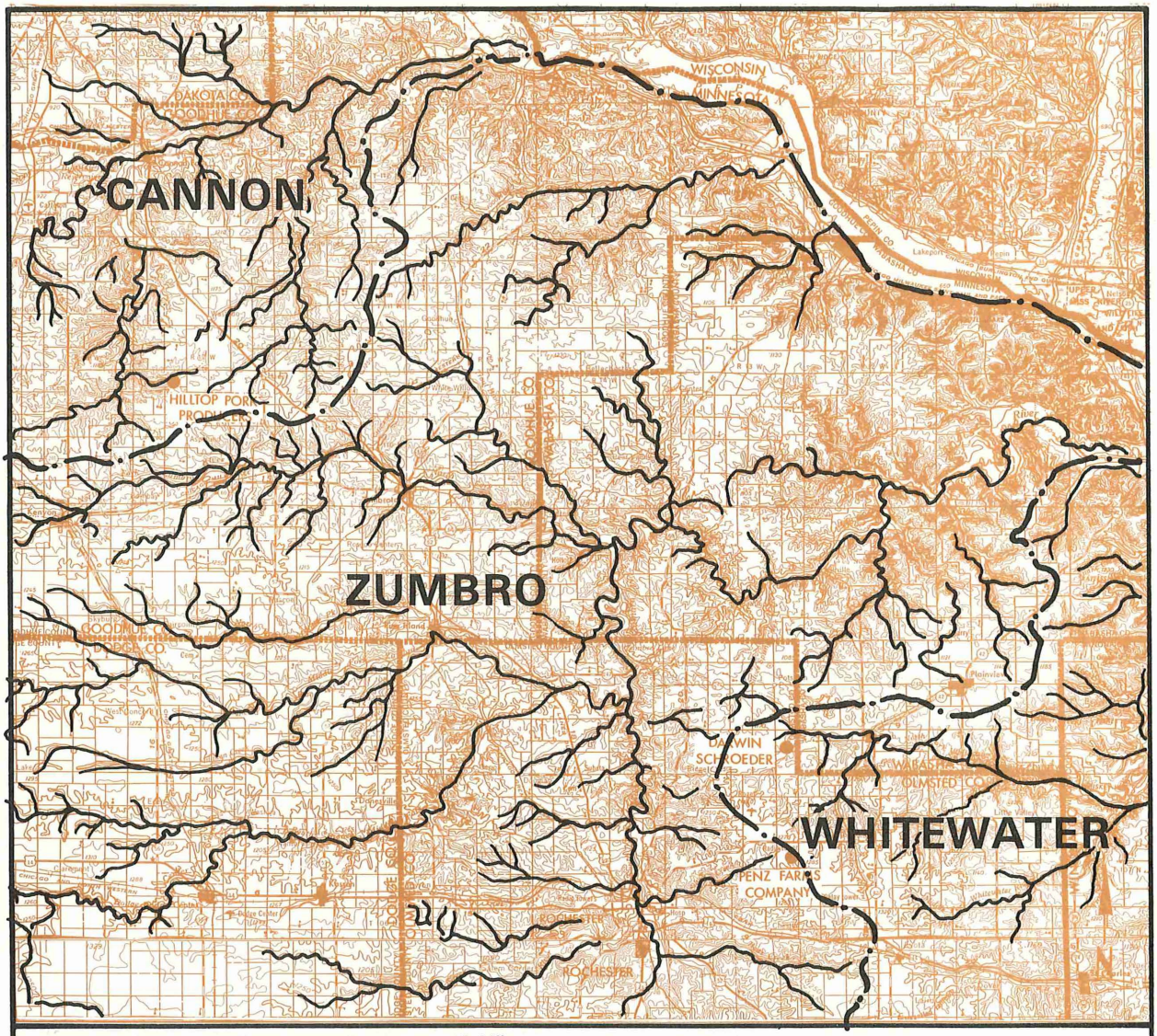
The study area contains portions of the Cannon River, Zumbro River, and Whitewater River watersheds (Figure 4.5-3). All of these major river systems drain eastward into the Mississippi River.

TABLE 4.5-3

CHARACTERISTICS AND DISTRIBUTION OF SOILS IN PARCELS AVAILABLE FOR MANURE APPLICATION

Symbol	Series	Texture	Land Area as a Percentage of Each Parcel																		Capability Subclass	Hydrologic Soil Group	Depth to High Water Table (feet)
			Penz Farms Company							Darwin Schroeder						Hilltop Pork Producers							
			A	B	C	D	E	F	G	A	B	C	D	E	F	A	B	C	D	E	F			
56	Waubeek	Silt loam	33	35	-	22	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	IIe	B	>6
55	Floyd	Silt loam	22	9	16	-	5	-	32	-	-	-	-	-	-	-	-	-	-	-	-	IIw	B	2-4
310	Atkinson	silt loam	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	B	>6
16W	Maxfield	Silty clay loam	12	14	-	-	1	-	6	-	-	-	-	-	-	-	1	5	-	-	2	IIw	B	1-3
13W	Kato	Silt loam	11	2	32	19	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	IIw	C	0-3
58	Kasson	Silt loam	3	25	-	-	13	-		-	-	-	-	-	-	-	-	-	-	-	-	IIs, IIe	C	2-4
57	Ostrander	Silt loam	2	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	B	>6
52	Racine	Silt loam	-	7	43	6	-	-	-	-	12	-	15	-	2	-	-	-	-	-	4	IIe	B	>6
471	Mt. Carroll	Silt loam	-	3	-	-	10	43	32	47	50	36	70	-	-	-	39	18	81	74	34	I, IIe	B	>6
59	Skyberg	Silt loam	-	2	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	IIw	C	1-3
431	Oronoco	Silt loam	-	2	-	-	7	21	10	-	-	-	-	-	-	-	-	-	-	-	-	IIe	B	>6
15W	Garwin	Silty clay loam	-	-	9	12	4	-	-	5	5	13	15	-	-	-	4	6	16	13	12	IIw	C	1-3
42	Port Byron	Silt loam	-	-	-	19	-	6	11	12	8	5	-	69	66	-	14	61	-	-	20	I, IIe	B	>6
43	Seaton	Silt loam	-	-	-	20	-	-	-	-	-	-	-	-	-	87	42	9	-	-	18	I, IIe, IIIe	B	>6
11	Chaseburg	Silt loam	-	-	-	-	4	9	-	-	5	-	-	-	-	-	-	-	-	-	-	I, IIe, IIIe	B	3-6
320	Waucoma	Silt loam	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	IIe	B	6
203	Joy	Silt loam	-	-	-	-	-	10	9	18	6	10	-	-	-	6	-	1	3	13	8	I, IIe	B	>10
333	Vasa	Silt loam	-	-	-	-	-	11	-	-	-	11	-	-	-	-	-	-	-	-	-	I	B	>10
41	Timula	Silt loam	-	-	-	-	-	-	-	15	-	13	-	-	-	-	-	-	-	-	2	IIe, IIIe, IVe	B	>10
6W0	Otter	Silt loam	-	-	-	-	-	-	-	3	4	-	-	-	-	-	-	-	-	-	-	IIw	B	0-2
162	Kegonsa	Silt loam	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	IIs, IIe	B	>10
46	Lindstrom	Silt loam	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	IIe	B	>10
444	Littleton	Silt loam	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	-	IIe	B	1-3
12	Judson	Silt loam	-	-	-	-	-	-	-	-	-	-	-	31	14	-	-	-	-	-	-	IIw	B	3-5
22	Muscatine	Silt loam	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	-	-	-	-	IIw	B	2-5
71	Colo	Silty clay loam	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	IIIw	B	1-3
65	Frontenac	Silt loam	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	VIIe	B	>6
32	Dubuque	Silt loam	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	IIIe	B	>3

Sources: USDA SCS 1965, 1976a, 1976b, 1977.



LEGEND

— · — Watershed Divide

——— Major Drainage

Contour Interval 50 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.5-3
Major Watersheds in Project
Study Area

547-1 7904264 7904263

Although the major water source for these rivers is surface run-off, groundwater is an important component in stream flow during periods of low precipitation (USGS 1974, 1975a, 1975b; Ackroyd, Walton, and Hills 1967). In general, the contribution of groundwater to streamflow increases to the east in each of these major watersheds, primarily because of the more deeply incised river valleys, which cut through and expose permeable water bearing formations (USGS 1974, 1975a, 1975b). The annual fluctuation in streamflow in the Cannon, Zumbro, and Whitewater river systems is due to variations in precipitation and temperature. Maximum flows are generally recorded in the late spring, while low flows generally occur in the winter (USGS 1974, 1975a, 1975b).

Table 4.5-4 summarizes available streamflow data for the Cannon, Zumbro, and Whitewater river watersheds. As shown on this table, mean annual discharge of guaged streams and rivers within the study area ranges from 0.186 to 0.480 cubic feet per second (cfs) per square mile of drainage area (2.5 to 6.5 inches per year).

Flood magnitude is related to the size of the area drained by a stream or river. The three project sites are all located near the headwaters of the local stream systems and are drained by small, intermittent streams. None of the project sites are located within designated 100-year floodplains (HUD 1978a, 1978b).

Penz Farms Company

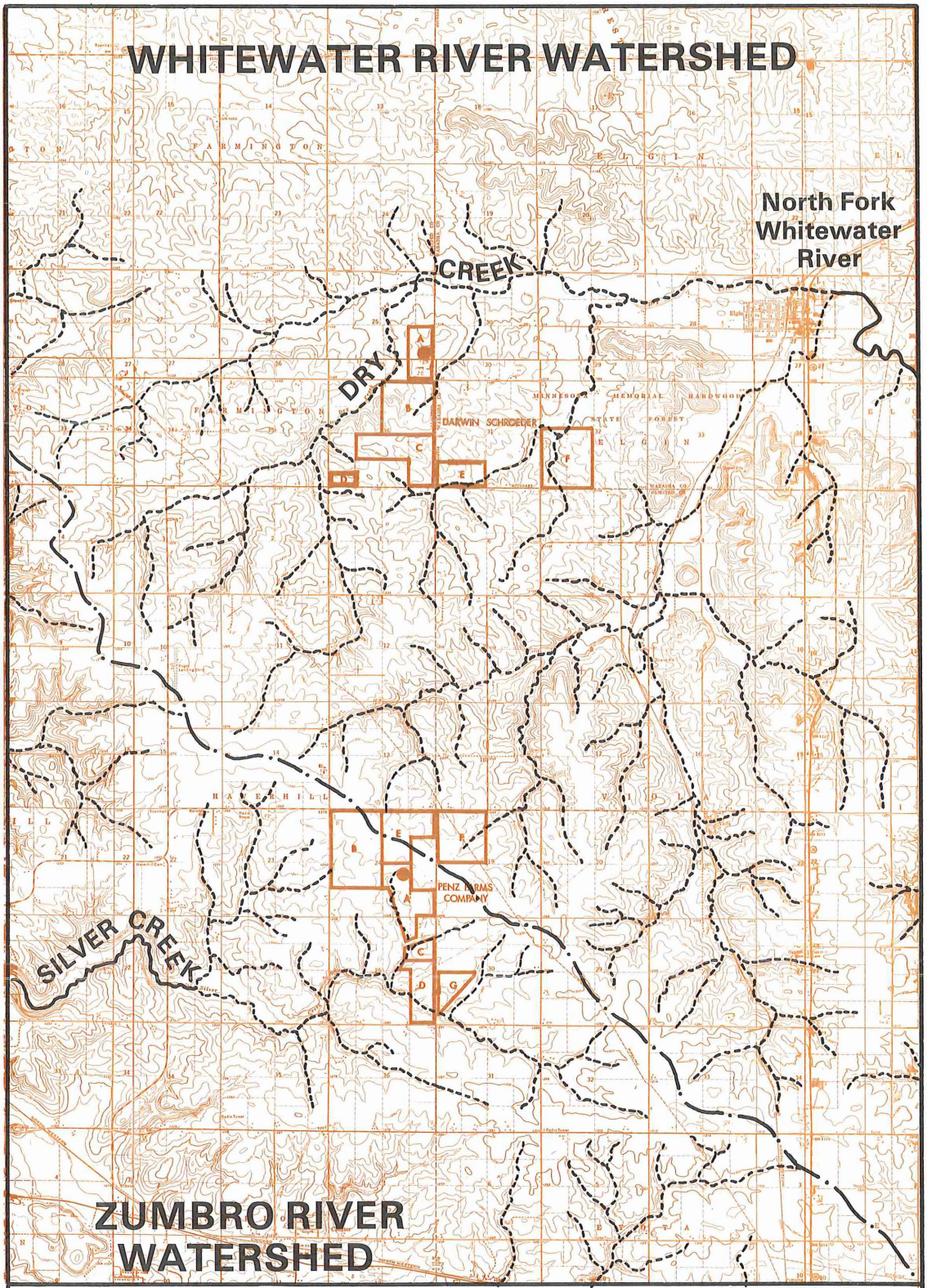
The Penz Farms Company facilities site is located approximately 2,000 feet southwest of the topographic divide between the Zumbro and Whitewater River watersheds (Figure 4.5-4). As shown in this figure, the facilities site and most of the available manure application parcels are drained by intermittent tributaries of Silver Creek. Silver Creek flows into the Zumbro River near Rochester, Minnesota. Portions of parcels B and E and all of parcel F are drained by intermittent tributaries of the North Fork Whitewater River. The only known use of surface water in the Penz Farms Company and Darwin Schroeder project region is for livestock water supply (Poblete 1979; USGS 1975a, 1975b).

TABLE 4.5-4

SUMMARY OF AVAILABLE STREAM FLOW RECORDS FOR THE CANNON, ZUMBRO, AND WHITEWATER RIVER WATERSHEDS

River or Stream and Location	Approximate Location Relative to Facilities Site	Drainage Area (square miles)	1977 Mean Discharge (cfs)	Long-Term Mean Annual Discharge (cfs)	Mean Annual Discharge per Square Mile		Maximum Recorded Discharge (cfs); date	Minimum Recorded Discharge (cfs); date
					1977	Long-Term		
Little Cannon River near Cannon Falls, MN, T112NR18W Sec. 25	9 miles NNW of Hilltop Pork Producers Site	89*	-	26 (est)* (41 years)	-	0.292	-	-
Cannon River at Welch, MN, T113N R16W Sec. 27	16.5 miles NE of Hilltop Pork Producers Site	1,320*†	-	490*	-	0.371	36,100* date unknown	2.5* date unknown
Belle Creek at Vasa, T112 NR 16W		75*	-	14 (est)*	-	0.186	-	-
N. Fork Whitewater River near Elba, MN, T107NR10W Sec. 7	13 miles ENE of Penz Farms Company; 13 miles ESE of Darwin Schroeder	101†	30.9†	42.7† (12 years)	0.306	0.423	16,100† June 21, 1974	11† Feb. 21, 1968
Whitewater River near Beaver, MN, T108NR10W Sec. 15	16 miles ENE of Darwin Schroeder; 18 miles NE of Penz Farms Company	271†	103†	-	0.380	-	19,200† June 21, 1974	61† Dec. 21, 1977
Zumbro River at Zumbro Falls, MN, T110NR14W Sec. 14	17 miles NNW of Penz Farms Company	1,130†	261†	510 (55 years) 480+ (1930-1971)	0.231	0.451 0.423	35,900+ date unknown	27+ date unknown
S. Fork Zumbro River near Rochester, MN, T107NR14W Sec. 36	6.5 miles WNW of Penz Farms Company	304†+	62.5†	146† (25 years)	0.206	0.480	19,600+ date unknown	8.4+ date unknown

Sources: *USGS 1974
†USGS 1975a
+USGS 1975b



PENZ FARMS COMPANY

LEGEND

- Perennial River or Stream
- Watershed Divide
- Intermittent Stream

Contour Interval 20 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.5-4
Surface Drainage of Penz Farms Company and Darwin Schroeder Project Region

556-2 7904092 7904262

Darwin Schroeder

The Darwin Schroeder facilities site and manure application parcels are drained by intermittent tributaries of Dry Creek. Dry Creek joins the North Fork Whitewater River approximately 4 miles east of the facilities site.

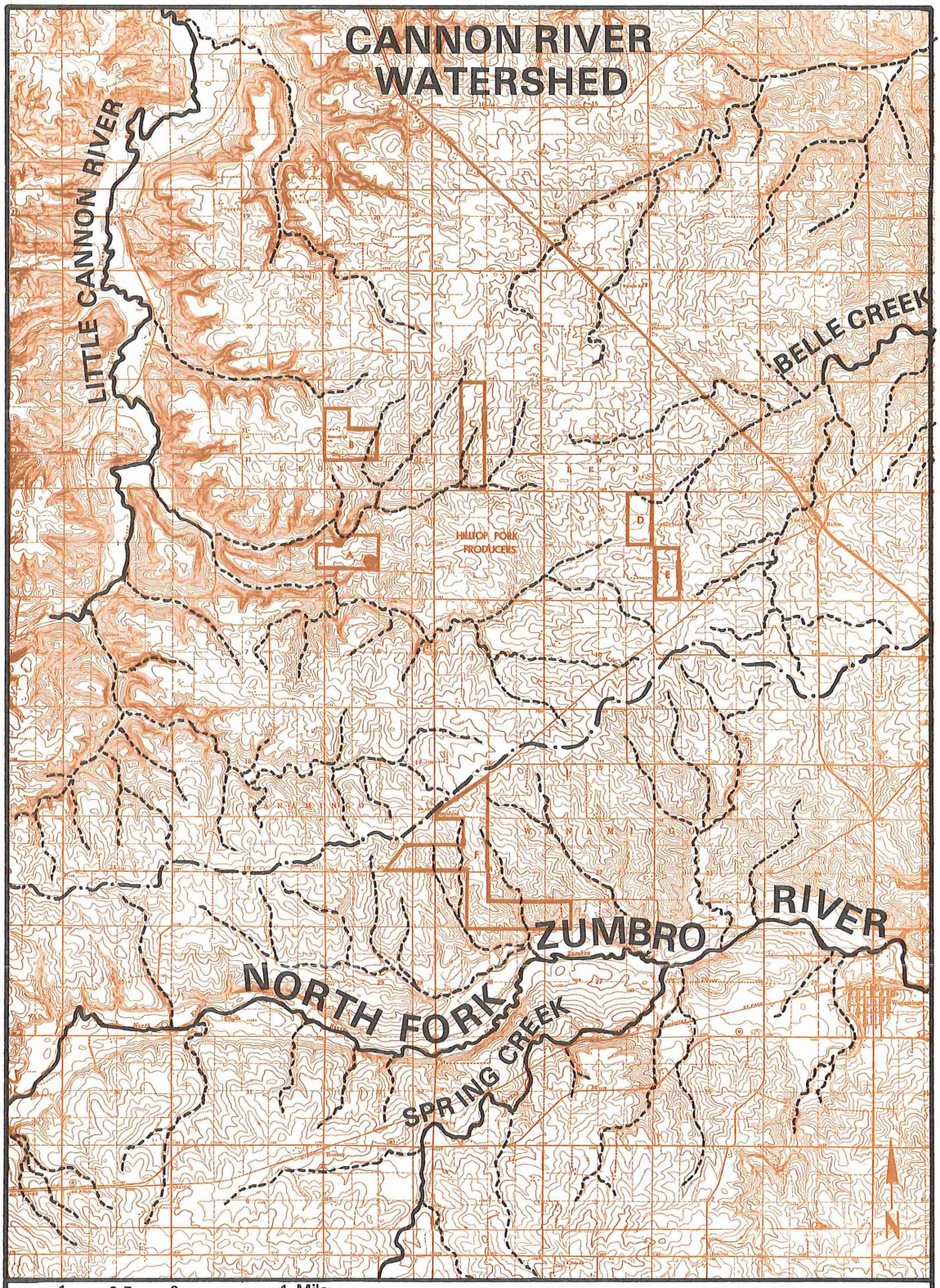
Hilltop Pork Producers

The Hilltop Pork Producers project site is located in the Cannon River and Zumbro River watersheds (Figure 4.5-5). The facilities site; parcels A, B, and C; and portions of parcels D and E are drained by intermittent tributaries of the Little Cannon River. The eastern portions of parcels D and E are drained by intermittent tributaries of Belle Creek. Parcel F drains southward to the North Fork Zumbro River. The southernmost portion of this parcel is approximately 500 feet north of the 100-year floodplain of the North Fork Zumbro River (HUD 1978a).

Groundwater

Most of the water supply for municipal or private use in the study area is derived from groundwater sources. Southeastern Minnesota yields more groundwater than any area of the state, and some of the bedrock aquifers in the area are among the highest yielding in the United States (Hogberg 1972). The regional supply of groundwater is plentiful and, with moderate treatment, the groundwater is suitable for most uses (Hogberg 1972). Table 4.5-5 summarizes 1970 data regarding water use in southeastern Minnesota.

Many of the geological formations underlying the study area yield significant amounts of groundwater. The water-bearing formations present in the study area are grouped into three aquifer systems: the upper, middle, and lower. The upper aquifer system includes unconsolidated surficial deposits as well as the Maquoketa/Dubuque Formations (not present at the project sites) and the Galena Formation. The Decorah Shale acts as a confining bed separating the



HILLTOP PORK PRODUCERS

LEGEND

——— Perennial River or Stream

—·— Watershed Boundary

-------- Intermittent Stream

Contour Interval 10 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.5-5
Surface Drainage of Hilltop Pork Producers Project Region

469-4 7904109 7904261

TABLE 4.5-5

1970 WATER USE IN SOUTHEASTERN MINNESOTA

Use	Cannon River Watershed (million gallons)			Zumbro River Watershed (million gallons)			Root River Watershed* (million gallons)		
	Groundwater	Surface Water	Total	Groundwater	Surface Water	Total	Groundwater	Surface Water	Total
Public Supply									
Domestic**	1,800	0	1,800	2,590	0	2,590	1,920	0	1,920
Industrial	370	0	370	1,070	0	1,070	424	0	424
Rural Supply									
Domestic†	93	0	93	974	0	974	1,210	0	1,210
Livestock	680	120	800	936	384	1,320	1,580	279	1,859
Irrigation	74	36	110	5	2	7	7	2	9
Self-Supplied									
Industrial	3,400	60	3,460	1,160	14	1,170	2,170	312	2,482
Thermoelectric Power	6	26,000	26,006	21	4	25	0	6,110	6,110
Watershed Total††	6,423	26,216	32,639	6,760	404	7,160	7,311	6,703	14,014

Sources: USGS 1974, 1975a, 1975b.
*Contains the Whitewater River.
**Population served: 50,000, Cannon River; 89,245, Zumbro River; 57,900, Root River.
†Population served: 34,000, Cannon River; 35,590, Zumbro River; 44,100 Root River.
††Population served: 84,000, Cannon River; 124,835, Zumbro River; 102,000, Root River.

upper and middle aquifer systems (Hogberg and Gilmer 1976). The middle aquifer system consists of the Platteville and Glenwood Formations, the St. Peter Sandstone, the Shakopee and Oneota Formations, and the Jordan Sandstone. The lower aquifer system is separated from the middle aquifer system by the St. Lawrence Formation confining bed. Geologic units included in the lower aquifer system are the Franconia, Ironton, Galesville, and Mt. Simon Formations.

Table 4.5-6 summarizes the water-bearing properties of aquifer systems present in the study area. As shown in this table, groundwater yield can vary widely, not only between aquifers, but within a single formation. This is accounted for by variations in permeability, thickness, and structure of the formations.

Groundwater flow in the project study area contains both horizontal and vertical components. In the project region, the horizontal component of groundwater flow in the upper aquifer system parallels the surface water drainage pattern with groundwater divides approximately underlying surface drainage divides (USGS 1974, 1975a, 1975b). In the middle aquifer system, groundwater movement is generally toward the northeast, again roughly paralleling surface drainage (USGS 1974, 1975a, 1975b). Because of the greater hydraulic head in the upper aquifer system, downward vertical flow of groundwater recharges the underlying middle aquifer system, although this flow is retarded by the confining Decorah Shale (USGS 1974, 1975a, 1975b). The presence of fractures and other karst features in the project region complicates the pattern of groundwater flow, as it allows horizontal or vertical flow in the direction of least resistance. Additionally, the presence of numerous uncased multiaquifer wells in the project region provides a greater opportunity for downward interaquifer flow (Hult 1979).

Penz Farms Company

The Penz Farms Company project site is underlain by the upper aquifer system, which consists of 28 to 100 feet of unconsolidated surficial deposits and 100 to 200 feet of dolomite and limestone (Galena Formation). This aquifer system is unconfined, and the depth

TABLE 4.5-6

WATER-BEARING PROPERTIES OF AQUIFER SYSTEMS PRESENT IN STUDY AREA

Aquifer System	Formations	Age*	Yield (gallons per minute)	Remarks
Upper	Pleistocene deposits	Q	low to moderate†† 10-30** (low)	May be much higher in sand and gravel, till layers form local confining beds.
	Maquoketa/Dubuque	O	moderate**	Springs issuing from joints and fractures in Galena and Maquoketa yield 70-180 gpm** higher yield (to wells) in
	Galena		50-150 in upper part of Galena	fractured or karsted zones.
Middle	Platteville/Glenwood	O	generally low**	Middle aquifer system is artesian over much of area, but unconfined in areas where the upper aquifer system is missing (e.g., Darwin Schroeder project site).
	St. Peter Sandstone	O	80-200†	
	Shakopee/Oneota	O	50-360†	Higher yields generally indicate broken zones**
	Jordon Sandstone	C	15-450†	
Lower	St. Lawrence/Franconia	C	moderate to high**	Usual pumping rate = 195-1,200 gpm†
	Ironton/Galesville/ Mt. Simon	C	100-400†	

*Q = Quaternary
O = Ordovician
C = Cambrian
**Source: Hogberg and Gilmer 1976
†Source: USGS 1975b
††Source: Hogberg 1972

to the water table ranges from 2 to 10 feet (USDA SCS 1976b). The Decorah Shale occurs at the base of this system and restricts vertical flow of groundwater into the underlying middle and lower aquifer systems.

Groundwater flow in the shallow upper aquifer system is predominately toward local surface water systems and generally coincides with local surface drainage (USGS 1975a). Therefore, water infiltrating into the ground on the facilities site; parcels A, C, D, and G, and portions of parcels B and E flow through the upper aquifer system and contributes to the flow of Silver Creek. Water infiltrating into parcel F and the northeast portions of parcels B and E flows toward the North Fork Whitewater River. An unknown, but probably minor, portion of the total groundwater recharge from the project site moves through the poorly permeable Decorah Shale to the middle aquifer system. There are 13 residences within a 1-mile radius of the Penz Farms Company facilities site. Most, if not all, of these residences use private wells to supply water for domestic consumption and other uses (Poblete 1979). The number of wells completed in each aquifer system is unknown (Poblete 1979). However, the middle aquifer system is generally the most widely used groundwater source in the project region (USGS 1975a).

Darwin Schroeder

The Galena Formation of the upper aquifer system is missing at the Darwin Schroeder project site. Unconsolidated surficial deposits directly overlie the Decorah shale confining bed or the St. Peter Sandstone, Platteville, and Glenwood formations of the middle aquifer system (see Figure 4.5-1). The depth to the water table at the project site generally ranges from 6 to 10 feet (USDA SCS 1977). The geologic profile at the facilities site contains approximately 40 to 55 feet of unconsolidated deposits underlain by the St. Peter Sandstone (USDA SCS 1977).

Water that infiltrates into the ground at the project site moves both laterally and vertically. Lateral groundwater movement in the unconsolidated deposits is approximately coincident with surface water

drainage, that is, toward Dry Creek. An unknown portion of on-site groundwater recharge moves downward to the bedrock aquifers of the middle aquifer system. Groundwater flow in the middle aquifer system is generally toward the northeast (USGS 1975b).

There are 13 residences within a 1-mile radius of the Darwin Schroeder facilities site. Each of these residences uses groundwater supplies for domestic consumption and other uses. The number of wells completed in each of the aquifer systems present (middle and lower) is unknown; however, the most widely used aquifers in the project region are within the middle aquifer system (USGS 1975a, 1975b).

Hilltop Pork Producers

The upper aquifer system underlies the Hilltop Pork Producers project site and consists of unconsolidated surficial deposits and dolomite and limestone of the Galena Formation. The upper aquifer system is unconfined, and the depth to the water table at the project site generally ranges from 6 to 10 feet (USDA SCS 1976b).

Groundwater flow in the shallow, upper aquifer system is predominately toward local surface water systems and generally coincides with surface water drainage (USGS 1975a). Infiltrating water that reaches the water table below the facilities site and parcels A, B, C, D, and E flows through the upper aquifer system to local streams and rivers (Little Cannon River and Belle Creek) in the Cannon River watershed. Water that infiltrates into the ground on parcel F flows southward through the upper aquifer system and contributes to the flow of the North Fork Zumbro River. An unknown, but probably minor, portion of the total groundwater recharge at the project site moves downward through the poorly permeable Decorah Shale to underlying aquifer systems.

Twelve residences are located within 1-mile of the facilities site, and each uses groundwater supplies for domestic consumption and other purposes (USGS 1975b). The number of wells completed in each aquifer system is unknown; however, the middle aquifer system is the most widely used groundwater source in the project region (USGS 1974, 1975b).

Karst Hydrology

The term "karst" signifies topographic and groundwater conditions present in areas with a high degree of rock solubility. Karst topography is formed over bedrock consisting of dolomite or limestone (carbonate rocks) and is characterized by closed depressions (sinkholes), caves, and underground drainage. Carbonate formations in karst regions may rapidly transmit groundwater through joints and solution-enlarged cavities without the filtering capacity normally associated with groundwater flow.

The entire study area is underlain at various depths by carbonate formations. Tropical weathering conditions during the Cretaceous period are believed to have caused the process of karstification in the study area (Hogberg 1973). This accelerated rate of chemical and physical weathering of the limestone and dolomite formations, particularly along existing joints and block faults, resulted in the development of karst features throughout southeastern Minnesota. Karst features may extend to depths of more than 100 feet below the present land surface (Hogberg 1973). The Galena Formation (present below the Penz Farms Company and Hilltop Pork Producers project sites) and the Platteville and Shakopee Formations (present at various depths below all three project sites) are known to contain karst features elsewhere in the study area (Hogberg 1973).

Within the study area, the distribution of existing surface karst features and the potential for future land subsidence as a result of karstification are related to surficial geology. Ongoing studies by the Minnesota Geological Survey (1979) indicate that the major concentrations of sinkholes in southeastern Minnesota are located between the eastern edge of the deep glacial drift and the easternmost surface outcrop of the Decorah Shale, where thin surficial deposits overlie the Cedar Valley, Maquoketa, Dubuque, and Galena Formations. The nearest mapped concentration of sinkholes is located approximately 10 miles south of the Penz Farms Company facilities site. Isolated sinkholes occur over most of the southeastern Minnesota region (Minnesota Geological Survey 1979).

No sinkholes or other surficial karst features are known to exist on the three proposed facilities sites (USDA SCS 1976b, 1977). However, isolated karst features are common throughout the study area. Moreover, extensive subsurface systems of solution-enlarged channels may exist in areas without visible surface karst features (Minnesota Geological Survey 1979).

Although hydrologic conditions in karst regions are complicated, it is generally recognized that there is less potential for sinkhole development where thick surficial deposits or noncarbonate formations overlie the limestone or dolomite rocks (Minnesota Geological Survey 1979; Hult 1979; USDA SCS 1977, Hogberg and Gilmer 1976). In addition, thick deposits of fine-grained geologic materials retard the flow of any effluents released at the land surface and minimize the potential for contamination of underlying carbonate aquifers. The Midwest Plan Service (1975) recommends a minimum thickness of 20 feet of surficial materials between a potentially contaminating land use (such as a manure storage basin) and underlying carbonate rocks. In a letter to the MPCA discussing the question of land use in southeastern Minnesota, the Director of the Minnesota Geological Survey suggested that a suitable location for potentially contaminating land uses should contain a minimum of 20 feet of poorly permeable surficial materials if the site is underlain by carbonate bedrock (Walton 1977). The thickness and type of surficial materials present at each proposed facilities site are discussed in Section 4.5.1.

4.6 Land Use

4.6.1 Existing Land Use

Regional Land Use

Minnesota is generally divided into three major land use zones: forest, agricultural, and transitional (Borchert 1974). The study area is located in a region that is undergoing land use change from agriculture to the transitional zone. Projections indicate that within this transitional zone new urban development can be expected to be in constant competition and conflict with existing agricultural and rural land uses (MSPA 1978). A growing population and expanding industrial base statewide is placing increased pressure within this transitional zone for direct withdrawal of land from agricultural production, thereby eroding the viability of farming operations. Additionally, scattered new nonfarm oriented development in rural areas will require increased urban services.

This statewide growth trend is particularly evident in the study area. During the period 1969 to 1974, Olmsted County increased its harvested cropland by only 10% and Goodhue County by 11%, while the adjacent counties to the south and west increased harvested cropland with rates ranging from 12% to 24% (MSPA 1978). While increased agricultural production moderates, population and urbanization continue to increase. From 1975 to 1990, Minnesota State Planning Agency (MSPA) projects that Olmsted County will require an additional 6,393 acres of land (a 38% increase) to be converted from agricultural to residential, commercial, industrial, and other urban uses. Goodhue County is projected to need an additional 4,060 acres to be converted from agricultural to urban uses (an increase of 35%).

Both Olmsted and Goodhue Counties recognize they will be undergoing increased growth pressure and have developed plans to control and direct growth away from prime agricultural lands and toward marginal agricultural lands on the fringe of existing urban areas.

Project Sites and Adjacent Area

Existing land use conditions within a 3-mile radius of each project site have been identified and mapped on Figures 4.6-1 and 4.6-2. These maps also identify each of the proposed confined swine locations, as well as the areas available for application of animal wastes. Land uses were identified through aerial photograph interpretation and a field reconnaissance conducted in early February 1979. A discussion of land use conditions around each of the three project sites follows.

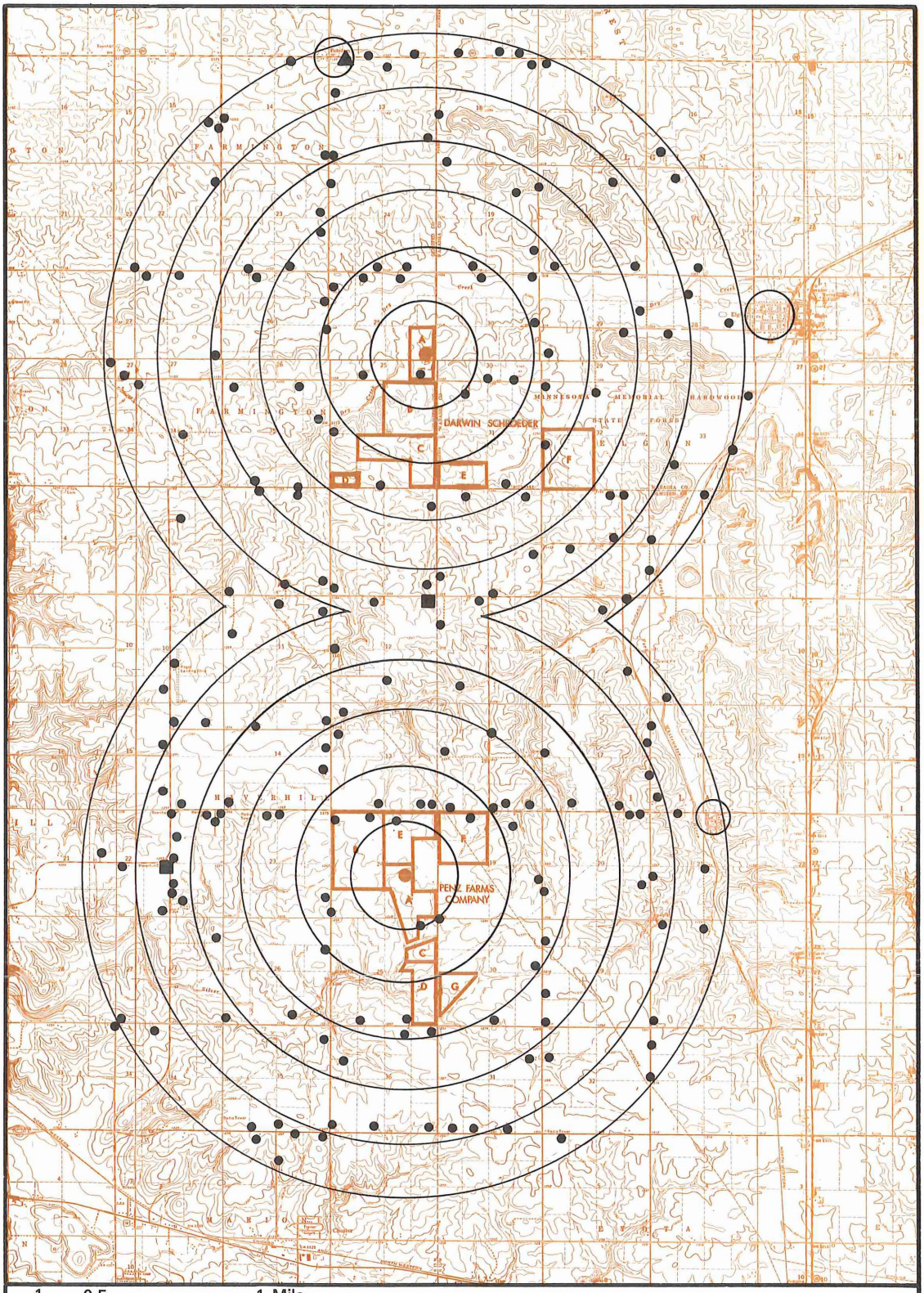
Penz Farms Company

The proposed facilities site is currently used for corn production. Recent crop yields have been approximately 100 to 140 bushels per acre per year (Penz Farms Company 1979). Therefore, the entire 5-acre facilities site currently produces approximately 500 to 700 bushels of corn per year.

A confined hog finishing operation of 1,200 pigs including a storage basin has existed for the past few years in the northwest corner of manure application parcel B (Penz Farms Company 1979). The proposed facilities site and the seven manure application parcels are all under existing crop production generally involving a four-year rotation pattern of two years corn, one year beans, and one year oats. Occasionally, a five-year rotation is implemented with two years corn, one year beans, one year oats, and one year hay. Additionally, some peas are grown each year, with each acre put to peas on an average of less than once every ten years.

The Calvin Penz residence is located in the northwest corner of manure application parcel B. One other residence is located in parcel B, one in parcel E, and one in parcel F.

Two residences are within 0.5 miles of the proposed facilities site (see Figure 4.6-3). Table 4.6-1 shows the number of residences in each distance zone and Figures 4.6-1 and 4.6-2 show their location.



PENZ FARMS COMPANY

LEGEND

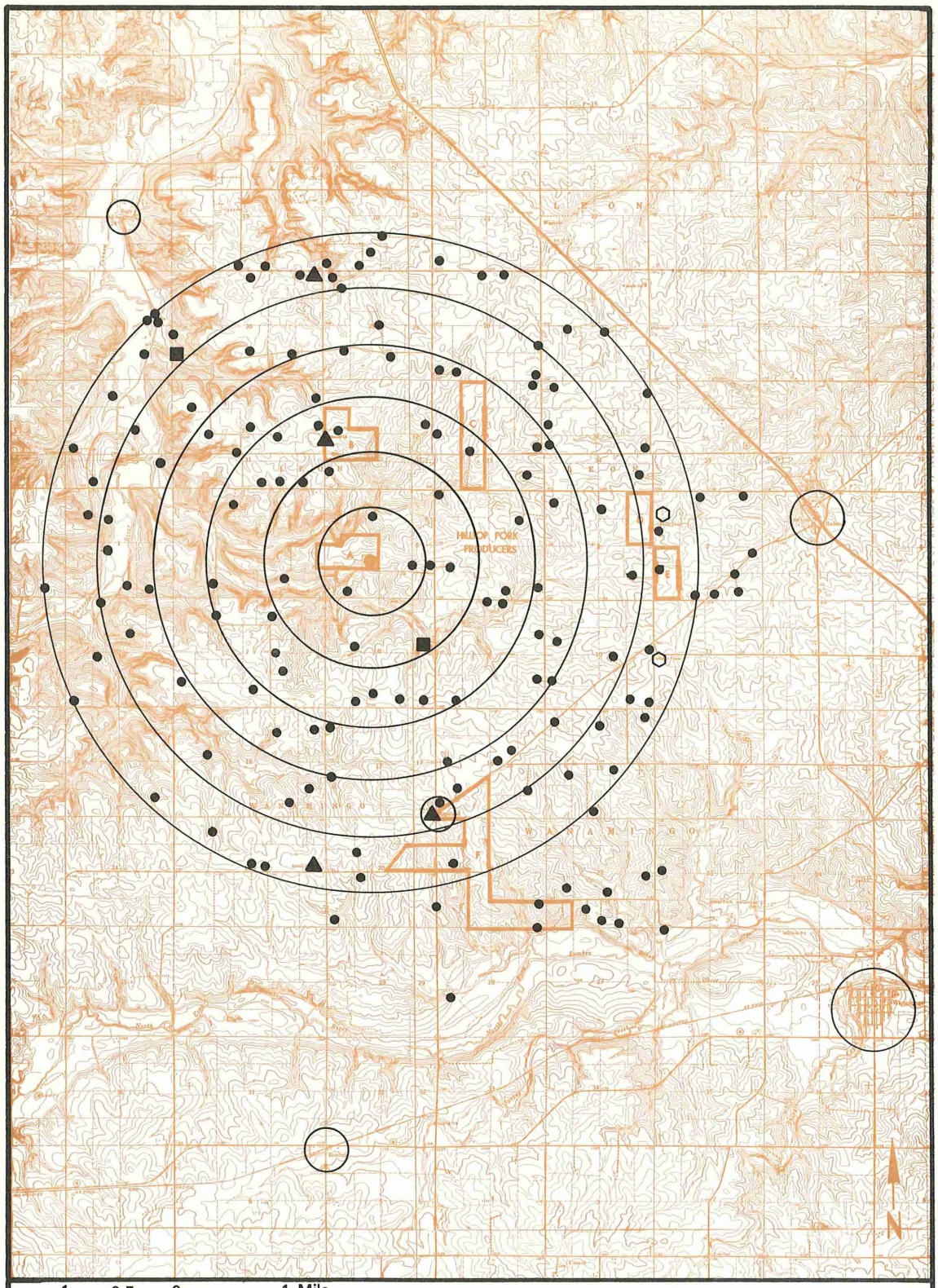
- 0.5-Mile Radii
- Community
- Residence
- Cemetery (2)
- Church & Cemetery (1)

Contour Interval 20 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.6-1
Existing Land Use within a
3-Mile Radius of Projects
in Olmsted County

556-2 7904092 7904149



HILLTOP PORK PRODUCERS

LEGEND:

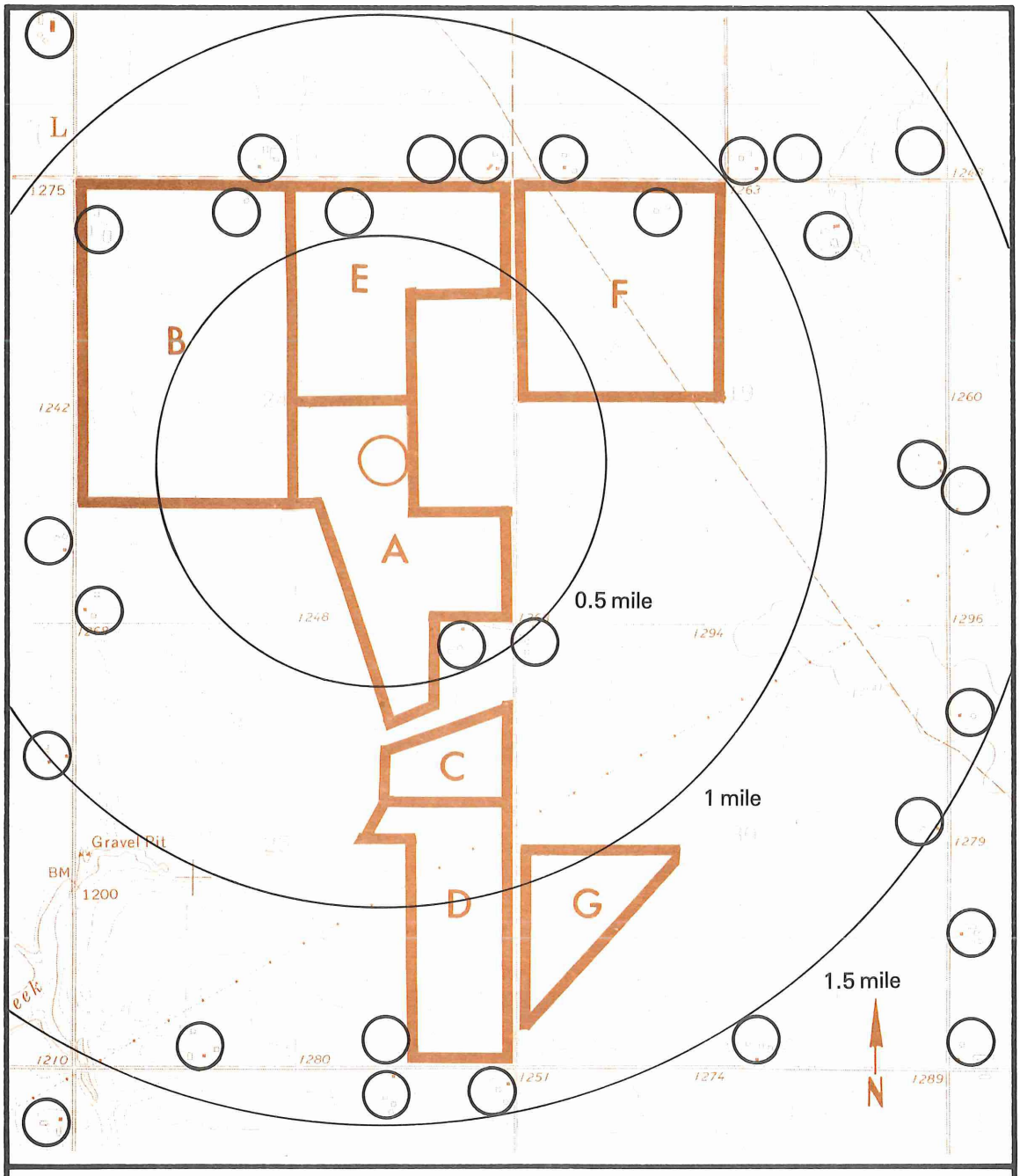
- 0.5 – Mile Radii
- Community
- Residence
- Church & Cemetery (4)
- Extractive (2)
- Other Public (2)

Contour Interval 10 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.6-2
Existing Land Use within a
3-Mile Radius of Project
in Goodhue County

469-4 7904109 7904098



PENZ FARMS COMPANY

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

LEGEND

Residence

0.5-Mile Radii

Figure 4.6-3
Penz Farms Company Existing Residences

7904031 7904032 7904113

TABLE 4.6-1

RESIDENCES WITHIN 3-MILE RADIUS OF PROPOSED PROJECT SITES

Project Site	0 to 0.5 miles	0.5 to 1 mile	1 to 1.5 mile	1.5 to 2 miles	2 to 3 miles	Total
Penz Farms Company	2	11	19	17	70+	118+
Darwin Schroeder*	2	11	18	17	75+	123+
Hilltop Pork Producers	3	9	23	23	82+	140+

*Community of Elgin, population approximately 600, is 3 miles east.

Darwin Schroeder

The proposed facilities site is currently cultivated for corn production. Immediately to the south is the existing Darwin Schroeder homestead and farming operation. Included is a 2-acre homestead; a 5-acre, 200-head cattle rearing operation with barns and associated structures; and a 1-acre machine and grain storage complex (Schroeder 1979).

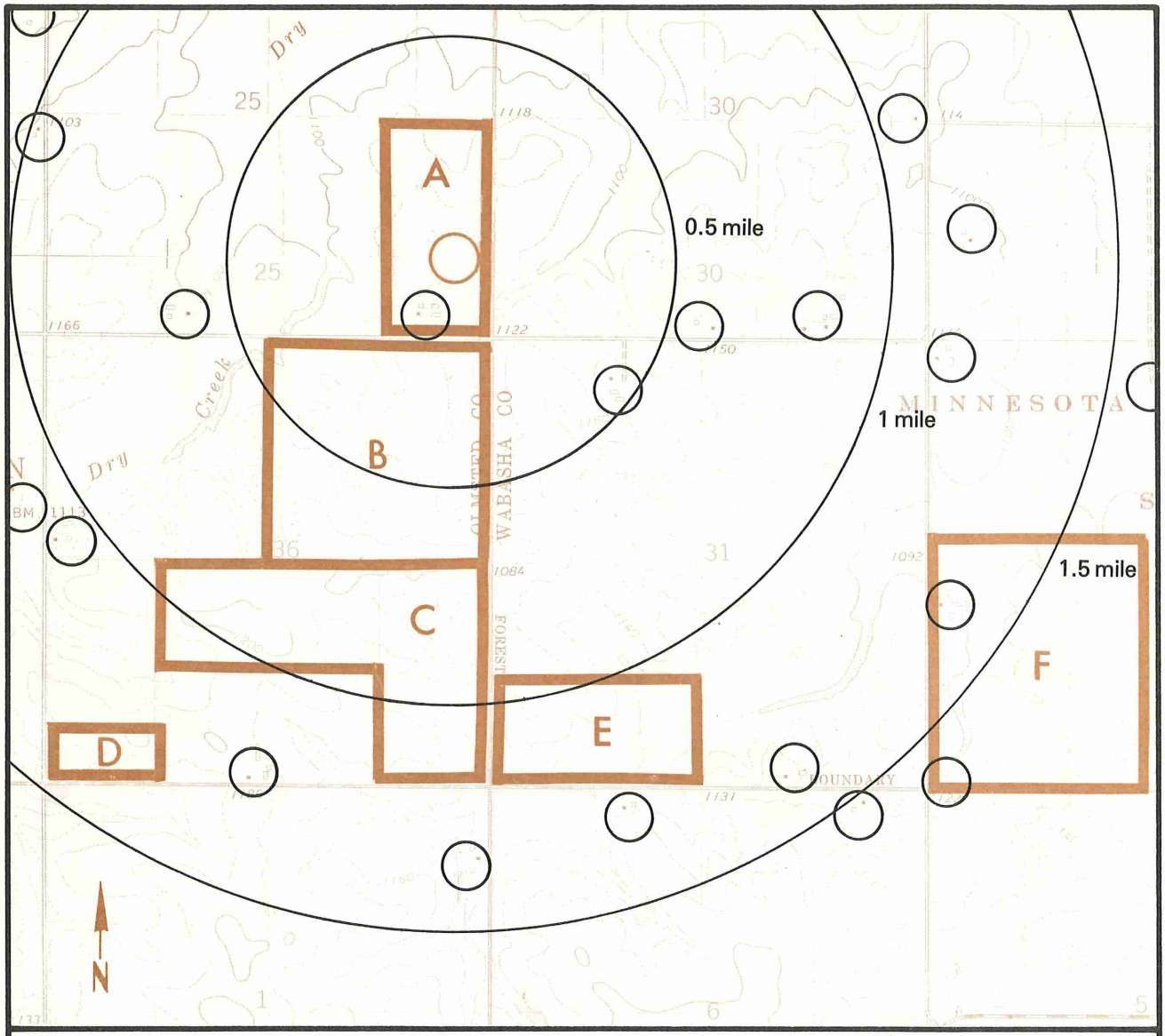
The Schroeder homestead and one to the southeast are the only residences within a 0.5-mile radius of the proposed facilities site (see Figure 4.6-4). Table 4.6-1 shows the number of residences within each distance zone. There are an estimated 123 plus residences within 3 miles of the proposed confined swine facilities. Potsdam is 3 miles to the north-northwest of the proposed site and contains 15 residences, a church, and a cemetery. The village of Elgin, population approximately 600, is just beyond the 3-mile radius directly west of the site.

The Darwin Schroeder residence is located within the boundaries of manure application parcel A. Two residences are located within the boundaries of manure application parcel F. No structures are located on any of the other manure application parcels.

Hilltop Pork Producers

The facilities site is currently dedicated to crop production. Hay and corn are rotated each year in the adjacent 5-acre segments (Hilltop Pork Producers 1979). The hay yield is approximately 4 tons per acre, with corn yielding 125 bushels per acre.

Three residences are within a 0.5-mile radius of the proposed facilities site (see Figures 4.6-5 and 4.6-6). Table 4.6-1 shows the number of residences within each distance zone. There are an estimated 140 plus residences within a 3-mile radius of the facilities site.



DARWIN SCHROEDER

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

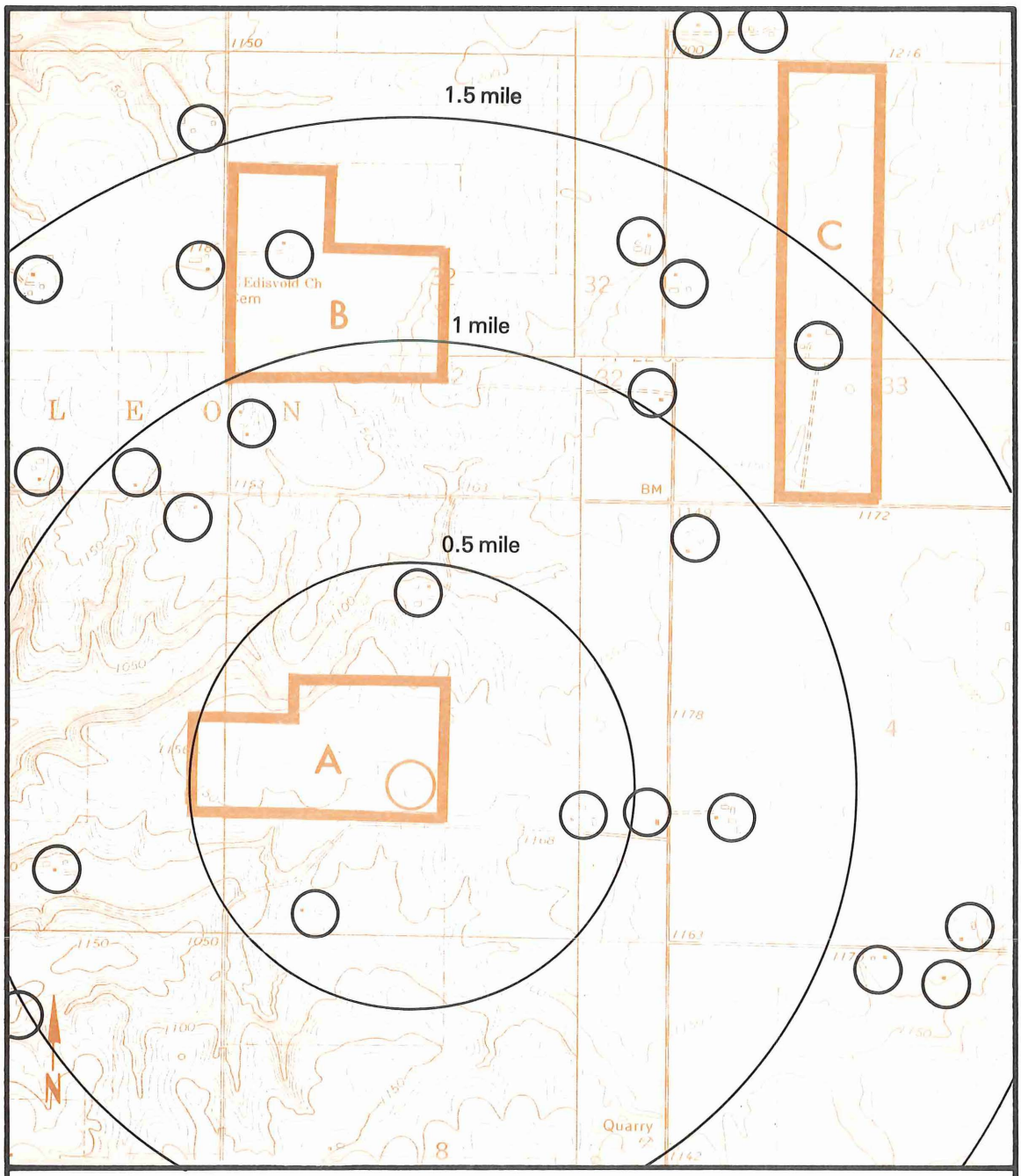
LEGEND

Residence

0.5-Mile Radii

Figure 4.6-4
Darwin Schroeder Existing
Residences

7904033 7904034 7904099



HILLTOP PORK PRODUCERS

LEGEND

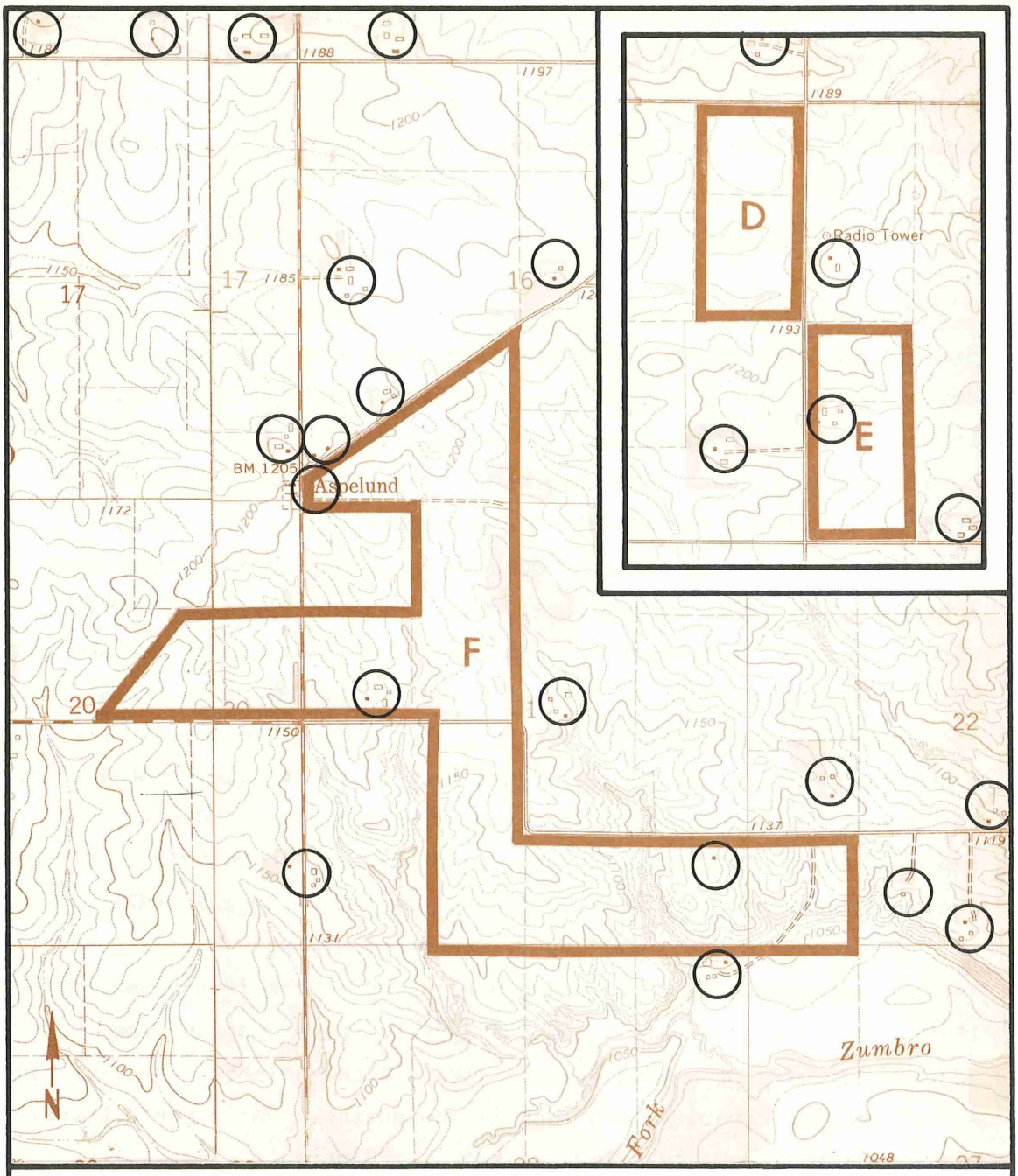
Residence

0.5-Mile Radii

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.6-5
Hilltop Pork Producers Existing Residences (a)

7904029 7904030 7904114



HILLTOP PORK PRODUCERS

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

LEGEND

Residences

Figure 4.6-6
Hilltop Pork Producers Existing Residences (b)

7904027 7904028 7904100

The nearest community to the facilities site is Aspeland, approximately 2.5 miles south. Wanomingo, approximately 5 miles southeast, is the largest community near the site. Other rural communities within the project area include Sogn, Hader, and Bombay.

Transportation

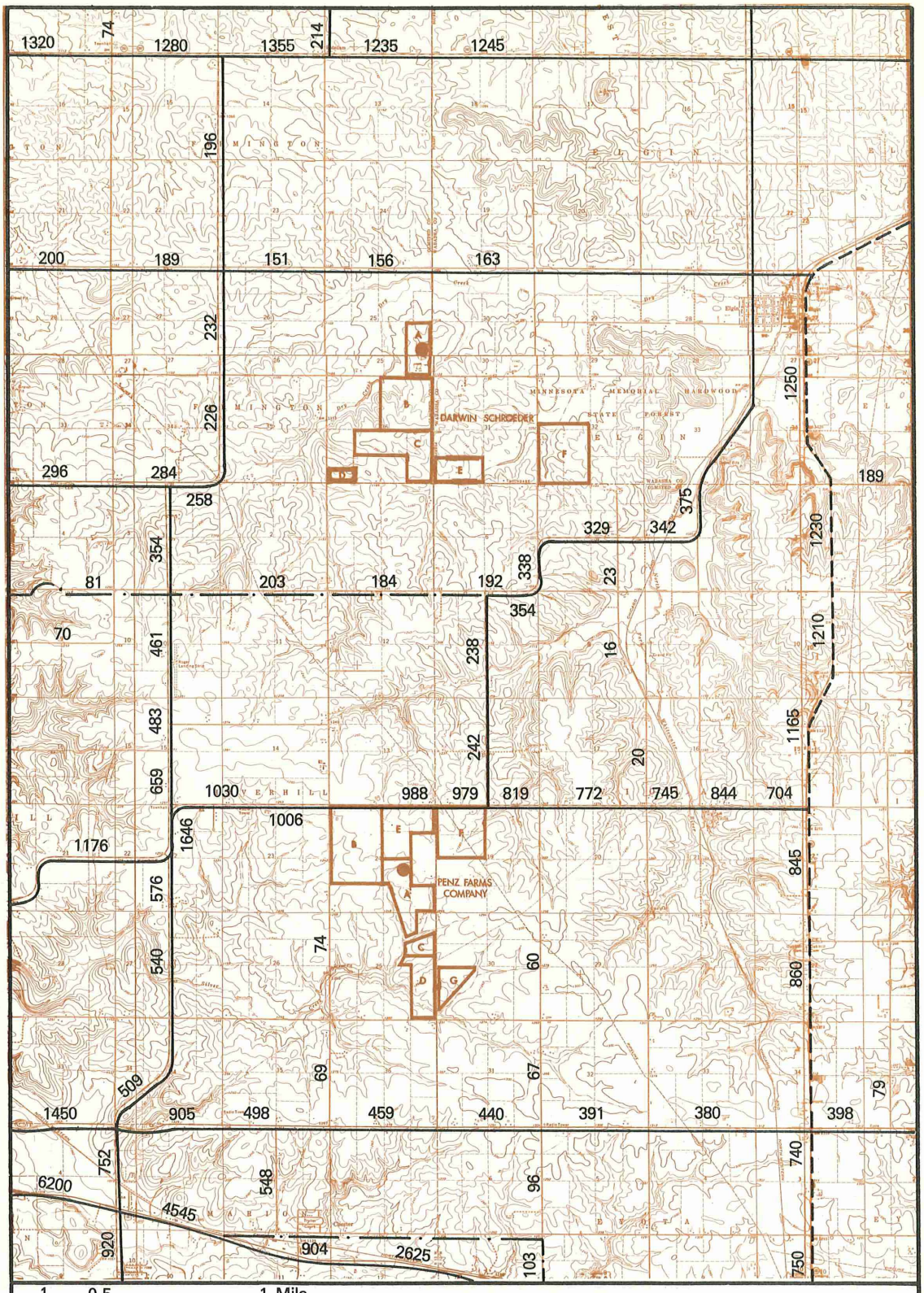
The proposed confined swine facilities and all manure application parcels for each of the three proposed operations are assessible via designated county or state roads. Figures 4.6-7 and 4.6-8 show the location, route designations, and average daily traffic volumes (ADT) on designated roads. (The data shown on the figures were obtained from the Minnesota Department of Transportation (1975, 1977).)

According to the Olmsted County Highway Engineering Department (Sheehan 1979), most of the County State Aid Highways adjacent to Darwin Schroeder and Penz Farms Company have a bituminous surface and a load-bearing capacity of 5 tons in the spring (March 20 to May 15) and 9 tons for the remainder of the year. County Highway 9, which has a concrete surface, has a year-round load-bearing capacity of 9 tons. The gravel township roads in the area have the same load-bearing capacity as the bituminous surface County State Aid Highways. All of these highways are currently used below capacity (Sheehan 1979).

In Goodhue County, all County State Aid Highways have a load bearing capacity of 9 tons in the non-spring months (Pinsonneault 1979). However, Highways 1 and 8 (westerly) have a spring load bearing capacity of 6 tons while Highways 9 and 8 (northeasterly) have a load bearing capacity of 5 tons in the spring. The present traffic usage on these roads is below capacity (Pinsonneault 1979).

Cultural Resources

The National Register of Historic Places and the Minnesota Inventory of Historic Places (Minnesota Historical Society 1979) indicate no record of designated historic or archaeological resources on or immediately adjacent to any of the facility sites or land spreading areas under study. One property (Dr. Just Christian



PENZ FARMS COMPANY

LEGEND

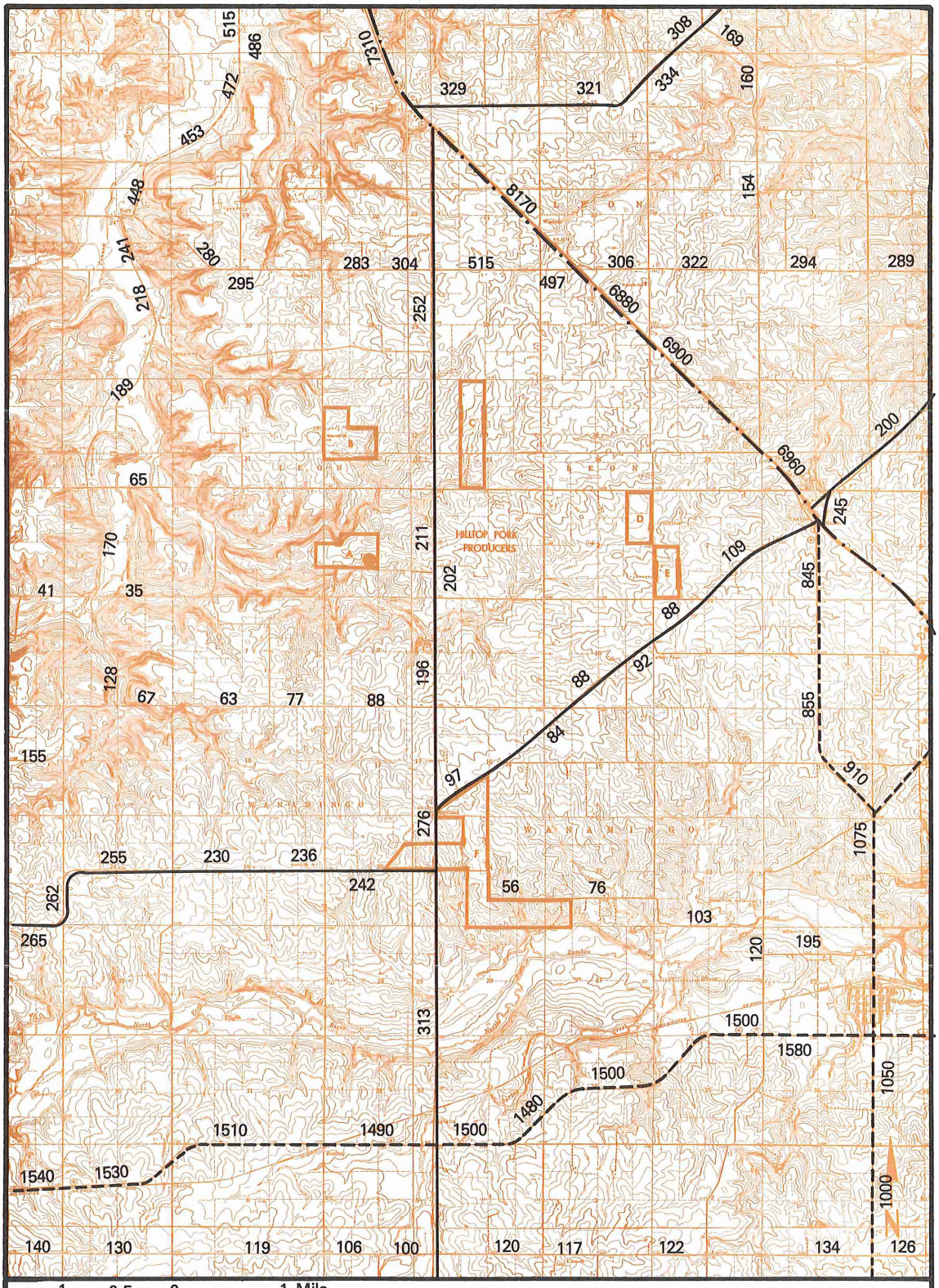
- County State Aid Highway
- State Numbered Trunk Highway
- County Road — Bituminous
- (Uncolored) County Road — Unimproved
- 500 Average Daily Traffic (ADT) Volume
- Contour Interval 20 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.6-7
Existing Transportation Route Classification and Volume in Olmsted County

Source: DOT 1975, 1977

556-2 7904092790415 3



LEGEND

- County State Aid Highway
- State Numbered Trunk Highway
- U.S. Highway
- (Uncolored) County Road — Unimproved
- 500 Average Daily Traffic (ADT) Volume
- Contour Interval 10 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.6-8
Existing Transportation Route Classification and Volume in Goodhue County

469-4 7904109 7904156

Gronvold Estate), located within the Hilltop Pork Producers project region, is listed in the National Register of Historic Places (Minnesota Historical Society 1979). It is approximately 3 miles southeast of the facilities site and approximately 1.5 miles west of parcel F. Several properties on and adjacent to Hilltop Pork Producers manure application parcels are included (but not designated) as "inventory sites" in the current Minnesota Historic Places Survey (Minnesota Historical Society 1979). Properties from this survey may be added, at a future date, to either the Minnesota Inventory of Historic Places, Minnesota State Historic Sites Registry, or National Register of Historic Places. Presently, the only designated property within the three study areas is the Dr. Just Christian Gronvold Estate, within the Hilltop Pork Producers project region. Table 4.6-2 lists an inventory of historic-cultural resources.

The Council for Minnesota Archeology, Office of the State Archeologist (Howard 1979) and the Minnesota Historical Society (1979) were also consulted. Their files indicated no record of known archeological resources within proximity to any of the parcels under study; however, records show the areas under study have never been systematically surveyed (Howard 1979). Nonetheless, the files indicated that "several of the locations (facilities sites and manure application parcels)...have a high potential for the existence of prehistoric habitations. These are the areas that are directly on or near major rivers or their tributaries...including the Zumbro River, Silver Creek, and tributaries to the Little Cannon River and Whitewater River" (emphasis added) (Howard 1979).

Aesthetic Character

The aesthetic character of any landscape is the result of a complex interaction of many factors, including physiography, land cover, land use, the presence of water, and viewer distance. The aesthetic perception of a site is based largely on the visual impression received, but can also be affected by the other senses, such as smell and sound. Odor and sound baseline and impact conditions are discussed in separate sections. Because the only

TABLE 4.6-2

INVENTORY OF HISTORIC CULTURAL RESOURCES

Name	County	Location	Theme
Minnesota Inventory of Historic Places (Designated)*			
German Lutheran Church & Cemetery	Olmsted**	Hwy 247 Potsdam Farmington Twp.	Social Institution: Religion
Siem Homestead	Olmsted	NW, NE, N 1/2 16-108-13 Hwy 241, 2-1/2 miles west of Potsdam Farmington, Twp.	Architecture: Gothic
National Register of Historic Places (Designated)*			
Dr. Just Christian; Gronvold Estate	Goodhue***	NE, NW 19-110 -17 Kenyon - Wanamingo Twp.	Architecture: Carpenter Gothic Social Institution: Medicine, Historic Figure
Minnesota Historic Places Survey Inventory Sites (Not Designated)*			
Farmhouse	Olmsted	SW,SW 5-110-17	
Edisvold Church	Olmsted	NW,SW 32-111-17	
H.M. Sande Farmhouse	Olmsted	E,NW 5-110-17	
Granary and Farmhouse	Olmsted	NW,NW 4-110-17	
Farmhouse and Barn	Olmsted	SE,SE 33-111-17	
Barn	Olmsted	NE,NE 35-111-17	
Farmhouse	Olmsted	SW,SE 4-110-17	
Abandoned Farmhouse	Olmsted	SW, NE 16-110-17	
Farmhouse and Barn	Olmsted	N,SW, 16-110-17	
Houses	Olmsted	N,SW 16-110-17	

TABLE 4.6-2 (Continued)

Name	County	Location	Theme
Wanamingo Town Hall Aspelund	Olmsted	SW,SW 16-110-17	
Farmhouse, Elevator, Silo and Barn	Olmsted	SW,NW 21-110-17	
Farmhouse	Olmsted	SW,NE 21-110-17	
Farmhouse	Olmsted	SE,SE 20-110-17	
Nelso-Talla Farm	Olmsted	W,SW 28-110-17	

*Source: Minnesota Historical Society 1979.
**Darwin Schroeder and Penz Farms Company project area.
***Hilltop Pork Producers project area.

visible changes to be caused by the proposed operations are associated with the confined swine facilities sites, aesthetic baseline and impact analysis has been limited to these sites. (A detailed discussion of the visual asthetic character of each of the proposed sites is contained in ERT 1979c.)

The area surrounding the proposed facilities is almost entirely in active agricultural use with some woodlots. In most cases, all structures within a 2-mile radius of the facilities site are rural residences associated with an active farm, with farm buildings immediately adjacent. The physiography throughout the entire area is gently rolling topography (ERT 1979c).

4.6.2 Land Use Plans, Ordinances, and Proposed Changes

Interviews were conducted with appropriate state, county, and local officials to identify land use plans and ordinances that may influence development of the three proposed facilities. Two county comprehensive land use plans and three zoning ordinances were found to be applicable (a detailed description of these documents is contained in ERT 1979c).

- General Land Use Plan for the Olmsted County Area, 1978
- Olmsted County Zoning Ordinance, Revised 1976
- Elgin Township Agricultural Land Preservation Ordinance, Wabasha County 1977
- Comprehensive Guide Plan Goodhue County Minnesota, 1969
- Goodhue County Zoning Ordinance, Amended 1977

The only known proposed major land use change near any of the proposals is a residential subdivision approximately 1.5 miles north of the Darwin Schroeder site in Wabasha County. The subdivision, known as "Wooded Acres," would include a total of forty 3-acre housing lots in Sections 17 and 18 Elgin Township. Plans call for initial development of 18 lots with the remaining 22 lots reserved for future expansion (Back 1979). The proposal is currently awaiting final approval.

4.7 Ecology

4.7.1 Terrestrial Ecology

Vegetation

The vegetation of the study area was once dominated by prairie grasses and oaks. Today, however, the natural vegetation has been mostly cleared and replaced by agricultural crops. Scattered small stands of natural vegetation have resulted from succession on abandoned fields and pastures.

In Goodhue, Olmsted, and Wabasha Counties, most of the land once covered by bluestem prairie, oak savanna, and to some extent floodplain forest is presently used for row crops. In 1977, these three counties had a total of 1,109,200 acres of land in farm (Minnesota Crop and Livestock Reporting Service 1978). Of this cultivated area, 31% was planted in corn, 15% in hay, 14% in alfalfa, 8% in oats, and 7% in soybeans.

The proposed facilities sites and manure application parcels are currently used almost exclusively for agricultural purposes. Feed corn is the primary crop grown on this land, and it is rotated with soybeans, oats, alfalfa, or hay on a four- to five-year rotation schedule. Some peas are grown in the area; each acre is planted to peas less than once every ten years.

In portions of the project sites, agricultural practices have been abandoned, and old field communities have developed. Characteristic plants of these old fields include goldenrod, bluegrass, sweet clovers, and sumacs (MDNR 1977). As these old field communities mature, pioneer tree species such as boxelder are succeeded by oak, primarily bur oak and white oak. Although natural vegetation on and surrounding the project sites is sparce, what exists is predominantly oak (approximately 80%).

Most of the mature nonagricultural vegetation on the project sites is in shelter belts. These narrow strips of vegetation, which serve to protect buildings from wind, are often mixtures of deciduous and coniferous tree species, although pure stands also occur.

Wetlands

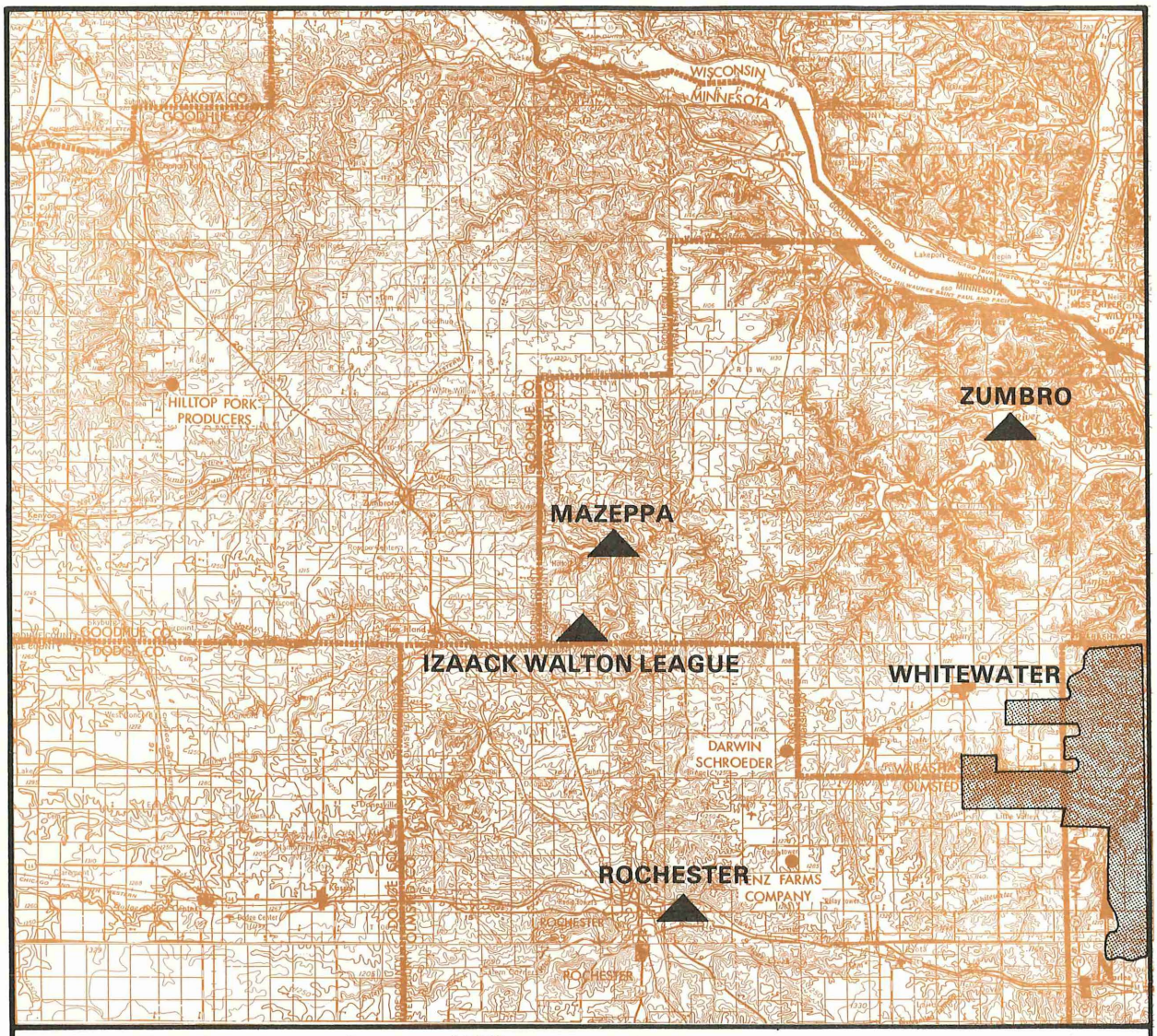
Wetlands are defined as "lowlands covered with shallow and sometimes temporary or intermittent waters" (Shaw and Fredine 1971). There are few wetlands in Goodhue, Olmsted, and Wabasha Counties. Throughout southern Minnesota, the many wetlands have been drained at an annual rate of 4% to increase the amount of tillable acreage (MDNR 1977). As a result, few natural wetlands remain in the study area (Henderson 1979a), and none are known to exist on the project sites.

Wildlife

The wildlife of the study area is generally typical of a disturbed upland prairie habitat. In areas where farming has been abandoned, old field communities have developed. Consequently, those animals common to edge communities are abundant. Additionally, the Mississippi River and many of its tributaries cut through this area of Minnesota and create bottomland habitat. Although this habitat is not large in acreage, it attracts another group of wildlife to the region that prefers moister, less disturbed habitat. The presence of wildlife management areas in the study area contributes to the wildlife diversity. Five state-owned areas are located in the study area (see Figure 4.7-1). In these areas wildlife is managed to encourage species diversity and productivity in a variety of habitats, including forests, marshland, river bottoms, and croplands (MDNR 1977).

Avifauna

Southeastern Minnesota supports a wide variety of avifauna (birds). Although the area is predominantly open farmland, it does have more wooded and hilly areas than either the southwestern or northwestern portions of the state. The Mississippi River is the dominant topographic and migratory feature in southeast Minnesota for avifauna, and it is responsible for attracting many species to the area (Eckert 1974).



MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 4.7-1
Minnesota State Wildlife
Management Areas in
Study Area

Contour Interval 50 Feet

547-1 7904264 7905041

Bird species likely to be found at the project sites can be separated into two groups according to their use of field areas: those that feed directly on crops and crop waste and those that feed on organisms typical of agricultural areas. Included in the first group of birds are the open-upland passerines (meadowlarks, blackbirds, sparrows, and longspurs), gallinaceous birds (turkey, bobwhite, pheasant, and partridge), and waterfowl (geese and surface feeding ducks) (Robbins, Brunn, and Zim 1966; MDNR 1977). These birds use agricultural fields in this area because of the high productivity of the food resource during the growing season and the availability of waste food during the nongrowing season. The practice of spreading manure on fields has further increased the habitat value because undigested food, such as kernels of corn, is easily obtainable from the manure (Porter 1979). The second group of avifauna typical in agricultural areas are those species that consume insects, small mammals, or herpetofauna. Bird groups in this category include raptors (vulture, hawks, falcons, and owls), plovers, sandpipers, and the cattle egret.

Many of the species expected to utilize the cropland on the project sites are game birds that can be legally hunted in Minnesota. This group includes the Canada goose, snow goose, black duck, American wigeon, mallard, ring-necked pheasant and turkey (MDNR 1977).

Mammals

Fifty-two species of mammals have been reported to occur in Goodhue, Olmsted, or Wabasha Counties, 46 of these at the Whitewater Wildlife Management Area (Burt and Grossenheider 1964; MDNR 1977). Of these, only 31 species would be expected to use agricultural fields or pastureland. These species include shrews, skunks, squirrels, mice, voles, rabbits, and deer. Crop waste, particularly corn, provides an easily available food supply for many of these species. White-tailed deer are an important game species in southeastern Minnesota. Populations in the project region are high; winter densities have been estimated at 20 to 30 deer per square mile (MDNR 1977; Porter 1979). Crops, especially corn, provide a major portion of the deer's food, particularly during the colder months of the year.

Herpetofauna

There are 45 species of reptiles and amphibians (herpetofauna) that occur naturally in Minnesota (Ernst 1973; Conant 1975). Thirty-three species of herpetofauna have been reported in southeastern Minnesota (Eckert 1974; Conant 1975; Heather 1979). Herpetofauna observed in the study area that may be found in agricultural fields include various species of turtles, snakes, salamanders, toads, and frogs (ERT 1979d).

4.7.2 Aquatic Ecology

The streams and rivers of the study area vary from intermittent streams to primary tributaries of the Mississippi River (see Section 4.5.2). The temperature regimes, flow rates, and susceptibility to flooding differ with each stream. They are all, however, subject to severe bank erosion. The bank erosion to a large degree determines the diversity and abundance of the aquatic organisms that occur in each waterway. The agricultural use of the land abutting the streams has eliminated the natural vegetation necessary for bank stabilitization. The heavy silt loads from the erosion coupled with the organic waste from domestic livestock that enters many waterways has limited the value of the aquatic habitat for many plant and animals species.

Fish

The range of freshwater fish populations is generally controlled by several abiotic factors that characterize a stream or river. These are stream temperature, oxygen concentration, rate and fluctuation of stream flow, and the availability of suitable shelter (Hynes 1970). These factors greatly influence the distribution of fish throughout the study area. This area has intermittent, fast-flowing, warm and cold water streams, and streams with severe flooding.

Intermittent streams are common throughout the study area. Dry Creek, which drains most of the Darwin Schroeder project site, flows only during periods of high rainfall. No fishery surveys have been conducted on this or other intermittent streams in the study area. However, because of erratic flow, no resident fish populations are expected to occur in these streams (Thorn 1979).

Dry Creek flows into the North Fork of the Whitewater River. The upstream section (river mile 15.0-23.5) of the North Fork, which joins Dry Creek at Elgin, is typical of the low flowing, warm water streams of the region. Silver Creek and Spring Creek* are two more such streams characterized by poor shading, slow currents, a muck-silt bottom, spring flooding, and unstabilized eroding banks. The fish populations of these streams are dominated by suckers and minnows, species especially tolerant of warm water conditions (Thorn, Sogla, and Ebbers 1978; Thorn 1979; Haugstad 1979b). With the exception of the bluegill in Silver Creek, these streams support no game fish species; however, they do have a bait fish value (Haugstad 1979b).

Belle Creek and Little Cannon River, two tributaries of the Cannon River, are slightly larger streams with higher flow rates than those previously discussed. They are also characterized, however, by muck bottoms, heavy siltation caused by severe streambank erosion, and seasonal flooding. At the upper reaches the heavy siltation and the lack of shade cause higher water temperatures (Peterson 1965; Sternberg and Grunwald 1971; Thorn 1979). The crop of bottom dwelling fish food in this area is also limited by the silt load (Peterson 1965). In addition, these streams, especially the Little Cannon, have been polluted by organic waste from domestic livestock, which depletes the oxygen supply (Sternberg and Grunwald 1971; Thorn 1979). These conditions provide little suitable habitat for game species, and both streams have been recently recommended for removal from trout stream

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*Spring Creek joins the North Fork of the Zumbro River less than one mile downstream from the Hilltop Pork Producers other available manure application parcel F. No fishery data is available for the North Fork of the Zumbro River. The river is presently being surveyed by personnel of the Minnesota Division of Natural Resources (MDNR).

status (Hawkinson 1976 and 1979). Brown trout were collected from the Little Cannon in the 1971 stream survey; however, at that time the water temperatures were deemed too high for good trout survival (Sternberg and Grunwald 1971). The stream is still stocked with trout by the Oxford Sportsman's Club of Cannon Falls but is not considered suitable for management by the MDNR (Thorn and Sogla 1977). No game fish were found in Belle Creek when the stream was sampled in 1964 (Peterson 1965) and in 1975 (Hawkinson 1976). Most of species captured were in the sucker-minnow group.

Belle Creek and the Little Cannon flow into the Cannon River at the northern edge of the study area . These streams join the Cannon at river miles 10.5 and 24.4, respectively. At mile 12.7, the Welsh Dam forms a barrier to fish migration, and thus separates the river into two distinct fish habitats. Below the dam, the major limiting factor on this portion of the stream is the seasonal flooding from the Mississippi River. Consequently, most of the species that occur here are rough or forage fish. The game species present, channel catfish, northern pike, sauger, and walleye, are limited in abundance and are considered to be migrants from the Mississippi River. Above Welsh Dam, the Cannon River has different characteristics. Silting is heavier here by a factor of 2 to 5, and organic waste loads from feedlots and agricultural practices are more severe (Coleman and Kopach 1972). The conditions, however, are suitable for warm-water game fish, such as smallmouth bass. The smallmouth bass are somewhat affected by the siltation, especially during spawning. The Cannon River was stocked with bass in 1972. Today it is subject to moderate fishing pressure. Anglers also fish for nongame species of redhorse and suckers on this portion of the river (Thorn and Sogla 1977; Hawkinson 1979). Brown trout also occur above Welsh Dam but only in limited numbers (Thorn and Sogla 1977).

The lower portion of the North Fork of the Whitewater River is the only section of water presently classified as a trout stream in the study area. A 6.2-mile section (river mile 2.1-8.3) is the most suitable for trout. This portion passes through undeveloped woodlands owned by MDNR. Consequently, banks are more stable, and, thus,

erosion is light and water temperatures are lower because of less silt and more shade. There are also many deep pools and large boulders, which increase the value of the stream portion as trout habitat. The presence of wild brown trout fingerlings and yearlings indicates that natural reproduction occurs in the stream. The North Fork is stocked annually with hatchery-raised brown trout yearlings during the spring, summer, and fall. The stream is also stocked with brown trout fingerlings and adults and some rainbow trout fingerlings (Thorn, Sogla, and Ebbers 1978; Anderson 1979). Other abundant fish species in the North Fork are the slimy sculpin and the common sucker. The Whitewater River system (including the North Fork of the Whitewater River) is one of the most heavily utilized trout fishing areas in southeast Minnesota (MDNR 1977).

Macroinvertebrates

The diversity of aquatic macroinvertebrates in the streams and rivers of the study area is limited to a large extent by seasonal flooding and heavy silt loads (Coleman and Kopach 1972; Anderson 1979). Many of the species identified during MDNR stream surveys are characteristic of polluted, poor quality water (Haugstad 1979a). Common organisms reported include mayflies, caddisflies, stoneflies, crayfish, leeches, and snails (Thorn and Sogla 1977; Anderson 1979; Haugstad 1979a).

Aquatic Vegetation

The aquatic plants of some of the larger streams are limited to stream margins (Thorn and Sogla 1977). Abundance is reported to be low, and in some waterways, such as the Little Cannon River, plants are absent (Sternberg and Grunwald 1971). Duckweed is the most common species in the Cannon River and the North Fork of the Whitewater River. Other aquatic plants observed in the streams of the area include arrowhead, river pondweed, narrowleaf pondweed, variable pondweed, water buttercup, watercress, and Canada waterweed (Thorn and Sogla 1977; Thorn, Sogla, and Ebbers 1978; Haugstad 1979a).

4.7.3 Rare, Endangered, or Threatened Species

Minnesota has adopted two statutes, Minnesota Statute Chapter 97.488 (Protection of Threatened and Endangered Species) and Minnesota Statute Chapter 17.23 (Conservation of Certain Wild Flowers) that provide protection for certain species of flora and fauna. The species protected by these statutes are considered to be threatened with extinction throughout all or a significant portion of their ranges presently or in the foreseeable future.

Minnesota Statute Chapter 17.23 prohibits the buying or selling of certain wildflower species removed from public land or from private land without both the written consent of the owner or occupant of such land and the approval of the Commissioner of Agriculture. These plants, as well as other rare or endangered plants of the state, are listed in the publication Rare or Endangered Plants of Minnesota With Counties in Which They Have Been Found (Morley 1972).

The plants considered to be rare or endangered and legally protected under Minnesota law are the trailing arbutus, lotus lily, and all species of Gentiana, Lilium, Trillium, and Orchidaceae. None of these plants are known to occur on the project sites, although some do grow in the study area (Morley 1972). These species generally prefer rich woodlands, bogs, or swamps. A few species of Gentiana occur in wet prairie soils, such as those that occur on some of the manure application parcels (Peterson and McKenny 1968); however, the draining and cultivation of these areas has most likely eliminated these plants. Other species listed as "rare or endangered in Minnesota" (Morley 1972) "or in need of special consideration" (Moyle 1975) have not yet been afforded legal protection by the state legislature. Some of these species, such as maidenhair spleenwort, slender lip fern, snowy campion, roseroot, and several sedges and grasses do occur naturally in limited areas in Goodhue, Olmsted or Wabasha counties (Morley 1972). None are known to occur on the project sites.

The Protection of Threatened and Endangered Species statute protects those species designated as endangered by Section 4(C)(3) of the Endangered Species Act of 1973 (PL 93-205). Only five species of

fauna classified as endangered or threatened under federal (and thus Minnesota) law occur in Minnesota (Henderson 1979b). Of these five, only two, the peregrine falcon and the bald eagle, have been observed in the project region in recent years (MDNR 1977; Heather 1979; Gulden 1979). Neither are expected to utilize agricultural areas, such as the project sites (Robbins, Bruun, and Zim 1966).

Minnesota Statute Chapter 97.488 authorizes the Commissioner of Natural Resources to make any necessary additions to the list of endangered or threatened species. In accordance with this, the MDNR has prepared a list of animal species "in need of special consideration." These species are discussed in the MDNR publication ...the Uncommon Ones (Moyle 1975). Although most of these animals are not presently protected in the state, they "merit varying degrees of special consideration and management." A number of these species have been observed in the study area; most are uncommon or rare in occurrence.

The species of avifauna so designated by MDNR include the bobwhite quail (threatened species), common tern, double-crested cormorant, white pelican, Cooper's hawk, marsh hawk, osprey (species of changing or uncertain status) and common loon (species of special interest). All these birds have been observed at the Whitewater Wildlife Management Area (MDNR 1977), however, only the bobwhite and hawks would be expected to utilize agricultural fields, such as those on the project sites. The other species of avifauna prefer marsh or open water environments (Robbins, Bruun, and Zim 1966).

No mammal species that have been designated as "in need of special consideration" occur in the study area.

Five species of herpetofauna classified as threatened, of changing or uncertain status, or of special interest, are reported to occur in Goodhue, Olmsted, and Wabasha Counties. The massasauga, a threatened rattlesnake, was observed in 1978 in the Cannon River watershed (Heather 1979). The largest single population of Blanding's turtle in the United States inhabits the sand prairie area of McCarthy Lake in Wabasha County (Gulden 1979). The false map turtle, wood

turtle, and snapping turtle, have also been observed in the study area. All of these species could occur in agricultural areas; however, most of the turtles probably prefer moister sites (Conant 1975).

No fish species that have been designated "in need of special consideration" occur in the waterways of the study area.

4.8 Noise

To adequately characterize an existing community noise environment (for subsequently assessing noise impacts), it is generally necessary to identify the following elements: (1) noise-sensitive receptors, (2) noise sources, (3) terrain features, and (4) noise levels.

4.8.1 Noise-Sensitive Receptors

Noise-sensitive receptors in the vicinity of the three facilities sites consist of widely separated farm houses, at distances of approximately 0.5 to 1 mile. Figures 4.6-3, 4.6-4, and 4.6-5 show the distribution and distances of houses with respect to the facilities sites and manure application parcels associated with the three projects. The nearest receptors to the facilities sites are located at distances of approximately 0.5 miles.

4.8.2 Noise Sources and Terrain Features

The proposed projects would be located in areas where the terrain is flat to gently rolling, generally open land used for agriculture. Noise sources consist of light traffic (cars and trucks) associated with local farming operations. Farm equipment and, in particular, diesel-engine powered machinery and feedstock blower units, may result in occasional, short-term noise generation. Other sources of noise that may be expected at various times of the year are associated with natural phenomena such as weather (wind and rain) and wildlife (insects and birds).

4.8.3 Noise Levels

Noise levels at sensitive receptors in the vicinity of the project site were estimated using a comparative land use approach. Table 4.8-1 indicates nominal values of the indicated noise-level

TABLE 4.8-1

ESTIMATED NOISE-LEVEL STATISTICS IN THE VICINITY OF THE PROPOSED PROJECT SITES

Time Period (hours)	Level Statistic* (dBA)		
	L_{90}	L_{50}	L_{10}
Day (7:00 A.M. to 10:00 P.M.)	30	35	43
Night (10:00 P.M. to 7:00 A.M.)	20	25	33

*Methodology and definitions based on ERT 1979e.

statistics. Depending on local noise source conditions (traffic volumes, farming equipment usage, etc.), it is estimated that there is a range of approximately five decibels less than or greater than the values listed in this table.

4.9 References

Ackroyd, E. A., W. C. Walton, and D. L. Hills 1967. Ground-Water Contribution to Stream Flow and Its Relation to Basin Characteristics in Minnesota. Minnesota Geological Survey. St. Paul: University of Minnesota.

AES undated. Management of Newly Purchased Feeder Pigs. Pork Industry Handbook 20. Agricultural Extension Service. St. Paul: University of Minnesota.

Anderson, D. 1979. Regional Fisheries Biologist, Minnesota Department of Natural Resources. Personal communication, February 22.

Back, K. 1979. Elgin Township Zoning Administrator. Personal communication, February 6.

Borchert, J. R. 1974. Perspective on Minnesota Land-Use 1974. Center for Urban and Regional Affairs and Minnesota State Planning Agency, University of Minnesota.

Burt, W. H. and R. P. Grossenheider 1964. A Field Guide to the Mammals. Boston: Houghton Mifflin Co.

Christiansen, R. and P. M. Raup 1979. The Minnesota Real Estate Market. Minnesota Agricultural Economist, February. Agricultural Extension Service, University of Minnesota.

Colman, J. and K. Kopach 1972. A Study of the State of Pollution of the Streams of the Cannon Valley Watershed, Summer 1972. Publication No. 3. Cannon Valley Development Association.

Conant, R. 1975. A Field Guide to Reptiles and Amphibians. Boston: Houghton Mifflin Co.

Cukor, G., N. R. Blacklow, F. E. Capozza, F. K. Zehra, and F. Bednavek 1969. Persistence of Antibodies in Human Milk. Journal of Clinical Microbiology.

Dunne, H. W. and A. D. Leman 1975. Diseases of Swine. Iowa State Press.

Eckert, K. R. 1974. A Birder's Guide to Minnesota. Minnesota Ornithologists Union, James Ford Bell Museum of Natural History, University of Minnesota, Minneapolis.

Endangered Species Act of 1973. Public Law 93-205.

EPA 1975a. National Water Quality Inventory: 1975 Report to Congress. EPA 440/9-75-014. U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA 1975b. Survival of Pathogens in Animal Manure Disposal. EPA 660/2-75-012, U.S. Environmental Protection Agency, Corvallis, OR.

EPA 1976. Quality Criteria for Water Research. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Ernst, C. H. 1973. The Distribution of Turtles in Minnesota. Journal of Herpetology 7(1): 42-47.

ERT 1979a. Socioeconomics: Related Actions EIS on Confined Swine Facilities. TWP 6. Document P-3634-300. Enviromental Research & Technology, Inc., Concord, MA.

ERT 1979b. Geology and Hydrology: Related Actions EIS on Confined Swine Facilities. TWP 7. Document P-3634-350. Environmental Research & Technology, Inc., Concord, MA.

ERT 1979c. Land Use: Related Actions EIS on Confined Swine Facilities. TWP 8. Document P-3634-400. Environmental Research & Technology, Inc., Concord, MA.

ERT 1979d. Ecology: Related Actions EIS on Confined Swine Facilities. TWP 9. Document P-3634-450. Environmental Research & Technology, Inc., Concord, MA.

ERT 1979e. Noise: Related Actions EIS on Confined Swine Facilities. TWP 10. Document P-3634-500. Environmental Research & Technology, Inc., Concord, MA.

FDA 1978. Draft Environmental Impact Statement: Subtherapeutic Antibacterial Agents in Animal Feeds. Federal Drug Administration, Bureau of Veterinary Medicine.

Gillespie, M. 1979. Olmsted County Auditor's Office. Personal communcation April 3.

Gulden, N. 1979. Area Wildlife Manager, Minnesota Department of Natural Resources. Personal communication, February 15.

Haugstad, N. 1979a. Area Fisheries Manager, Division of Fisheries, Minnesota Department of Natural Resources. Personal communication February 22.

Haugstad, M. 1979b. Area Fisheries Manager, Division of Fisheries, Minnesota Department of Natural Resources. Personal communication, March 22.

Hawkinson, B. 1976. Commissioner's Order Request, Belle Creek. Order No. 1852. Minnesota Department of Natural Resources, Division of Game and Fish, Section of Fisheries.

Hawkinson, B. 1979. Area Fisheries Manager, Division of Fisheries, Minnesota Department of Natural Resources. Personal communication, February 22.

Heather, J. 1979. Area Wildlife Manager, Minnesota Department of Natural Resources. Personal communication, February 15.

Henderson, C. 1979a. Nongame Supervisor, Minnesota Department of Natural Resources. Personal communication, February 14.

Henderson, C. 1979b. Nongame Supervisor, Minnesota Department of Natural Resources. Personal communication, March 6

Hilltop Pork Producers 1979. Personal communication.

Hogberg, R. K. 1972. Ground-Water Resources in Minnesota. Geology of Minnesota, A Centennial Volume, P. K. Sims and G. G. Morey, eds. Minnesota Geological Survey. St. Paul: University of Minnesota.

Hogberg, R. K. 1973. Field Trip Guide for the Environmental Geology of Olmsted County, Minnesota. Minnesota Geological Survey. St. Paul: University of Minnesota.

Hogberg, R. K. and T. H. Gilmer 1976. Hydrology and Groundwater Quality of Olmsted County, Minnesota. Minnesota Geological Survey. St. Paul: University of Minnesota.

Howard, M. A. 1979. Assistant to State Archeologist. Personal communication, February 28.

Hubbert, W. T., W. F. McCulloch, and P. R. Schnurrenberger 1975. Diseases Transmitted from Animals to Man. C. C. Thomas, Springfield, Illinois.

HUD 1978a. Flood Insurance Rate Maps, Goodhue County, Minnesota. National Flood Insurance Program. U.S. Department of Housing and Urban Development, Federal Insurance Administration.

HUD 1978b. Flood Insurance Rate Maps, Wabasha County, Minnesota. National Flood Insurance Program. U.S. Department of Housing and Urban Development, Federal Insurance Administration.

Hult, M. F. 1979. Interaquifer Flow through Uncased Wells in the Karst Regions of Southeast Minnesota. Problems Relating to a Safe Water Supply in Southeastern Minnesota. Minnesota Department of Health, January.

Hynes, H. B. N. 1970. The Ecology of Running Waters. Toronto: University of Toronto Press.

Institute of Agricultural Medicine 1974. State-of-the-art Report on Occupational Safety and Health in Agriculture. University of Iowa.

Kuehnast, E. L. 1972. Climates of the States: Minnesota. Climatology of the United States, No. 60-21.

Labor Market Information Center 1979 updated. Southeastern Minnesota Labor Force Estimates, August 1978.

Leman, A. 1979. Personal communication, April.

Lillie, R. J. 1970. Air Pollutants Affecting the Performance of Domestic Animals: A Literature Review. Agricultural Handbook No. 380. U.S. Department of Agriculture, Agriculture Research Service, August.

Loehr, R. C. 1977. Hazardous Solid Waste from Agriculture. Paper presented at the Fifth Life Sciences Symposium: Hazardous Solid Wastes and Their Disposal.

MDFG 1971. Stream Survey Little Cannon River August 12 to September 3 Goodhue County. Minnesota Division of Fish and Game.

MDFG 1977. Stream Survey Report FW-1-R-22; Whitewater River, North Branch T-31-18, Winona, Olmsted, and Wabasha Counties. Minnesota Division of Fish and Game.

MDFG 1978. Stream Survey Silver Creek, Olmsted County. Minnesota Division of Fish and Game.

MDNR 1977. Whitewater Wildlife Management Area Master Plan, 1977-1986. Minnesota Department of Natural Resources, Division of Fish and Wildlife, St. Paul, MN.

MDNR 1978. Map of Minnesota Peatlands. Minnesota Department of Natural Resources, Minerals Division.

Messina, J. E. and R. S. F. Campbell 1975. Wild Rodents in the Transmission of Disease to Animals and Man. Veterinary Bulletin 45:87.

Midwest Plan Service 1975. Livestock Waste Facilities Handbook. Ames, Iowa: Iowa State University.

Miner, J. R. and T. E. Hazen 1969. Ammonia and Amines: Components of Swine Building Odor. Transactions of the American Society of Agricultural Engineers.

Minnesota Crop and Livestock Reporting Service 1978. Minnesota Agricultural Statistics 1978. U.S. Department of Agriculture, Minnesota Department of Agriculture.

Minnesota Department of Transportation 1975. 1975 Traffic Map, Olmsted County, Minnesota.

Minnesota Department of Transportation 1977. 1977 Traffic Map, Goodhue County, Minnesota.

Minnesota Geological Survey undated. Unpublished Well Records. St. Paul, MN: University of Minnesota.

Minnesota Geological Survey 1966. Map of Mineral Resources of Minnesota. St. Paul: University of Minnesota.

Minnesota Geological Survey 1979. Southeastern Minnesota Ground Water Study. Problems Relating to a Safe Water Supply in Southeastern Minnesota. Minnesota Department of Health, January.

Minnesota Historical Society 1979. Selected Data from Minnesota Historic Places Survey, Minnesota Inventory of Historic Places, National Register of Historical Places, Minnesota State Historic Sites Registry. Compiled and transmitted by S. Queripel, Environmental Assessment Officers, Minnesota Historical Society, February 28.

Minnesota Rule APC 9 and 10.

Minnesota Statute §561.01.

Minnesota Statute Chapter 116B.

Morley, T. 1972. Rare or Endangered Plants of Minnesota with Counties in Which They Have Been Found. Unpublished. Department of Botany, University of Minnesota.

Moyle, J. B. 1975. ...the Uncommon Ones. Minnesota Department of Natural Resources

MPCA 1977. Minnesota Air Quality 1971-1976. Prepared by I. Ritchie, Minnesota Pollution Control Agency.

MPCA 1978. Air Quality Violations Report. Minnesota Pollution Control Agency.

MSPA 1978. Notebook of Land Use Projections. Minnesota State Planning Agency, Environmental Planning Division.

NOAA 1973. Earthquake History of the United States. National Oceanic and Atmospheric Administration, U.S. Department of Commerce Environmental Data Service, Boulder, CO.

NOAA 1975. Monthly and Annual Wind Distribution by Pasquill Stability Classes for Rochester, Minnesota. Computer printout. National Oceanic Atmospheric Administration Environmental Data Service. National Climatic Center, Ashville, NC.

Parham, W. E. and G. S. Austin 1969. Clay Mineralogy, Fabric and Industrial Uses of the Shale of the Decorah Formation, Southeastern Minnesota. Minnesota Geological Survey. St. Paul, MN: University of Minnesota.

Pelczar, J. and R. D. Reid 1965. Microbiology. New York: McGraw-Hill Inc.

Penz Farms Company 1979. Personal communication, March 13.

Peterson, A. R. 1965. Biological Report on Belle Creek Watershed, Goodhue County. Minnesota Department of Conservation, Division of Game and Fish, Section of Research and Planning.

Peterson, R. T. and M. McKenny 1968. A Field Guide to Wildflowers of Northeastern and North-Central North America. Boston: Houghton Mifflin Co.

Pinsonneault M. 1979. Engineer, Goodhue County Highway Engineering. Telephone communication, April 9.

Poblete, W. B. 1979. Olmsted County Health Department. Telephone communication, March 6.

Porter, Dr. W. 1979. School of Environmental Science and Forestry, SUNY, Syracuse, NY. Personal communication, March 2.

Possehl, H. 1979. Olmsted County Auditor's Office. Personal communication in February.

Purrington, A. 1979. Labor Market Information Center. Personal communication, April 4.

Robbins, C. S., B. Bruun, and H. S. Zim 1966. A Guide to Field Identification - Birds of North America. New York: Golden Press

Schroeder, Darwin 1979. Personal communication, February 1979.

Seal, J. R., D. J. Spencer, and H. M. Meyer 1976. A Status Report on National Immunization Against Influenza from the National Institute of Allergy and Infectious Diseases of the National Institute of Health, Center for Disease Control and the Bureau of Biologics of the Food and Health Administration. Journal of Infectious Diseases 133:715-720.

Shaw, S. P. and C. G. Fredine 1971. Wetlands of the United States: Their Extent and Their Value to Water Fowl and Other Wildlife. Circular 39. U.S. Department of Interior, U.S. Fish and Wildlife.

Sheehan, M. 1979. Assistant Engineer, Olmsted County Highway Enginering. Telephone communication, April 9.

SIGMA Associates 1979. Final Report of Sigma Associates, Inc. Problems Relating to Safe Water Supply in Southeastern Minnesota. SIGMA Associates, Inc., ed. Minnesota Department of Health, Minneapolis, MN, January

Sternberg, R. B. and G. L. Grunwald 1971. Stream Survey, Little Cannon River. Minnesota Division of Game and Fish, Section of Technical Services.

Stombaugh, D. P., H. S. Teague, and W. L. Roller 1969. Effects of Atmospheric Ammonia on Pigs. Journal of Animal Science.

Thorn, William 1979. Division of Fisheries, Minnesota Department of Natural Resources. Personal communication, March 22.

Thorn, W. and D. Sogla 1977. Stream Survey, Cannon River. Minnesota Department of Natural Resources, Division of Fish and Wildlife.

Thorn, W., D. Sogla, and M. Ebbers 1978. Stream Survey Report, Whitewater River, North Branch, Winona, Olmsted, and Wabasha Counties. Minnesota Division of Fish and Wildlife, Section of Fisheries.

Twin City Testing and Engineering Laboratory 1976. Unpublished Soils Engineering Report prepared for Mr. Calvin Penz.

University of Minnesota Agricultural Experiment Station 1973. Minnesota Soil Atlas St. Paul Sheet. Miscellaneous Report 120-1973. St. Paul: University of Minnesota.

USDA SCS 1965. Soil Survey of Wabasha County, Minnesota. U.S. Department of Agriculture and Soil Conservation Service. Washington, D.C.: U.S. Government Printing Office.

USDA SCS 1976a. Soil Survey of Goodhue County, Minnesota. U.S. Department of Agriculture and Soil Conservation Service. Washington, D.C.: U.S. Government Printing Office.

USDA SCS 1976b. Soil Resource Information. Sections 14.23, 14.24, 14.25, Haverill Township, Minnesota. Upper Zumbro Soil and Water Conservation District. Department of Agriculture and Soil Conservation Service. Washington, D.C.: U.S. Government Printing Office.

USDA SCS 1977. Inventory and Evaluation of Soil Resources. Farmington Township, Minnesota. Upper Zumbro Soil and Conservation District. Department of Agriculture and Soil Conservation Service. Washington, D.C.: U.S. Government Printing Office.

USDC 1971. 1970 Census of Population and Housing. U.S. Department of Commerce, Bureau of Census.

USDC 1975. 1974 Census of Agriculture - County Data. U.S. Department of Commerce, Bureau of Census.

USDC 1976. Population Estimates and Projections. Current Population Report No. 762. U.S. Department of Commerce, Bureau of Census.

USGS 1974. Water Resources of the Cannon River Watershed, Southeastern Minnesota. U.S. Geological Survey, Washington, D.C.

USGS 1975a. Water Resources of the Zumbro River Watershed, Southeastern Minnesota. U.S. Geological Survey, Washington, D.C.

USGS 1975b. Water Resources of the Root River Watershed, Southeastern Minnesota. U.S. Geological Survey, Washington, D.C.

Walton, M. 1977. Minnesota Geological Survey. Letter to S. Gardebring, Minnesota Pollution Control Agency, August 1.

Wright, H. E., Jr., 1972a. Physiography of Minnesota. Geology of Minnesota: A Centennial Volume. R. K. Sims and G. B. Moray, eds. Minnesota Geological Survey. St. Paul: University of Minnesota.

Wright, H. E., Jr., 1972b. Quarternary History of Minnesota. Geology of Minnesota: A Centennial Volume. R. K. Sims and G. B. Moray, eds. Minnesota Geological Survey. St. Paul: University of Minnesota.

5. ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

5.1 Air Quality

5.1.1 Odor Impact Analysis

Biochemical Mechanisms of Odor Emissions from Livestock Operations

Odors associated with livestock feeding operations have been identified in connection with animal wastes, putrefying feed, and treatment chemicals. In a confined swine facility, anaerobic waste decomposition is by far the predominant odor source. Odorous gases, such as hydrogen sulfide, which has the characteristic odor of rotten eggs, and the mercaptans, amines, and various organic acids are produced by the action of anaerobic microorganisms on the manure over a period of time. These organisms release extracellular enzymes (such as hydrolases), which, in turn, attack the proteins and carbohydrates in the manure (Mosier, Morrison, and Elmund 1977). By contrast, aerobic wastes produce earthy or, perhaps, barely perceptable ammonia odors that are not normally deemed objectionable.

The major factors influencing the processes that release odorant gases are (1) temperature, (2) moisture content, (3) pH level, (4) oxidation reduction potential, and (5) anaerobic residence time. Some of these factors are interrelated.

Temperature

Untreated anaerobic waste storage facilities in temperate climates are relatively odorless during the winter season but release offensive odors in the warmer weather (Mosier, Morrison, and Elmund 1977). Higher temperatures generally increase the rates of chemical reactions (up to a certain point), and the optimal growth and reproduction rates of various anaerobic microorganisms are known to vary with ambient temperature (Alexander 1961).

Moisture Content and Humidity

High moisture levels enhance bacterial growth and the anaerobicity of the entire process of waste decomposition (Mosier, Morrison, and Elmund 1977). Moisture also affects the oxidation-reduction (redox) potential. Researchers such as Sobel (1969) have found that manure diluted with water produces stronger and much more offensive odors than undiluted manure.

pH Level

The pH level is a measure of the hydrogen ion concentration of an aqueous solution. The key role of the pH is related to the reduction of sulfates to sulfides under anaerobic conditions. At pH levels of 7 or lower, the potential for hydrogen sulfide formation and, hence, the objectionable odors associated with this gas are greatly enhanced (White, Taiganides, and Gole 1971). Both the intensity and quality of resulting odors are affected by the pH level.

Redox Potential

The redox potential (Eh) is a measure of the tendency of chemical compounds in the manure pack to become oxidized (high Eh) or reduced (low Eh). Because oxidation and reduction are respectively associated with the loss and gain of (negatively charged) electrons, the redox potential is quantified in terms of millivolts. Aerobic conditions generally predominate at Eh greater than 400 millivolts. The most serious odor problems are generally associated with redox potentials in the range of 0 to -150 millivolts, characterized by the formation of sulfides and the rapid accumulation of hydrogen sulfide gas (Mosier, Morrison, and Elmund 1977).

Anaerobic Residence Time

Up to a point, the longer the manure pack is deprived of oxygen, the more time the anaerobic microorganisms that generate odorous gases will have to attack the waste material and reproduce. Because the

surface of the pack is exposed to the air and is, therefore, aerobic, these gases (hydrogen sulfide, mercaptans, amines, etc.) become "locked in" the storage basin (or residual underhouse wastes). However, if the pack is agitated (such as immediately prior to landspreading), then the "seal" is broken and the odorants escape. This explains the highly offensive community odors that are often associated with such activities as withdrawal of manure prior to land application and clean-out of underhouse pits or clogged pipes.

Odorants Associated with Swine Waste Decomposition

Of the more than 50 chemical compounds that have been positively identified as volatiles associated with swine wastes (Kreis 1978), approximately 15 are known odorants (Table 5.1-1). A few of the volatiles, such as p-cresol, are odorless substances whose concentrations have been correlated with perceived odor intensity of the manure vapor (Schaefer 1977). Many of the odorants, such as ammonia (Miner and Hazen 1969; Robertson 1971; Skarp 1975), indole, skatole (Travis and Elliot 1977), and the carbonyl compounds (Hartung, Hammond, and Miner 1971), are present in subthreshold concentrations.

Of the odorant gases identified, only a very few have been quantified in terms of ambient concentrations. Virtually all of these investigators measured concentrations of the subject odorant either inside swine buildings and underhouse pits (Lebeda and Day 1965; Hartung, Hammond, and Meyer 1971, Robertson 1971; Skarp 1975; Schaefer 1977; Travis and Elliot 1977) or from manure samples (Barnwart and Bremner 1975). The major odorants considered were ammonia and hydrogen sulfide, although ammonia was nearly always present in subthreshold concentrations. Some substances, such as the carbonyls, were also measured at subthreshold levels but, like ammonia, are believed to contribute to perceived odor through an additive or synergistic effect (Hartung, Hammond, and Miner 1971). Virtually no studies have been performed for an actual anaerobic settling basin or outdoor waste storage facility, the component of swine operations that generally constitutes the principal source of odor.

TABLE 5.1-1

CHEMICAL COMPOUNDS ASSOCIATED
WITH SWINE WASTE ODORS

Substance	Principal Investigator(s)
Sulfur-Containing Compounds	
Hydrogen Sulfide	Merkel et al. 1969; Banwart and Bremner 1975; numerous other authors
Dimethyl Sulfide	Banwart and Bremner 1975
Dimethyl Disulfide	Miner et al. 1976
Nitrogen-Containing Compounds	
Trimethylamine	Miner et al. 1976
Ethylamine	Miner and Hazen 1969
Ammonia	Numerous authors (see text)
Indole	Schaefer 1977; Travis and Elliot 1977
Skatole	Schaefer 1977; Travis and Elliot 1977
Carbonyl-Containing Compounds	
Acetic Acid	Miner et al. 1976
Propionic Acid	Miner et al. 1976
n-Butyric Acid	Miner et al. 1976
Acetaldehyde	Hartung et al. 1971, Merkel et al. 1969
Propionaldehyde	Hartung et al. 1971, Merkel et al. 1969
Acetone	Hartung et al. 1971, Merkel et al. 1969
2-Butanone	Hartung et al. 1971
Ethanol	Hartung et al. 1971
Propanol	Hartung et al. 1971

Representative Odorants

The only two odorants for which there are sufficient data on which to base a quantitative analysis of probable community odors from confined swine facilities are ammonia and hydrogen sulfide. Ammonia is usually present in relatively high concentrations (with respect to the lower limit of instrument detection) within confined feeding operations and has a fairly narrow range of odor threshold levels reported in the literature (about 35 to 50 ppm). Furthermore, because of the interest in the nitrogen content of the manure as a nutrient, the subject of ammonia losses associated with livestock wastes has been extensively investigated. However, ammonia is usually measured at subthreshold concentrations and is not exclusively a product of anaerobic decomposition (Mosier, Morrison, and Elmund 1977), nor is it associated with the most offensive odors from confined swine facilities (particularly ventilated buildings with slatted floors (Irgens and Day 1965)).

Hydrogen sulfide, on the other hand, has been identified by numerous authors as a principal contributor to objectionable anaerobic swine manure odors and is almost exclusively the product of anaerobic decomposition (Banwart and Bremner 1975; Muehling 1970; Mosier, Morrison, and Meyer 1977). For these reasons, hydrogen sulfide is used in this study as the "representative odorant."

It is recognized that there are a number of problems connected with the use of hydrogen sulfide as the "most reasonable representative odorant." The major ones are given below.

- Reported values of the odor threshold concentration for hydrogen sulfide vary by several orders of magnitude, from 0.00047 ppm (Manufacturing Chemists Association (1968) - 100% panel response) to 0.78 ppm (Sheehy, Achinger, and Simon undated). A summary of reported hydrogen sulfide thresholds is presented in Table 5.1-2.
- The threshold levels provide no indication of suprathreshold response. Determining suprathreshold response or "annoyance" levels is generally more difficult than predicting odor threshold levels.

TABLE 5.1-2

ODOR THRESHOLD CONCENTRATIONS REPORTED FOR HYDROGEN SULFIDES

Source	Odor Threshold Concentration Reported (ppm)	Comments
Manufacturing Chemists Association (1968)	0.00047	Pure hydrogen sulfide gas, 100% panel recognition
	0.00021	Pure hydrogen sulfide gas, 50% panel recognition
	0.0047	Evolved from sodium sulfide, 100% panel recognition
	0.001	Evolved from sodium sulfide, 50% panel recognition
National Air Pollution Control Administration (Sullivan 1969)	0.0072	100% panel recognition
	0.072	50% panel recognition
V.A. Ryazanov (1952) (U.S.S.R.)	0.072	
California State Department of Health (Sanders et al. 1970)	0.029 $\pm$ 0.005	Range: 0.012 to 0.069 ppm Standard Deviation: 0.005 ppm Panel Size: 16 persons (subject to progressively increasing hydrogen sulfide concentrations)
U.S. Bureau of Mines (Katz and Talbert 1939)	0.13	Ascending order of stimulus presentation
Sheehy, Achinger, and Simon (undated)	0.78	

- There is wide variability among the limited measurement data that have been collected for hydrogen sulfide concentrations in swine buildings.
- The degree to which hydrogen sulfide is depleted through oxidation (either in swine buildings, above outdoor storage basins, or in downwind transport) is highly uncertain.

Quantification of Odorant Emissions from the Proposed Facilities

The methodology for determining the hydrogen sulfide emissions from the two major components of the proposed facilities (the swine buildings and the outdoor waste storage system) is based on:

- the limited data available on ambient concentrations of hydrogen sulfide and ammonia inside confined swine facilities,
- results of the nitrogen balance (and ammonia releases) estimated for these projects (see Section 1),
- assumptions pertaining to the proportionality (within each facility component) of emissions and concentrations, and
- assumptions pertaining to the variability of hydrogen sulfide to ammonia ratios among the different facility components.

The key assumption is that the ratio of hydrogen sulfide to ammonia emissions is of the same order for all system components. All sulfide losses, moreover, are spread over a five-month period (mid-May to mid-October) for conservatism. All estimates are made for routine operation of the facilities. Peak odorant levels that may be induced by agitation during clean-out or manure application, or because of an unforeseen system breakdown, are discussed qualitatively. Such "upset" conditions are extremely difficult to quantify and, moreover, the probability of these conditions occurring simultaneously during adverse (from an odor standpoint) meteorological conditions is very small compared to routine operations. On the other hand, the possibility of upset conditions inducing severe, short-term community

odor impacts cannot be discounted. For this reason, several measures have been suggested to mitigate potential impacts associated with such conditions (see Section 6.1).

Estimates of hydrogen sulfide emissions from the three proposed feeding facilities are given in Table 5.1-3.

Quantification of Community Odor Impact for the Study Area

At present, there are no standards or criteria for livestock odors that could be used to determine whether odorant emissions from the proposed actions have the potential to constitute a public or private nuisance. Several states, however, have promulgated (primarily nonagricultural) ambient odor regulations based on the dilutions to threshold (D/T) concept (Leonardos 1974); D/T being the number of times that odorous air (the air generating the complaints) must be diluted with an equal amount of "odor-free" air to reduce the odor to the threshold of perceptability, as determined by a panel.

Most of the state regulations based on the D/T concept specify a D/T of 7 as the criterion for offensiveness. Huey et al. (1960) reported that, based on past experience, complaints are likely to become more frequent at D/T levels of 7 or above, with a D/T exceeding 31 likely to constitute a "serious nuisance."

This investigation is based on characterizing community odor impacts in terms of the number of times the predicted hydrogen sulfide concentrations must be diluted in order to obtain a threshold concentration of 0.024 ppm. The 0.024 ppm value is the reported mean of the California experiments (Sanders et al. 1976), minus one standard deviation and was selected as representing an intermediate value among the several different threshold levels reported (see Table 5.1-2). The odorant concentrations were computed using an area source advection-diffusion model out to a distance of 2.2 miles from each facility site.

Two meteorological situations were examined:

- a "worst-case" situation, where light winds (1.0 meters per second (m/sec), or about 2.2 mph) and stable atmospheric conditions were assumed; and

TABLE 5.1-3

ESTIMATED HYDROGEN SULFIDE EMISSIONS FROM
PROPOSED SWINE FACILITY COMPONENTS

Applicant	Estimated Emissions of Hydrogen sulfide (milligrams per second)	
	Confined Swine Facility**	Outdoor Waste Storage System
Penz Farms Company	500	1,820
Darwin Schroeder	500	1,820
Hilltop Pork Producers	650	560

Note: Routine operating conditions assumed.

*Five-month period corresponding to maximum ammonia losses (approximately mid-May to mid-October).

**Assuming a mean ventilation rate of 11 ft^3/hr-lb live weight for all buildings.

- a "typical-case" situation, characterized by neutral atmospheric conditions and winds approximately the summer average for the study area (5 m/sec or about 11 mph).

The second situation, which occurs 44% of the time in the period from April through October (the season with the greatest potential for high odorant emissions from livestock feeding operations), is considered to be representative of what an odor panel would be likely to encounter during a spot visit.

The maximum range (distance from the facility source) of odor impact was estimated for each of the two sets of wind/stability conditions at four different odor intensity levels: threshold, D/T equals unity (twice the threshold concentration), D/T equals 3, and D/T equals 7 (the level most commonly specified in state regulations for nonagricultural odors). Results are presented in Table 5.1-4 (columns 2 and 3) and in Figures 5.1-1 and 5.1-2. The term "maximum range" refers to the most remote point directly downwind of the source that is predicted to experience the applicable intensity (D/T) level or higher. Clearly, at any given instant, only those receptors within a relatively narrow sector of the compass will experience the odor impacts predicted.

As shown in Table 5.1-4 and Figures 5.1-1 and 5.1-2, the maximum ranges of odor stimuli are identical for the Penz Farms Company and Darwin Schroeder facilities, varying from 1.7 miles for the threshold level under the worst-case wind/stability to 0.5 miles for D/T equals 7. There is no overlap of the odor ranges between the Penz Farms Company and Darwin Schroeder facilities. The distances are considerably less for Hilltop Pork Producers, ranging from 1.15 miles at threshold (under worst-case conditions) down to 0.34 miles at D/T equals 7. For the "typical-case" situation of 5 m/sec (11.2 mph) winds and neutral stability, the ranges are substantially lower for all three applicants. At the threshold level of odor perception, the maximum ranges are 0.53 miles for Penz Farms Company and Darwin Schroeder and 0.34 miles for Hilltop Pork Producers. This is about 30% of the values estimated for the applicants under worst-case conditions. A D/T of 7 or greater would be experienced only by

TABLE 5.1-4

QUANTITATIVE SUMMARY OF POTENTIAL FACILITY ODOR IMPACTS
BASED ON PREDICTED HYDROGEN SULFIDE CONCENTRATIONS

Odor Intensity$^{\Delta}$	Maximum Range of Odor Stimulus (miles)*		Maximum Number of Residences Within Range of Odor Stimulus**	
	Worst-Case Meteorological Conditions†	Typical-Case Meteorological Conditions††	Worst-Case Meteorological Conditions†	Typical-Case Meteorological Conditions††
Penz Farms Company				
Threshold	1.74	0.53	41	3
D/T = 1	1.12	0.34	15	0
D/T = 3	0.74	0.22	10	0
D/T = 7	0.50	0.09	2	0
Darwin Schroeder				
Threshold	1.74	0.53	37	2
D/T = 1	1.12	0.34	13	1
D/T = 3	0.74	0.22	5	1
D/T = 7	0.50	0.09	2	0
Hilltop Pork Producers				
Threshold	1.15	0.34	13	0
D/T = 1	0.74	0.22	5	0
D/T = 3	0.50	0.09	3	0
D/T = 7	0.34	0.03	0	0

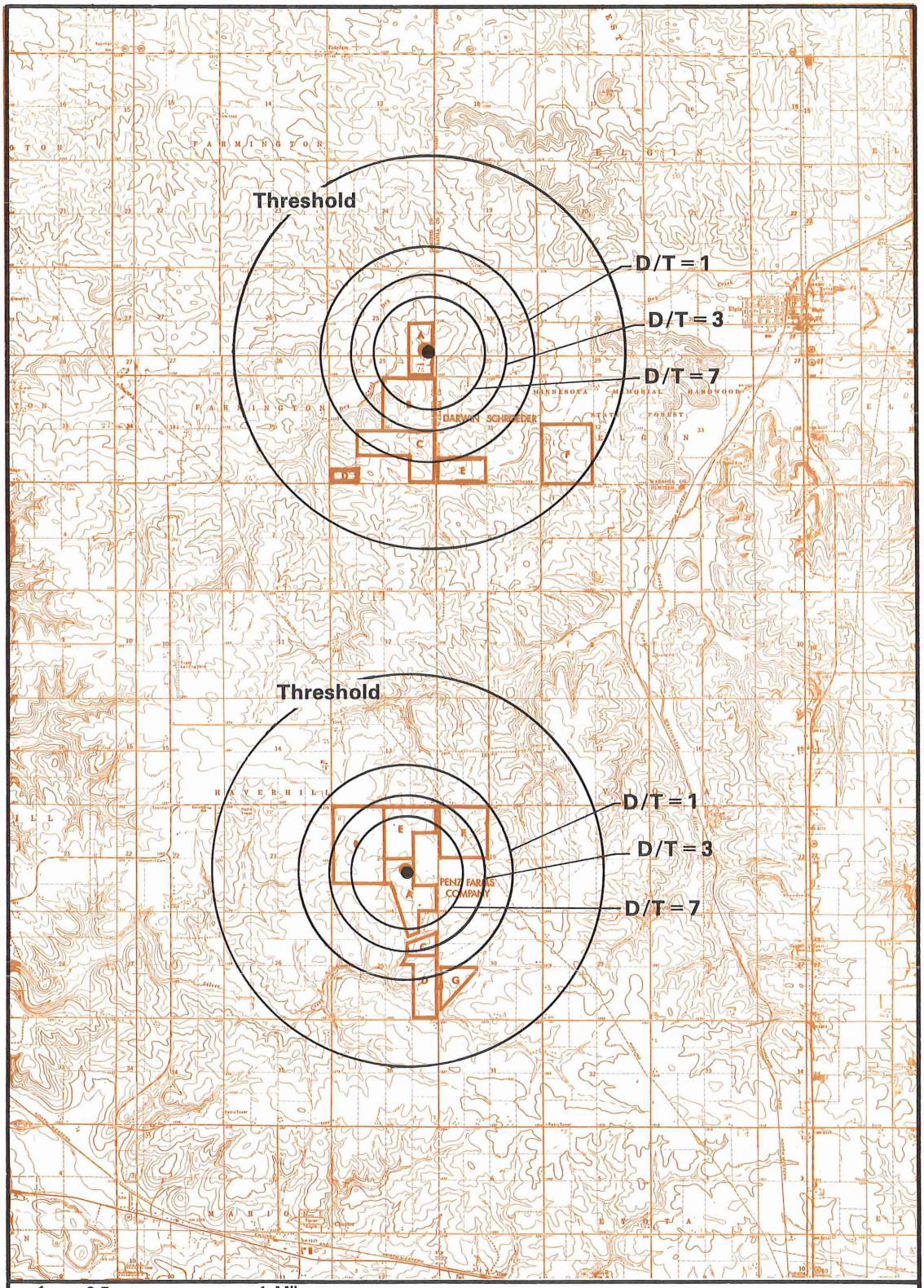
*Representing the envelope of all possible wind directions.

**The term "maximum number of residences" refers to the number of houses that may, at one time or another, be situated within the odor ranges given in columns 2 and 3. At any given instant, the actual number of residences will be only a fraction of this number, depending on the wind direction.

†Wind speed: 1.0 m/sec (2.2 mph), stable atmospheric conditions.

††Wind speed: 5.0 m/sec (11.2 mph), neutral atmospheric conditions.

$^{\Delta}$Refers to the minimum odor intensity that will be experienced when the receptor is directly downwind of the proposed feeding operation.



PENZ FARMS COMPANY

Legend

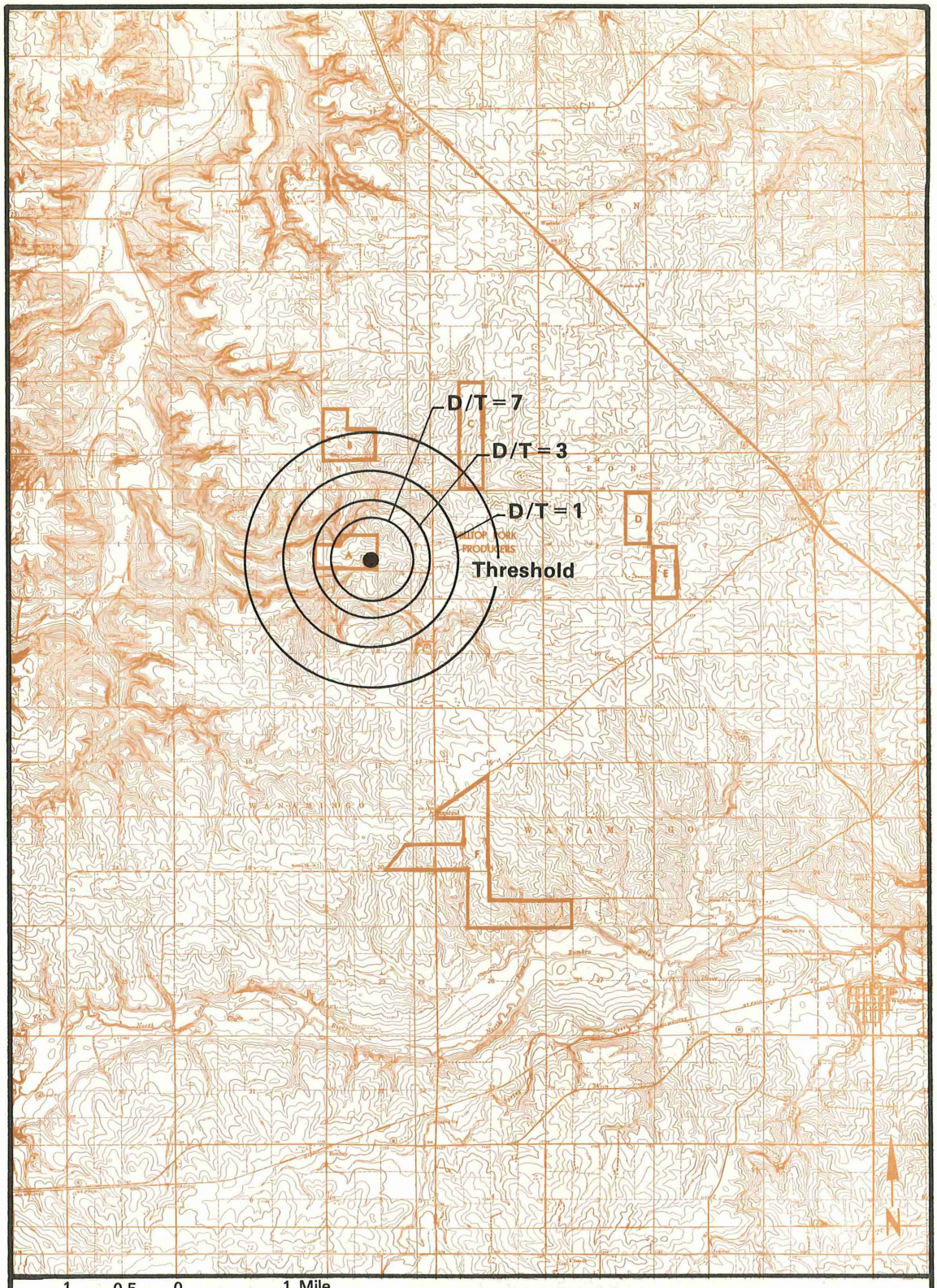
D/T = Dilution to Threshold

Contour Interval 20 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 5.1-1
Maximum Range of Odor Stimuli for Penz Farms Company and Darwin Schroeder Study Regions (Worst-Case Meteorological Conditions)

556-2 7904092 7905065



HILLTOP PORK PRODUCERS

Legend

D/T = Dilution to Threshold

Contour Interval 10 Feet

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

Figure 5.1-2
Maximum Range of Odor Stimuli
for Hilltop Pork Producers
Study Region (Worst-Case
Meteorological Conditions)

469-4 7904109 7905066

downwind receptors within approximately 500 feet of the Penz Farms Company or Darwin Schroeder facilities and within approximately 150 feet of the Hilltop Pork Producers system (that is, probably not beyond the facility site).

To assess the degree of community odor impact, the potential number of (existing) residences within each maximum range that could experience various odor intensity levels is given in the last two columns of Table 5.1-4 for the two wind/stability conditions examined. The actual number of houses simultaneously experiencing a particular odor intensity impact will be only a fraction of the numbers given in Table 5.1-4; that is, only those houses downwind of the facilities. Based on these predictions, threshold levels or greater may be experienced at 41 residences in the Penz Farms Company study region, 37 in the Darwin Schroeder study region, and 13 houses in the vicinity of Hilltop Pork Producers site under worst-case conditions. The potential for particularly offensive (D/T equals 7) odors exists at the two residences closest to the Penz Farms Company and to the Darwin Schroeder feeding operations. No houses in the Hilltop Pork Producers study region are in this category.

The numbers in the final column of Table 5.1-4 indicate that a total of about five residences in the study area (three adjacent to the Penz Farms Company facility and two near the Darwin Schroeder operation) may be subject to chronic odor problems if these facilities are unmitigated. In the Darwin Schroeder study region, moreover, odorant concentrations at the nearest house (the applicant's house) are predicted to be at least four times the threshold level on a regular basis. Odor problems predicted for residences near the Hilltop Pork Producers site are confined to relatively infrequent "worst-case" conditions.

During the seven-month "warm season" (April through October) worst-case wind/stability conditions would occur from about 0.01% of the time (about 5 minutes per month, on the average) to about 0.25% of the time (about 2 hours per month), with the higher frequencies observed in August for northeast, north-northeast, and southerly winds. The highest frequency of worst-case occurrence over the entire seven-month period is for westerly winds (0.25%); that is, for receptors due east of each facility (ERT 1979a).

For the "typical-case" wind/stability conditions, most of the seven-month frequencies fall between 2% and 4%, with a high of nearly 7% associated with southerly winds. In general, houses north to northwest of each facility would have comparatively greater potential for chronic odor problems (provided they are within the ranges given in Table 5.1-4), and houses southwest of each operation would have the lowest potential (ERT 1979a). The predominance of southerly winds is even more evident in May and (particularly) August than at most other times of the year. In August, for example, southerly winds occur more than 12% of the time, implying that a number of residences north of the Penz Farms Company properties (especially those adjacent to parcels B, E, and F) may be subject to intermediate level odor impacts; that is, somewhere between worst-case and typical-case impacts.

5.1.2 Other Air Quality Impacts

Aside from odor impacts, pollutant emissions will be released from various facility related operations, such as construction activities, diesel generator operation, and (for the Penz Farms Company) the operation of landspraying equipment. The issue of potential aerosol contamination (primarily from landspraying) has been raised by a number of concerned individuals within the study area and, therefore, will be discussed first.

Potential Aerosol Impacts

Mechanisms for the release of microbioaerosols into the atmosphere from the proposed facilities and adjacent land parcels include:

- routine exhaust of swine facility air from the building ventilation systems;
- agitation of residual waste material during periodic cleaning of the buildings, underhouse pits, and outdoor storage containers;

- agitation of outdoor storage basins during withdrawal of effluent for land application; and
- landspraying operations (Penz Farms Company only).

The actual aerosol concentrations at sensitive receptors will in each case depend on such factors as meteorological conditions, receptor distances from the most intensive operations, the housekeeping practices implemented by each applicant, and (for Penz Farms Company) the rate of manure application. Community health impacts are dependent on all of these factors as well as the concentrations of pathogenic microorganisms in the waste effluent and their survival rates in the atmosphere. These impacts are discussed in Section 5.3.

No studies have been conducted that predict community microbioaerosol concentrations from existing or hypothetical swine facilities, or from landspraying operations that use swine manure as fertilizer. Microbioaerosol concentrations inside ventilated beef cattle housing units were measured by Goodrich et al. (1974) at levels of 100 to 200 total colony forming units per liter, or about one or two orders of magnitude higher than those normally experienced by nonrural residents. If concentrations of this order were to occur in the proposed swine facilities, the impact on any downwind residences would be negligible (ERT 1979a). Goodrich et al. (1974) also reported three studies that evaluated airborne microbial concentrations associated with spray irrigation of beef cattle oxidation ditch wastes. A significant conclusion of their study (which measured concentrations from 0 to 113 miles downwind) was that, although a noticeable build-up of microorganisms occurred during the spraying operation, counts made after the spraying was completed were the same as those made before it began (that is, no build-up of ambient microbioaerosol levels). The results also indicated that (above 5 mph) downwind bacterial counts increased with higher wind speeds, implying that aerosol impacts can be minimized with proper management techniques (that is, restricting spraying to periods of light or

moderate winds). Conversely, impacts are maximized with improper management techniques (that is, spraying during periods at high wind).

Fugitive Dust Impacts

Fugitive dust will be released from facility construction activities and from routine agricultural operations associated with fertilization, plowing, planting, etc. Activities in the latter category are traditional sources of particulate emissions in virtually all rural areas of the United States, and are currently being performed within the land parcels of the applicants, and elsewhere in the project regions and, as such, represent a negligible incremental air quality impact.

Construction related activities such a landclearing; moving heavy trucks and equipment over unpaved areas; excavation; grading; stockpiling; and transport of sand, gravel, and fill material; and debris haulage, generate fugitive dust by wind action or entrainment caused by mechanical means. A small fraction of this becomes indefinitely suspended (TSP) and a still smaller fraction is in the respirable range. The temporary nature of construction is recognized by the Clean Air Act Ammendments of 1977 and such activities are exempt from the various source control provisions of the Act. Darwin Schroeder has agreed to implement measures to control construction related air quality impacts if necessary.

On-Site Generators

The power requirements for routine facility operations will be supplied by the regional electric utility companies. The facilities will be equipped with back-up diesel generators so that ventilation of the swine buildings can be maintained if the power failed. Community air quality impacts of these generators will be negligible.

Impacts of Vehicular Exhausts

During construction, pollutants emitted from the exhausts of construction vehicles and equipment (primarily carbon dioxide and nitrogen oxide) would constitute a negligible air quality impact on public receptors in the study regions, primarily because they would be operating only for very short periods of time on roads adjacent to homes in the communities. Routine operation of tractors and other vehicles on land parcels would be carried on to the same degree as at present, so these activities will not generate any significant incremental impacts.

5.2 Water Quality

5.2.1 Run-off

Operations management practices for each site will be a determinant in the short-term and long-term impact of the proposed action. Incorporation of manure soon after spraying or spreading as well as avoidance of manure application in the high run-off months of early March and June are good management practices that are assumed in determining the water quality and overall impact of this action.

Although the ratio of different nitrogen forms will change, the impact on water quality should be unnoticable and may result in a net decrease in nitrogen reaching streams.

Manure loading will be based on nitrogen limitation; that is, the amount of available nitrogen in the applied manure will correspond to nitrogen uptake by crops. This scheduled nitrogen loading is similar to current practices. Manure has been shown to improve tilth, increase water holding capacity, lessen wind and water erosion, improve aeration, and promote growth (Midwest Plan Service 1975). The change to a more stable nitrogen source (organic) and immediate incorporation of the manure may result in less water quality impacts than caused by current application of commercial fertilizers that do nothing to amend the soil. The major chemical constituents of the manure are immobilized in the soil with the exception of nitrate (Concannon and Genetelli 1971).

The Darwin Schroeder facility has proposed to route surface run-off from the existing 1-acre cattle feedlot area to the proposed manure storage basin. Run-off from this 100-head operation is currently uncontrolled and drains into Dry Creek. Animal lot run-off may contain potential disease carrying organisms, organic material, suspended solids, and nutrients in sufficient quantities to threaten human health (MPCA 1975). Thus, this component of the proposed action would eliminate an existing possible source of water contaminants.

Waste Treatment System

The proposed solids settling basin for the Darwin Schroeder site and the storage basins for both Penz Farms Company and Darwin Schroeder are earthen structures. Each basin would be lined with a 6-ml thick plastic liner.

It is assumed that the basin and outer banks would be stabilized with a vegetative cover as soon as possible after construction to eliminate erosion. Should the bank give way, there would be a potential for adverse effects to receiving streams (during periods when local intermittent streams were running) or to groundwater. Nitrates, formed from conversion of manure components under oxidizing conditions, would be released to the environment. Provided that proper construction and maintenance procedures are observed, release of manure from the storage facilities is considered unlikely.

Hilltop Pork Producers would store manure in above-ground storage tanks. Impacts to surface water quality could occur if these tanks ruptured (during periods when local intermittent streams were running), however, the probability of this occurrence is low.

Health Effects

Some treated manure that is withdrawn from the storage facilities will be recent and should it rain following manure application, pathogen levels in surface water draining the sites could increase. As discussed in Section 5.3, however, the probability of disease-causing organisms surviving the conditions imposed by manure storage and land application is low.

The greatest potential for adverse pathogen-related effects to surface water would be by direct release of stored manure to surface water (that is, failure of storage basin retaining walls during periods when local intermittent streams were running). Proper construction and maintenance of banks would minimize this potential.

5.2.2 Groundwater

Nutrient Loading

Each applicant has proposed land application of manure at nitrogen-based agronomic rates. Additionally, soils would be periodically tested to determine nutrient content. Thus, nitrogen loadings would correspond to annual crop needs, and would not result in an increase in the quality of nitrates released to groundwater.

The application of manure beyond the amount calculated to supply nitrogen to crops is generally acknowledged to constitute poor mangement because of the high potential for pollution of groundwater by nitrates. Nitrogen availability to crops depends on three factors: (1) the ammonia content of the manure that is readily available; (2) the mineralization rate of organic nitrogen that determines the amount of nitrogen available to the crop over several growing seasons; and (3) the application method, since substantial volatilization losses of ammonia may occur if the manure is applied on the surface and not readily incorporated into the soil. Because of the slow availability of organic nitrogen to the crop, allowable nitrogen loadings are generally based on initial 4-year or 5-year application cycles to achieve steady-state conditions.

As described in Section 5.5, proposed manure application rates (based on nitrogen requirements) would add greater quantitites of phophorous and potassium to the soil than is required for crop growth.

The water solubility of phosphorous in organic forms (manure) and as orthophosphate (chemical fertilizer) is low. Recent studies have shown no significant downward movement of phosphorous in soils after application of swine manure (Powers, Wallingford, and Murphy 1975).

As discussed in Section 5.5, the soils in the proposed manure application parcels have a relatively high capacity to retain salts (such as potassium, calcium, and magnesium). Proposed loading rates may result in a long-term buildup of salts in soils. Salts such as sodium and potassium may be subject to leaching to groundwater (Powers, Wallingford, and Murphy 1975). Therefore, proposed manure

application rates could result in increased concentrations of salts in groundwater below the project sites. However, each applicant has proposed to base manure application rates on laboratory testing of manure and soils. Adjusted application rates on the basis of such testing would supply nutrients at levels needed for crop growth, and increased leaching of salts to groundwater would not occur. Possible application rates based on phosphorous and potassium crop uptake are discussed in Section 6.5.

Waste Storage System

Southeastern Minnesota is considered to be an area susceptible to groundwater contamination because of the presence of karstified carbonate formations. Such formations rapidly transmit groundwater through solution-enlarged joints and faults. The proposed manure storage systems are designed to minimize or eliminate seepage; thus, during normal operation, significant quantities of contaminants would not be released to groundwater.

The potential for significant groundwater contamination associated with the proposed action is related to (1) the potential for sinkhole development at each facilities site, (2) the structural integrity of the manure storage systems, and (3) management practices. As discussed in Section 5.5, the sinkhole potential at the Penz Farms Company and Darwin Schroeder facilities sites is considered low. However, if sinkholes were to develop at these sites, rupture of the earthen storage basins would release ammonium and nitrates to local groundwater. The sinkhole potential at the Hilltop Pork Producers facilities site is not known. Although no surface karst features exist at the facilities site, no borings have been conducted to determine the depth to carbonate rocks. (As discussed in Section 5.5, the thickness and type of geologic materials overlying carbonate bedrock is an important determining factor with regard to sinkhole potential.) However, the proposed above-ground storage tanks would afford a greater degree of safety (with respect to containment of wastes in the event of sinkhole development) than the earthen

basins proposed by Penz Farms Company and Darwin Schroeder. Sinkhole development of proportions sufficient to threaten the integrity of the steel and concrete storage system is considered unlikely.

Accidental leakage from storage tanks proposed by Hilltop Pork Producers is highly improbable because of the structural integrity of these steel and concrete units. Proposed plastic liners (Penz Farms Company and Darwin Schroeder) would be overlain by one foot of soil. This protective layer would be installed to prevent rupture of the liner. However, during manure withdrawal, overlying soil may be removed by the action of the pump. Thus, some potential would exist for liner rupture in the pump-out area of each basin.

If the liners ruptured, effects on groundwater would be determined by the amount of seepage from the lagoon and the ability of the soil to remove the nutrients in the manure. The amount of seepage would be limited by the biological sealing found in manure-holding ponds or basins (Miller, Robinson, and Gallagher 1976). Natural sealing of anaerobic lagoons has been shown to inhibit, or in some cases, eliminate seepage (Miller, Robinson, and Gallagher 1976; Ciravolo et al. 1977).

The potential environmental effects resulting from liner rupture may be estimated on the basis of available studies on the migration of pollutants from unlined earthen swine manure basins. Available literature regarding seepage from eight swine manure storage basins indicates that seepage from basins located on fine-grained soils is generally restricted to less than 10 feet from the facility (Miller, Robinson, and Gallagher 1976; Ciravolo et al. 1977). Seepage was detected at a distance of 100 feet from one basin located on fine-grained soil with a high water table, however, drinking water standards were not exceeded beyond a 10-foot radius (Ciravolo et al. 1977).

The primary constituent of seepage from swine manure storage basins is ammonium (Miller, Robinson, and Gallagher 1976; Ciravolo et al. 1977), although some increase in nitrates in groundwater below these facilities has been noted (Ciravolo et al. 1977). The accumulation of ammonium below a manure basin is not in itself

detrimental; however, under aerobic conditions, ammonia is converted to nitrate, which is mobile in the environment (Miller, Robinson, and Gallagher 1976). The soils below a manure basin are likely to remain anaerobic during use of the basin, however, abandonment may promote aerobic conditions and release nitrates to the environment (Miller, Robinson, and Gallagher 1976).

The carbonate aquifers present at various depths below each facilities site (see Section 4.5) are susceptible to contamination. Groundwater in these formations is transmitted by direct flow through solution-enlarged channels. As described in Section 4.5, a known thickness of 20 to 28 feet of clay till is present at the Penz Farms Company facilities site. Regional data suggest that this thickness may be much greater. Excavation of the manure storage basin (approximately 10 feet deep) would leave a minimum buffer of 10 to 18 feet of clay between the bottom of the basin and the underlying carbonate (Galena Formation) aquifer. Rupture of the plastic liner at this site could result in the release of nitrates to the underlying carbonate aquifer. The potential impact to water quality in this aquifer will depend on the total thickness of the clay deposits present; however, available data regarding existing manure basins suggest that significant quantities of contaminants are not likely to migrate beyond 10 feet below the basin.

The thickness of unconsolidated deposits at the Darwin Schroeder facilities site is estimated to be 40 to 55 feet (USDA SCS 1977). Excavation of the settling and storage basins would leave an estimated thickness at 28 to 43 feet of clay till underlying these facilities. The glacial till is underlain by an unknown thickness of sandstone, which is, in turn, underlain by carbonate rocks (Platteville Formation). On the basis of available data regarding unlined swine manure basins, it is predicted that this thickness of poorly permeable geologic materials would be sufficient to prevent contamination of the carbonate aquifers in the event of liner rupture at this facility. However, some increase in nitrate concentrations in groundwater within the clay till would occur.

The exact depth to the high water table at the Penz Farms Company and Darwin Schroeder facilities sites is not known. Information regarding typical depths to the water table associated with soil types present at each site (see Section 4.5) suggests that the seasonal high water table at these sites may be higher than the elevation of the bottom of the proposed manure basins. Therefore, some means of preventing lateral movement of groundwater, such as plastic curtains or tile drains, may be required. Design specifications regarding control of the water table are not currently available. If tile drains are used, a possible avenue would be created for the movement of any manure effluent released from the basins. Depending on the placement of drainage tiles, any manure effluent released because of a rupture could move quickly to local drainages. Thus, during periods when local intermittent streams were flowing, rupture of the liner could result in adverse effects to surface water quality.

Health Effects

Infant methemoglobinanemia is the most notable acutely toxic effect of nitrate exposure. Methemoglobinanemia occurs when an oxidizing agent such as nitrite, which is formed in the stomach from nitrate, combines with hemoglobin, reducing the oxygen-carrying capacity of the blood. Infants under three months old are particularly susceptible; children older than three months and adults generally are not. This disease is rare where water supplies contain less than 10 mg/l of nitrate nitrogen.

5.3 Public Health

5.3.1 Swine Health Impacts

The greatest impact resulting from inadequate swine health maintenance procedures is economic; that is, loss of marketable pigs. Ancillary impacts relate to the swine population; once exposed to and infected by pathogenic organisms, they will be weakened, have a slower weight gain, and possibly die because of secondary infections. Swine density in a confinement facility can result in serious epidemics among the pigs if proper care and disease prevention practices are not taken.

The human impact resulting from inadequate swine health maintenance procedures should be limited to the workers within the confinement facility. If proper medication is not available for the swine population, the risk of exposure to other (nonworker) humans increases; improper or delayed disposal of dead animals would also increase the health risk to outside humans and other animals.

5.3.2 Impacts Related to Disease Potential and Transmission

For disease to spread from swine to humans, direct contact, mechanical vectors, or biological vectors are required. The following six factors must be present for infection of humans or other animals by swine pathogens to occur:

- a causative agent (sick pig),
- an infective dose of the pathogen,
- a mechanism of escape from the causative agent,
- transmission vectors,
- a method of entry into the new host, and
- the susceptibility of the host (Patton 1978).

Direct Contact

Although humans working in swine production facilities are a good source for investigating the disease transmission potential from swine to humans, no data are current available on zoonotic diseases for this group of people (Geyer 1979). Most observers of these people, however, judge them to be normal and healthy, constituting evidence that zoonotic disease risk from swine to man is low (Institute of Agricultural Medicine 1974).

Veterinarians who have direct contact with sick animals and herds are another high risk group. Aside from brucellosis, which is increasingly rare in swine, veterinarians are not infected with zoonotic diseases at a higher rate than other groups (Hubbert, McCulloch, and Schnurrenberger 1975).

Mechanical Vectors

There is little documented evidence to indicate aerosol transfer of disease from swine or confined swine facilities to humans (Institute of Agricultural Medicine 1974). Additionally, pathogen density is reduced cubically as distance from the confined swine facility increases. Aerosol transmission of an infective dose of a disease is, therefore, unlikely (Donaldson 1978).

Man and farm vehicles can mechanically transmit disease. Reasonable sanitary practices, however, would be sufficient to control the transmission of zoonotic diseases by this route.

Animal wastes spread on the soil represent a possible means of mechanical transmission of zoonotic disease. The duration of pathogen survival in the soil is difficult to predict because of the many interrelating factors. These include ultraviolet radiation, temperature extremes, soil infiltration potential, soil pH, soil moisture, length of storage of manure, method of storage, competition with other soil microbes, and the antibacterial chemicals of the soil. Thompson and Moore (1978) concluded that pathogens in manure are usually retained in the soil but die rapidly.

Most of the organisms that may be contained in the applied manure will be held in the upper few inches of the soil. Coliform organisms were found to be almost completely held in the top two inches; over 90% were retained in the top half-inch (Patton 1978).

In karst areas, such as portions of southeastern Minnesota, the porosity of bedrock can result in greater movement of pathogens. Pathogens will move with the groundwater flow in porous and saturated geologic materials. A survey conducted to determine the presence of health problems in karst areas of other states concluded that although there were potential problems, no documented evidence was available. The few case histories that were documented involved contamination of water supplies of municipal systems or septic tank origins (SIGMA Associates, Inc. 1979). No data were found to indicate problems in karst areas resulting from land application of animal wastes (SIGMA Associates, Inc. 1979).

Moore et al. (1977) concluded that pathogen survival in wastes applied to the soil is short and rarely constitutes a health hazard if proper management practices are used. The practices include: preventing direct surface run-off immediately after waste application, applying wastes to soil surfaces to obtain maximal pathogen reduction from ultraviolet radiation, and allowing a short time for natural reduction of pathogens before grazing or harvesting.

The greatest potential hazard to the community from a swine farm is likely to be direct contamination of water supplies by animal wastes (Leman 1979). If this is controlled, other mechanical vectors of zoonotic disease are very unlikely. The potential for release of stored manure to the environment is discussed in Sections 5.2 and 5.5.

Biological Vectors

Virtually any of the community fauna could serve as a biological transmitter of zoonotic diseases. This possibilty is modified by at least two factors: (1) confined swine have a low likelihood of exposure to the community fauna; therefore, direct transmission to the

fauna is improbable and (2) modern sanitary practices have precluded community exposure to the pathogens of the fauna. Additionally, properly managed carcass disposal by rendering or incineration minimizes biological transmission of disease.

Exposure of birds, insects, or other fauna to the settling and storage basin could be a possible transmission vector. Axtell et al. (1975) studied mosquito production and control in lagoons. They found that at loading rates of 80 cubic feet or less per 180-pound hog, there was little or no mosquito production. This implies that there should be little concern about mosquitoes as disease vectors. The factors controlling mosquito production are organic load, amount of vegetation, and/or floating debris on the lagoon (Axtell 1975). Various insect growth regulators and insecticides were used in experimental lagoons with no reduction in lagoon performance (Axtell 1975). Should insects become a problem, there are available control measures.

Summary

The Penz Farms Company, Darwin Schroder, and Hilltop Park Producers operations would use completely confined, environmentally controlled facilities. This confinement offers two public health advantages. First, it encourages and facilitates good sanitary practices. Rooms and floors are cleanable, which encourages efficient production. Second, confinement buildings assist in separating the swine from the mechanical and biological vectors that might transmit human disease. Small rodents are the only likely disease transmitters that may not be completely controlled. Whereas confinement production methods reduce the potential for zoonotic disease, new risks are created for the pigs; preventive medicine must be intensified because of the density and possibility of epidemics.

Standard management practices as proposed should aid in preventing major disease epidemics. Proposed veterinary consultation will help modify future preventive medicine practices according to the specific needs of the facilities.

The proposed disposal methods for animal carcasses are satisfactory and aid in limiting the spread of disease. If the proposed efficient disposal practices were not observed, carcasses would attract both scavengers and bacterial decayers and would constitute a public health hazard. Nearly all of the wastes would be stored for several months prior to soil application. This period of anaerobic storage would kill most potential pathogens (ERT 1979b). Manure application to fields producing row crops provides another buffer to the spread of zoonotic disease. Humans would not directly consume the row crops grown in these fields. The possibility of direct contamination of human food crop is increased by the Penz Farms Company proposal to spray wastes onto fields. This potential problem is ameliorated, however, by the increased ultraviolet radiation destruction of the pathogens.

Numerous pathogens and toxins are capable of causing disease in both swine and humans. If diseases of swine pose any threat to humans, it is most likely to be to their handlers and caretakers. Because these people are known to be normal and healthy, the zoonotic disease transmission potential from swine to humans is probably low (Leman 1979).

For pathogens or toxins from the swine to cause human disease in the community surrounding the proposed farms, there would need to be unusual circumstances, poor sanitary practices, or some highly improbable mechanical or biological vector.

If there is a complete breakdown of modern sanitary practices at these facilities (assuming accident release of stored manure as discussed in ERT 1979a and 1979f), the only possible risks to the surrounding community are leptospirosis, salmonellosis, and ascarid eggs. Other public health hazards discussed are either too uncommon to occur or would not reach the human population with a sufficient dose to be infective. The "worst possible situation," therefore, would be that the fauna of the community would have endemic leptospirosis and salmonellosis of swine origin, and the soil on

community farmland would contain swine ascarid eggs. Normal community health standards and practices would have to break down before these conditions could occur in humans.

5.3.3 Feed Additive Residue Impacts

This section assesses the potential impacts of additives proposed for use by the applicants. Deworming drugs would be used infrequently and in small amounts, hormones and copper would not be used at all, and pesticides for external parasite control would be used infrequently and in small amounts. Since Malathion, a pesticide recommended for parasite control (AES undated), is considered nonpersistent and has a half-life of less than two weeks, it will not cause adverse environmental effects subsequent to land application of the manure (Hague and Freed 1975). For these reasons, the remainder of the section will address health and environmental impacts caused by penicillin, Tylan, tetracycline, and sulfamethazine.

Some degree of excretion in either urine or feces of swine has been observed with all four antibacterials (ERT 1979b). The amount of activity contained in these residues varies, however. Although the residues have been shown to reduce rates of organic matter biodegredation, no complete inhibition of biological processes resulting from the presence of these residues has been documented. The impact on the soil subsequent to manure application would be minimal. Although three of the four antibacterials are found naturally in soils, residues do not have the competitive advantage held by the organisms present in the soil, and especially of the native microorganisms that produce antibiotics.

The soil microflora is specifically adapted to its environment, whereas residues introduced by land application of manures are at a disadvantage; they are thrown into a "foreign" environment. In addition to microbiological competition, residues are exposed to and may be inactivated by chemical reactions or physical absorption in the soil.

Patton (1978), after a review of feed additive environmental effects, stated: "No evidence could be found in the literature of the past 25 years that the use of penicillin in food-producing animals has caused adverse effects to the environment due to the recycling or land application of waste products from these medicated animals."

The health and environmental impacts resulting from the use of penicillin, tetracyclines, sulfamethazine, and tylosin are summarized in Table 5.3-1 and 5.3-2.

The greatest impact resulting from the use of antibacterials is the frequent formation of multiple drug-resistant organisms. Drug resistant pathogens can cause severe problems in both humans and animals because some antibacterials will not be effective against the resistant organisms. Limiting the use of antibacterials, especially penicillin and tetracyclines, in animal feeds as has been proposed by the FDA would greatly reduce the drug-resistant population and allow the antibacterials to fulfill their primary function, that is, controlling bacterial infections in both humans and other animals.

5.3.4 Health Effects Related to Odorous and Nonodorous Compounds

The carbon dioxide concentration in a ventilated swine confinement building averages about 0.06% to 0.07% (Midwest Plan Service 1975). The levels will rise fairly rapidly without proper ventilation. A concentration of 25% carbon dioxide can cause human death after a few hours. Pigs will become dizzy and possibly unconscious above 10%; adults exposed to 20% will recover if clean air is returned (Midwest Plan Service 1975).

Concentrations of ammonia as low as 1 ppm can be noticed. Dangerous levels, for example, 0.5% (5,000 ppm), may cause suffocation in humans (Midwest Plan Service 1975). Ammonia is an irritant to animals; long periods of exposure may result in respiratory diseases.

Hydrogen sulfide is the most toxic of the relevant odorous compounds. The gas is formed under anaerobic conditions; when wastes are aerated the gas is released. Low concentrations are a severe

TABLE 5.3-1

CHARACTERISTICS OF PROPOSED ANTIBACTERIALS

Drug	Percentage of Swine Oral Dose Excreted As Active Compound	Resistant Bacteria Excreted	Environmental Half-Life (days)	Soil Mobility	Bioaccumulation Potential	Inhibition of Soil and Fecal Bacteria
Chlortetracycline	40-50	frequently	>20	Adsorbed and released in bioactive form from most soils.	High for bones; moderate for plants	Yes, persists < year
Procaine Penicillin	20	very frequently	<7*	Not adsorbed freely, mobile.	Unlikely	Possible, not demonstrated.
Sulfamethazine	75	frequently	<20	Adsorbed and released in bioactive form from most soils.*	Short-term possible; long-term unlikely	Possible, not demonstrated
Tylosin	29-67	frequently	?	Adsorbed strongly to only some soils.	?	Possible, not demonstrated.

Source: FDA 1978.

*Based on indirect physical and chemical data.

TABLE 5.3-2

TOXICITIES OF PROPOSED ANTIBACTERIALS

Drug	Algae And Phytotoxicity	Fish Toxicity	Mammalian, Avian Toxicity	Selection for Drug-Resistant, Nonenteric Bacteria
Chlortetracycline	Not enough data, unlikely	Highly unlikely	Highly unlikely	Possible, not demonstrated.
Procaine Penicillin	Not enough data, unlikely	Not enough data	Highly unlikely	Possible, not demonstrated.
Sulfamethazine	Highly unlikely	Highly unlikely	Highly unlikely	Possible, not demonstrated.
Tylosin	Highly unlikely	Not enough data	Highly unlikely	Possible, not demonstrated.

Source: FDA 1978

irritant to humans. The odor does not increase proportionally with the concentration and is not an adequate warning of potential asphyxiation. Levels of 1,000 ppm can cause death through asphyxiation (Midwest Plan Service 1975). High concentrations can also cause animal death by asphyxiation. As discussed in Section 5.1, hydrogen sulfides levels in the community surrounding the proposed operations would be well below levels causing irritation or deleterious health-related effects, even under worst-case conditions.

Methane is not considered toxic, but is explosive at concentrations of 5% (Midwest Plan Service 1975).

Harmful or lethal concentrations of carbon dioxide, ammonia, and methane gases would not occur in the communities surrounding the proposed facilities. Within the swine confinement facilities, harmful or lethal doses would only occur as a result of ventilation failure or vigorous agitation of stored manure (Midwest Plan Service 1975).

5.4 Socioeconomics

5.4.1 Impacts During Construction

The primary impacts of the construction phase would be on employment and income for local merchants and vendors. The three projects would employ approximately 25 construction workers for a period of 5 to 5-1/2 months. The total construction payroll is estimated at $200,000 (ERT 1979c). Since all three operators anticipate using local construction labor, it is likely that this money would be used to purchase goods and services in the immediate area. The local economy would also receive part of the $2.3 million spent on other construction costs. Local building materials suppliers and local building craftsmen would be used when possible.

There would not be any construction-related impacts on population, community facilities, or other parts of the local economy. Construction activities would not stimulate an influx of nonlocal workers because local labor should be adequate for the job. Although areas immediately adjacent to the construction site may experience noise and/or traffic impacts, these would be short term and would only temporarily affect the value of adjacent property. The road system is the only community facility directly involved, and there should be no difficulty in accommodating the traffic associated with the construction activity (see Section 5.6). Finally, the construction phase of these projects should in no way impair the operation of other farm activities in the area.

5.4.2 Impacts During Operation

This discussion of operational phase impacts focuses on four issues: (1) the effect of the proposed facilities on family farming, (2) changes in property values attributable to odors, (3) increases in local employment and income, and (4) increases in tax revenues. The facilities do not appear to affect other socioeconomic factors. There would be no major influx of nonlocal workers, the local population

would not be increased, nor would the demographic profile of the area change. The communities where the facilities would be located would remain stable, homogeneous, and predominantly agricultural. In addition, there should be no change in property taxes associated with these facilities since they would not require any additional services.

Effect on Family Farms

Some residents of the region where the confined swine facilities would be located have expressed concern that these operations represent a threat to family farming in the area. This sentiment is a reaction to certain changes in the basic structure and techniques of American farming. Nationally, the number of farms has decreased, while the size and degree of specialization has increased. The family farm issue involves three specific considerations: (1) the type of organization, (2) the possible competitive advantage of a large swine producer, and (3) the proliferation of similar large-scale facilities in the area.

It is generally believed that the organizational characteristics of a farming operation can affect the social and cultural values of the community. The concept of the independent family farm, with its emphasis on simple sole proprietorship, is strongly identified with traditional American values. In contrast, corporate farming has been viewed by some as a negative influence that causes a decrease in the number of farms, the decline of the small town, the entry of nonfarm capital into the agricultural sectors, and a shift of farm management decision-making to nonfarmers (Hail 1970). However, it is increasingly evident that a corporate structure has distinct legal, estate, and tax advantages for all types of farms.

As Table 5.4-1 shows, only a few farms in the counties where the proposed facilities would be located have been incorporated, and the majority of those are still defined as family farms. There has been some recent increase in the number of farm corporations, but they still represent a very small percentage of total farms in the area.

TABLE 5.4-1

NUMBER AND TYPE OF CORPORATE FARMS BY COUNTY (1975-1977)

Source	Olmsted		Goodhue		Wabasha	
	1975	1977	1975	1977	1975	1977
Minnesota Corporations						
Domestic Family Farm	4	11	7	11	6	13
Domestic Authorized Farm	2	3	0	0	3	3

Source: Minnesota Department of Agriculture 1976, 1977, 1978.

Penz Farms Company and Darwin Schroeder meet the state qualifications for incorporation as a domestic family farm, and both are currently incorporated as such. Hilltop Pork Producers is not now incorporated; however, the applicant, Mr. Donald Kunde, indicated that if he decides to incorporate, he would attempt to do so as a domestic family farm. Since these operations are in accordance with the state law designed to protect family farming, their method of organization should not be considered a danger to family farming in the area.

There is also a fear that the proposed operations would economically undermine family farming in the area because of the competitive advantage of the larger producers. This advantage could develop from two factors: lower costs of production and dominance of the hog market in the region.

There is a significant difference in the costs of hog production for different sizes of operations (ERT 1979c). Lower labor unit costs, year-round use, economies of scale, and better management reduce the overall cost of these enterprises. The primary competitive advantage of these lower costs results from the ability of large producers to survive changing economic conditions better than more marginal operations.

There is no doubt that the proposed swine operations are larger than most others in the area. Penz Farms Company and Darwin Schroeder each plan a maximum inventory of 4,185 hogs and pigs, while Hilltop Pork Producers would have a maximum inventory of 4,275 hogs and pigs. In contrast, over 50% of the hog producing farms in each county had between 25 and 100 pigs in 1974, and a very small percentage produced over 500 market hogs per year (ERT 1979c).

It is not presently possible to accurately predict the actual difference in hog production costs among Penz Company Farms, Darwin Schroeder, and Hilltop Pork Producers and other hog producers in the area. If other producers skillfully use their capital, labor, and other resources, the difference in production costs would not be as great. However, it is reasonable to assume that in certain situations the proposed operations could be more competitive than others.

Despite their potential for achieving economies of scale, it is unlikely that the three farms would have a major economic impact on the hog market in the area. Because there are many other factors that influence pricing and marketing, such as long-term economic trends, seasonal variations, and product quality (Williams and Clover 1978), these operations would affect area market conditions for swine only insofar as they relate to total hog production and the hog slaughtering capacity available. These factors would not be influenced by the proposed facilities.

The planned combined hog production of these facilities would be a small percentage of the area's current swine production. These three producers plan to market approximately 25,300 hogs annually (Penz - 8,300; Schroeder - 8,300; and Hilltop - 8,700). This total is approximately 10% of the 1977 swine production in the three counties and 2.7% of the 1977 pig crop in the Southeast District (ERT 1979c). The operators have stated their intentions to try to market their hogs directly to the two largest meat packing plants in Minnesota (George A. Hormel Company at Austin and Wilson Foods Corporation at Albert Lea). These plants buy hogs from all over the southern part of the state. A spokesman for the Hormel plant states that his facility requires 1.50 to 1.75 million hogs a year to operate and that handling part of the increased hog production associated with these proposals would not be a problem (Kingston 1979).

The proposed action may contribute to the proliferation of similar large-scale facilities in the area in that others may want to follow their example. However, it is clear that this would be only one of a number of factors affecting the future of livestock operations in the area.

There is clearly a trend toward larger farming operations in this country (U.S. General Accounting Office 1978). This trend appears to be an inevitable consequence of both internal and external features of the agricultural economy in the United States. The techniques of farming, skills of farmers and the kind and source of resources used in farming have changed radically over the last 100 years, changing the structure of American farming. In addition, farming has become

more sensitive to developments in the nonfarm economy: the scarcity and rising prices of its industrial input materials, land price inflation and rising taxes, and changing government policy. Changes in farm size and structure in any area are likely to continue to be stimulated by these factors and not simply by the entry of large-scale operations into an area (Hail 1970).

If other large hog producers were to develop in this area, the total hog production would rise. However, it is still unlikely that the overall hog market would be significantly affected owing to the large capacity of meat packing plants in the area and current concern about shortages.

Effect on Employment and Income

The three operations would employ 13 farm workers (Penz Farms Company: average 7; Darwin Schroeder: 3 fulltime; Hilltop Pork Producers: 2 full-time and 1 part-time). The combined annual payroll would be approximately $149,000, or an average of $11,462 per employee. The farm workers would be local residents.

Effects on Property Values

The property within a 3-mile radius of the proposed confined swine facilities is devoted to a combination of farming and farm residential uses. The value of these different types of properties is based on different factors. Agricultural land value depends on its ability to support agricultural activity, the distance to market, and the market price for the agricultural products. The value of the residential properties is determined partly by their association with the agricultural land, but also by their attractiveness as a residential location.

Any changes in property values would be caused by the effect of the odor produced by the confined swine facilities and associated activities. Since these operations would not interfere with any of

the factors that contribute to the value of the adjacent agricultural land, it is highly unlikely that these values would be affected. However, it is possible that the value of the farm residences that abut the site boundaries or are within the proximity could decline. (The likelihood of such an occurrence would also depend on the availability of more attractive farm residence-agricultural land packages in the area.) Still, such impacts are likely to diminish rapidly with increased distance from the site.

Effect on Property Tax Revenues

The property tax revenue attributed to the proposed facilities sites are expected to increase substantially in value while other project site components are not. During the first two years of operations, Olmsted County would receive an additional $33,968 a year, and Goodhue County would receive an extra $17,832 (ERT 1979c). After that time, the property would be depreciated at a rate of 2.5% a year (Coons 1979; Rapp 1979). Over the 25-year economic life of the projects, the additional tax revenues would vary according to changes in local tax rates as well as the depreciation.

5.5 Geology and Hydrology

5.5.1 Impacts During Construction

Geology and hydrology related impacts during the construction phase would be limited to possible effects on soil erosion. Construction activities would involve excavation and other disturbance of soils. Existing slopes on the Penz Farms Company and Darwin Schroeder facilities sites range from 0% to 2%. Such slopes are sufficiently low to preclude significantly increased soil erosion rates during constructon. Existing slopes at the Hilltop Pork Producers facilities site range up to approximately 10%. Disturbance of such slopes during excavation and construction would result in a significant increase in soil erosion rates. No measures to prevent or control soil erosion during construction have been proposed.

5.5.2 Impacts During Operation

Potential geology and hydrology related environmental effects associated with the proposed action are related to the chemical and physical properties of soils present on manure application parcels and the potential for sinkhole development at the proposed facilities sites.

Soils

The proposed action would not significantly affect soil erosion rates on manure application parcels as existing farming practices would continue unchanged. No adverse effects on the chemical properties of soils are anticipated as a result of land application of manure. Soil fertility, infiltration capacity, and water-holding capacity may be improved by the addition of organic matter.

Penz Farms Company, Darwin Schroeder, and Hilltop Pork Producers would apply manure on silt loam soils. Swine manure applications would be at nitrogen-based agronomic rates that have been documented

as having no detrimental long-term effects on soils (Sutton et al. 1978). Nitrogen loadings have been identified by the applicants to be 175 to 200 pounds per acre (lb/acre), 200 lb/acre, and 143 lb/acre, respectively, for the Penz Farms Company, Darwin Schroeder, and Hilltop Pork Producers operations. These rates represent the optimum amount of nitrogen required for crops such as corn and grains (Martin, Leonard, and Stamp 1976). A slow buildup of soil nitrogen reserves is expected from long-term annual manure applications (Russell 1973). This cumulative effect occurs because all of the nitrogen in manure is not mineralized the first year. For example, it has been estimated that a manure application rate that releases 100 lb/acre of nitrogen the first year will supply approximately 200 lb/acre after 20 years of continuous application at the same rate (Olsen and Barber 1977).

Owing to cumulative effects, the nitrogen loading requirement would decrease after the first year. Estimated total nitrogen in manure applications during the first five years are shown in Table 5.5-1. Nitrogen mineralization is variable depending upon climatic and soil conditions. Thus, nitrogen levels in soils must be periodically tested during long-term manure applications.

Silt loam soils at the manure application sites have medium levels of available phosphorous and low levels of potassium (USDA SCS 1976). Phosphorous and potassium levels in the applied swine manure are not expected to have short-term adverse effects on soils. However, it is assumed that a slow builup of phosphorous and potassium would occur in the soils with manure application rates based solely on nitrogen requirements. Proposed manure applications based on nitrogen loadings provide greater phosphorous and potassium than required for plant growth. For example, Penz Farms Company presently applies chemical fertilizer at 60/lb/acre phosphorous and 200 lb/acre potassium. Proposed manure application based on agronomic nitrogen loadings would supply 138/lbs/acre phosphorous and 341 lbs/acre potassium on Penz Farms Company parcels A and B (Table 5.5-2). Similar excess phosphorous and potassium loadings would occur on the other parcels (Table 5.5-2). These excess loadings are not projected

TABLE 5.5-1

NITROGEN LOADING RATES NECESSARY
TO MAINTAIN CORN YIELDS
(pounds per acre)

	Crop Requirement Available Nitrogen	1st Year Total Nitrogen	2 to 5 Years Rate Total Nitrogen*
Penz Farms Company			
Parcel A and B	175	307	190 to 200
Parcel F	175	368	160 to 210
Darwin Schroeder	230	323	250 to 260
Hilltop Pork Producers	165	232	175 to 200

Source: Sutton et al. undated.

*Based on residual organic nitrogen release ratio of 0.5, 0.35, 0.1, 0.05, for years 2 to 5, respectively.

TABLE 5.5-2

PHOSPHORUS AND POTASSIUM LEVELS ASSOCIATED
WITH NITROGEN LOADING RATES
(pounds per acre)

Project	Total Nitrogen*	Phosphorous	Potassium
Penz Farms Company			
Parcels A and B	195	138	341
Parcel F	205	80	200
Darwin Schroeder	250	205	500
Hilltop Pork Producers	175	123	210

*Based on an average total nitrogen requirement for the second through through fifth years of application.

to adversely effect soils or crops. Yearly applications of beef-feedlot manure that supplied 294-691/lb/acre/year phosphorous and 237-558 lb/acre/year potassium produced near maximum forage yields without adverse accumulations in the soil (Powers, Wallingford, and Murphy 1975). Accumulation of phosphorous and potassium were found no deeper than 1 to 1.5 feet in the silty clay loam soil. Silt loam soils at the project sites have a high capacity to absorb phosphorous and potassium so that monitoring of build-up in the surface soil would be required during long-term applications.

In general, additions of organic matter should improve soil fertility at the application sites. Organic matter has a cation-adsorption capacity 2 to 30 times as great as mineral colloids (Buckman and Brady 1969); therefore, the supply and availability of nutrients should be improved by manure application.

Injection and spraying of liquid manures will enhance the stability of soil structure, which will promote infiltration of water and adequate aeration for plant roots. Minnesota prairie soils have naturally high levels of organic matter; however, the addition of organic matter from manure can be beneficial in areas under long-term cultivation.

Hydrology

The proposed groundwater usage associated with operation of the confined swine facilities is predicted to have no adverse effects on local or regional groundwater supply. Each facilities site is underlain by aquifer systems capable of supplying large quantities of groundwater to wells without adversely affecting local or regional well yields (USGS 1974, 1975a, 1975b).

All three proposed facilities sites are underlain, at various depths, by carbonate rocks. The sinkhole potential and the susceptibility to groundwater contamination of each site are related to the thickness and type of geologic materials overlying these carbonate formations.

Major concentrations of sinkholes and other surface karst features in the study area occur in areas of thin or nonexistent unconsolidated surficial deposits. On the basis of site-specific, shallow soil borings and deep test holes in the vicinity of each project, the sinkhole potential at the Penz Farms Company and Darwin Schroeder facilities sites is considered low. A minimum thickness of 20 to 28 feet of fine-grained loess and till overlies dolomite and limestone (Galena Formation) at the Penz Farms Company facilities site. An estimated thickness of 40 to 55 feet of loess and glacial till and an unknown thickness of sandstone (St. Peter Sandstone Formation) overlies dolomite (Shakopee Formation) at the Darwin Schroeder site. Additionally, the high water present at each of these sites indicates that rapid groundwater movement (which is characteristic of karst areas) probably does not occur.

Soil borings have not been conducted on the proposed Hilltop Pork Producers facilities site. Regional data suggest that the Galena Formation is between 15 and 30 feet below the land surface. Although no surface karst features are known to exist at the facilities site, borings would be required to adequately determine the potential for sinkhole development. However, the probability of karst-related land subsidence of sufficient magnitude to threaten the structural integrity of the proposed storage tanks is considered low.

5.6 Land Use

5.6.1 Land Use Control Consistency

Both the Penz Farms Company and Darwin Schroeder proposals have been judged to be in compliance with county and local plans and ordinances (ERT 1979d). The proposed residence associated with the Hilltop Pork Producers proposal would not comply with Section IV A-1(A)b and other sections of the Goodhue County Zoning Ordinance, which require that a farm dwelling within an agricultural district be associated with a minimum 40-acre farm unit (ERT 1979d). The Hilltop Pork Producers proposal is presently for a 5-acre confined swine facilities, which the Goodhue County Zoning Administrator considers to be other than a bona fide "farm unit" as defined in the ordinance. Therefore, the Hilltop Pork Producers proposal would require a Conditional Use Permit under Section IV B-1(A)a of the ordinance and/or redefinition of the parcel associated with the confined swine facilities to at least the required minimum 40-acre farm unit parcel size. The proposed confined swine facilities and manure application activities are in compliance with the agricultural uses permitted under the Goodhue Zoning Ordinance.

5.6.2 Compatibility with Adjacent Land Uses

The proposed confined swine facilities are considered an agricultural activity that would be consistent with the prevailing agricultural land use in the area. Concentrated animal feeding operations are quite common in Olmsted County. As of March 1978, several hundred concentrated feedlots of 30 or more animals were in operation in Olmsted County and over 140 were within the project region for the Penz Farms Company and Darwin Schroeder proposals. The general appearance and physical characteristics of the proposed confined swine facilities would be similar to these existing feedlot operations, although the scale of operations is larger.

Since there is no conflict of type of land use, the issue of compatibility of the proposed operations with adjacent activities depends on whether or not the proposed operations create a nuisance.

Briefly, two of the key factors considered in a legal determination of nuisance related to feedlots are the nature of the locality (rural or residential) and the manner in which the business is conducted. Technically, these proposed operations are compatible in an agricultural area. For a detailed analysis of the nuisance issue and noxious odor impacts, see Sections 4.1 and 5.1.

5.6.3 Transportation

All of the proposed facilities will be accessed from existing county roads and highways. Average daily traffic on the existing road networks surrounding all three proposals is currently low (see Figures 4.6-7 and 4.6-8). The road network should adequately accommodate the additional traffic that would be generated. No significant transportation impacts are expected either during construction or operation.

For each proposal, excavation and grading of the entrance roads and sites would require that a bulldozer and backhoe be transported to and from the site over two weeks of construction. At the Darwin Schroeder site, an additional 9,000 cubic yards of fill would be transported to the site, and debris would be disposed of offsite. Because cut and fill would originate and be disposed of onsite for the Penz Farms Company and Hilltop Pork Producers construction, no transportation is required. Most construction materials, equipment, and supplies would be delivered in approximately 20 loads over the five-month construction period for the Penz Farms Company and Darwin Schroeder (similar information is not available for Hilltop Pork Producers). The average number of worker vehicle trips per day for each site is relatively small (Penz Farms Company - 8; Darwin Schroeder - 6; Hilltop Pork Producers - 4 to 10).

Operational Period

The transportation activities associated with all three proposals involve several major categories of vehicular transportation on public roads to and from the facilities.

- Delivery of initial swine stock to the facilities.
- Delivery of additional swine stock during operation.
- Delivery of animal feed throughout operation.
- Worker transportation throughout operation.
- Transfer of animal wastes from facilities site to manure application parcels.
- Removal of mature animals for delivery to packing plant throughout operation.
- Removal of dead animals throughout operation.

Transportation characteristics of each proposal vary. The condition and capacity of existing road networks are adequate to accommodate the increased traffic associated with the proposed actions. Therefore, no impact to the transportation network is expected.

The initial swine breeding stock would be delivered to each proposed operation by truck and would require several trips. Once the initial breeding stock is in place, Darwin Schroeder would require an additional one or two pick-up loads (5 swine each), and Hilltop Pork Producers would need one more truckload (12 swine) each year. At the Penz Farms Company, all breeding swine would be from the existing stock.

Animal feed and feed supplement would be provided primarily by local sources and delivered to each operation by truck. The Penz Farms Company would require three truckloads a week. Darwin Schroeder would transport corn grown near the site as harvested and would need one truckload a week of feed supplement from Elgin. All feed for Hilltop Pork Producers would be delivered by truck requiring 1.5 semi-truck and trailer deliveries per week.

Animal wastes from the Darwin Schroeder and Hilltop Pork Producers operations would be transported from the facilities site to the manure application parcels twice a year, once in the spring and once in the fall. Darwin Schroeder would use a tractor pulling a 3,000-gallon slurry wagon, which would make 16 to 30 trips a day for 10 to 20 days (300 total trips a season or 600 total trips per year). The trips would be 0.1 to 1.8 miles long and would use county roads

immediately south and east of the site. Hilltop Pork Producers would deliver 300 loads a season or 600 loads per year, transported in leak-proof containers mounted on trucks or wheeled behind trucks. Manure application on parcel A would not require any use of public roads. The other deliveries would require trips ranging from 1.5 to 2.8 miles and would use roads north and east of the facilities site. The Penz Farms Company would be making deliveries to parcels C, D, G, and F, which are all less than 1 mile from the facilities site along 80th Avenue Northeast. (Application to other parcels would not require use of public roads.)

Penz Farms Company and Darwin Schroeder plan to transport one truckload of approximately 160 animals per week to local packing plants. The Hilltop Pork Producers expect to transport three truckloads per week. Dead animals would be incinerated on site at Penz Farms Company and Hilltop Pork Producers; Darwin Schroeder would have them picked up by a local rendering service as needed.

5.6.4 Cultural Resources

The only property within the study area that is listed in the National Register of Historic Places (Minnesota Historical Society 1979) is the Dr. Just Christian Gronvold Estate in Section 19, Wanamingo Township, within the Hilltop Pork Producers project region. It is approximately 3 miles southeast of the facilities site and approximately 1.5 miles west of parcel F. Because of its distance from the facilities site and the manure application parcels, no impact is anticipated either during construction or operation.

Two properties, the German Lutheran Church and Cemetery, and the Siem Homestead, both near Potsdam, Farmington Township, are listed on the Minnesota Inventory of Historic Places (Minnesota Historical Society 1979). The closest proposed facility is the Darwin Schroeder site, approximately 3.5 miles southeast. Because of their distance from the Darwin Schroeder proposed facilities, no impact is anticipated either during construction or operation.

Several properties near the Hilltop Pork Producers manure application parcels are included (but not designated) as "Inventory Sites" on the current Minnesota Historic Places Survey (Minnesota Historical Society 1979). While they now have no official designation as historic sites, they are recognized as potential historic resources because they may be subsequently added to either the State Historic Sites Registry or the National Register of Historic Places. Those properties within available manure application parcels are:

- Parcel B - Edisvold Church (3) and
- Parcel F - Wanamingo Town Hall - Aspelund (12)
  - Farmhouse (13)

The number in parenthesis refers to their listing in Table 4.6-2. In addition, two properties are adjacent to parcel C and five properties are adjacent to parcel F. Manure application activity would occur only on cropland within the parcels and would be excluded from the residence sites. Therefore, no direct impact is anticipated during manure application operations. However, should odor be apparent, indirect impacts of a nuisance character could result. For a full discussion of potential odor impacts, see Section 5.1.

Finally, although no archeological resources are known to exist on or adjacent to any of the manure application parcels, there may be undiscovered evidence of prehistoric habitations on or near them (Howard 1979). Without a field examination or systematic survey by a professional archeologist, the existence of such cultural resources and potential impacts to them cannot be ascertained.

5.6.5 Impacts on Visual Aesthetic Character

Figures 5.6-1 and 5.6-2 show the general land areas from which the proposed facilities would be visible (viewsheds) within a 3-mile radius. The facilities would not be visible from the remainder of the study area because of the screening effects of topography and vegetation.

PENZ FARMS COMPANY

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

LEGEND

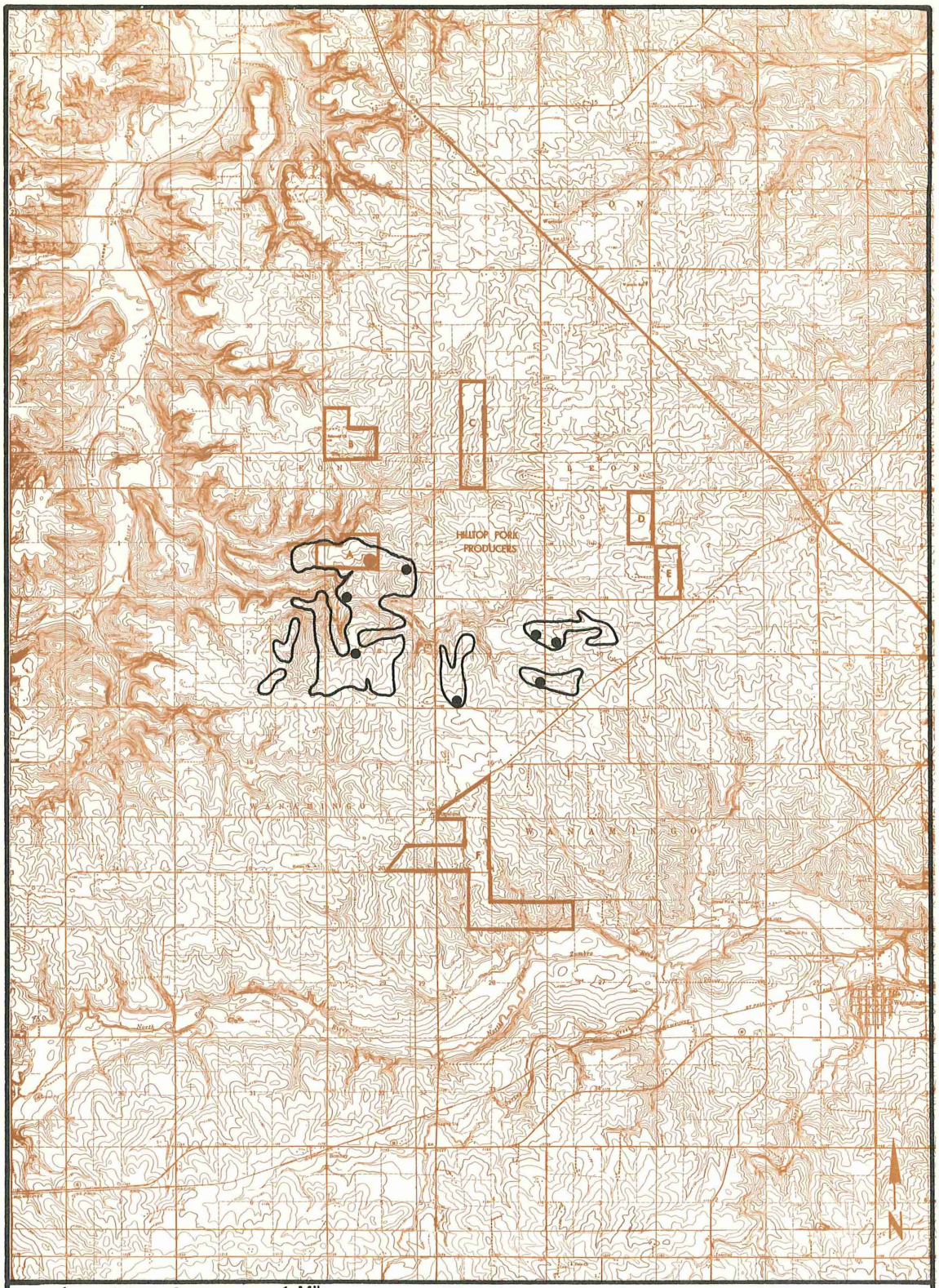
Generalized Viewshed

Residences within Viewshed

Contour Interval 20 Feet

Figure 5.6-1
Olmsted County Viewshed

556-2 7904092 7904148



1 0.5 0 1 Mile

HILLTOP PORK PRODUCERS

MINNESOTA POLLUTION CONTROL AGENCY
RELATED ACTIONS EIS ON
CONFINED SWINE FACILITIES

LEGEND

- Generalized Viewshed
- Residences within Viewshed

Contour Interval 10 Feet

Figure 5.6-2
Goodhue County Viewshed

469-4 7904109 7904146

Within the viewshed of each site, the facilities would appear similar to surrounding farm structures. From beyond 0.5 miles, the facilities would be visually perceptible by their mass and horizontal form.

The Darwin Schroeder facilities, while having a larger viewshed than either the Penz Farms Company or the Hilltop Pork Producers facilities, would be immediately adjacent to visually similar development. The Penz Farms Company and Hilltop Pork Producers, conversely, would be freestanding structures on sites where there are now no similar facilities immediately adjacent and, thus, would be more noticeable.

The residences within each viewshed are locations that would be potentially visually affected (Figures 5.6-1 and 5.6-2). There are 13 residences within the Penz Farms Company viewshed, 22 within the Darwin Schroeder viewshed, and 7 within the Hilltop Pork Producers viewshed. The nearest residence to the Penz Farms Company and Darwin Schroeder is at least 0.5 miles away. Two residences are within 0.5 miles of the Hilltop Pork Producers site.

Because of the small viewsheds, the relative absence of viewers within 0.5 miles of each, and the familiar and nondescript visual character of the proposed facilities, significant visual impact is not anticipated.

5.7 Ecology

5.7.1 Impacts During Construction

Terrestrial Ecology

The impact of construction on the terrestrial environment is not expected to be significant. The primary effect will be minimal losses of vegetative and wildlife habitat. This habitat is predominantly agricultural, interspersed with small areas of grasses and shrubs or shelterbelts. Wildlife species associated with these areas that may be disturbed by construction activity include those avian and mammalian species that use the vegetative matter onsite for food or shelter.

Approximately 14 acres of land will be cleared for construction of the confined swine buildings and manure storage facilities. At present, this land is primarily used for straight-row corn and hay production. After construction, these areas will no longer be suitable for crops. This will constitute a maximum loss of production of approximately 1,900 bushels of corn and 4 tons of hay annually. This is a minor loss relative to the large amounts of corn and hay produced in the study area.

Small areas of natural vegetation may also be eliminated by construction activities. However, on many of these areas as well as on other unused portions on the facilities sites, vegetation will be allowed to regenerate. Plant development in the regenerated communities may be limited by soil compaction. Compaction caused by heavy construction equipment can affect the soil moisture regime, soil aeration, and root penetrability. This may alter the original species composition of the plant communities, and exposed soil surfaces may permit the invasion of weeds. No wetlands will be affected by construction activities.

The clearing of vegetation on the facilities sites constitutes a loss of wildlife habitat. This loss is not considered to be of major significance because of the following factors.

- The land to be developed is primarily agricultural, and, therefore, does not offer a unique or high quality habitat for wildlife.
- Human activity is already evident on the sites, thus species requiring an undisturbed environment probably do not currently nest on or frequent the sites.
- The parcels of land to be developed are small and dispersed throughout a three-county area.
- Those species that prefer edge habitat may benefit from the regeneration of vegetation on site.

Construction activities will cause some losses of wildlife, particularly the smaller, slower moving species. These animals may be lost during clearing activities or as a result of increased construction traffic. Additional noise and human activity may also cause temporary avoidance by some wildlife of the facilities sites and surrounding area. These animals are expected to return to the area once construction activity has ceased.

Aquatic Ecology

No significant impacts on aquatic environments are expected to result from construction of the three confined swine and waste facilities. No aquatic habitats would be directly affected by site development. Siltation to streams could increase if a period of heavy rainfall follows the removal of vegetation from the facilities sites. A potential temporary increase in erosion is expected to have little effect on species abundance or diversity.

Rare, Endangered, or Threatened Species

No major impacts on rare, endangered, or threatened species of flora or fauna are expected to result from construction of the proposed facilities. Some species under special consideration by the MDNR that may occur on or near the facilities sites, such as the bobwhite quail, marsh hawk, or Cooper's hawk, are expected to avoid

the areas during construction. The loss of foraging habitat for these animals from elimination of less than 14 acres of agricultural fields is insignificant.

5.7.2 Impacts During Operation

Terrestrial Ecology

The application of swine manure to approximately 1,230 acres of agricultural land is not expected to have a significant impact on the terrestrial environment of the project sites or study area. The manure should improve soil quality and may cause earlier germination of crops. This would also result in a small increase in the habitat value of the fields for wildlife.

Proposed nutrient loadings to be used by the Penz Farms Company, Darwin Schroeder, and Hilltop Pork Producers operations will approximate those currently applied to the manure application parcels. These nutrient levels have been found to be sufficient for crops grown on silt loam soils without causing a buildup of nutrients or salts. Thus crop production is not expected to differ significantly from current levels.

Incorporation of swine manure will maintain or improve the present soil fertility. Since organic matter has a cation-adsorption capacity that is higher than that for mineral colloids (Buckman and Brady 1979), nutrients are maintained in greater supply for plants. Manure also increases the moisture-retaining capacity of the soils (McIntosh and Varney 1972). Thus in combination with the increase in soil temperature and aeration, organic matter can result in earlier germination and root development of plants (Lund 1978). In addition, organic matter improves soils structure for root growth throughout the growing season.

The application of manure to the proposed land parcels should not have any impact on wetlands as no wetland habitats are known to occur on the sites. The application of manure to agricultural fields is not expected to have a major impact on the wildlife of the study area. If

the manure increases site productivity or promotes earlier crop germination, then wildlife could potentially benefit from the additional food resource.

The possibility of swine disease transmission by resident wildlife and the impact of infestation on wildlife species in the project regions are discussed in Section 5.3. Wild animals are natural hosts for several diseases that infect swine, such as leptospirosis, hydatid disease, and rotavirus, but contraction of swine disease by wildlife as a result of the proposed activities is unlikely. Confinement of swine and incineration of animal carcasses will limit direct contact between wildlife and diseased swine. Infection of animals through contact with the applied manure is possible; however, this is not considered to be a major disease vector. Although the survival of pathogens in swine wastes has not been sufficiently investigated, duration of survival is expected to be short-term (see Section 5.3).

Aquatic Ecology

Significant effects on the aquatic environment from the proposed operational activities are not anticipated. Nutrient and solids run-off to streams will not increase over present rates. Run-off from manure application parcels is not expected to have an impact on fish or other aquatic species.

The proposed land parcels are located along intermittent streams with no fish value or at the head-waters of larger streams inhabited by fish tolerant of silty waters and organic matter. Direct surface run-off to these streams will be controlled under the proposed activities. At times of heavy rainfall, nutrient loads in the run-off will be greatly diluted by rainwater. These nutrients must travel a considerable distance downstream before reaching a stream area with game fish value. For the North Fork of the Whitewater River (the only designated trout stream in the study area), this distance is over 16 miles from the nearest proposed manure application parcel. This distance allows further dilution of nutrient concentration and some

transformation of nitrates and deposition of solids. Thus the impact of run-off from the manure application parcels on sensitive fish species should be minimal.

Rare, Endangered, or Threatened Species

No impacts on rare, endangered, or threatened species of flora or fauna are expected to result from the proposed manure application activities.

5.8 Noise

To determine the noise impacts associated with the construction and operation of the proposed facilities, the following three steps were followed.

(1) Noise sources for the construction and operational phases of the proposed facilities were identified.
(2) Sources were then modeled to predict future noise levels at various noise receptor distances from the facilities.
(3) Resulting noise levels with the project were compared with standards and with baseline conditions to assess the extent of noise impact.

5.8.1 Noise Sources

Each of the project's facilities would consist of one-story wood-frame buildings for breeding and gestation, farrowing and nursery, and finishing. The buildings would be constructed on concrete slabs. Estimated quantities and scheduling of significant pieces of construction equipment and operations are shown in Table 5.8-1. Construction activities would be confined to daylight hours for a total period of approximately five months. No pile driving or blasting would be required to construct the facilities.

Sources of noise during the operation period would consist of building ventilation fans and transportation equipment (trucks and tractors). Noise emission characteristics of these sources are presented in Table 5.8-2.

5.8.2 Noise Level Predictions

As noted in the Section 4.8, the nearest noise-sensitive receptors are approximately 0.5 miles to the acoustic center of the projects' building complex. Using this distance (and the supporting data summarized in ERT 1979e), noise levels were computed for the maximum noise conditions during project construction and operation. Table 5.8-3 presents noise level prediction.

TABLE 5.8-1

MAJOR CONSTRUCTION EQUIPMENT SCHEDULE

Equipment and Quantity	Individual Noise Level at feet (dBA)*	Approximate Schedule	Operation
1 Dozer	87	Operating during weeks 1 and 2	Site grading
1 Backhoe	85	Operating during weeks 3 and 4	Excavation for footings
1 Cement truck concrete	84	Operating during weeks 5 and 6	Delivery for footings and slabs

Source: Schroeder 1979.

*Source: EPA 1975.

**Overall construction period to take approximately five months, based on Monday to Saturday, 7:00 A.M. to 6:00 P.M. daily work schedule for six workers.

TABLE 5.8-2

SOURCES OF NOISE DURING OPERATION PERIOD

Source	Location	Quantities	Estimated Total Noise Emissions at 1,000 Feet (dBA)
Ventilation Fans	Breeding and Gestation	5 (1/4 hp), 14 (1/2 hp)*	40**
Ventilation Fans	Farrowing and Nursery	38 (1/4 hp), -*	40**
Ventilation Fans	Finishing	24 (1/2 hp), 4 (1/2 hp)*	39**
Feed Truck	Local Roads	1 or 2 per week	54 to 60
Hog Truck	Local Roads	1 per week	54 to 60
Tractors	Local Roads and Fields	Variable; up to 30 trips per day	54 to 57

*Quantities in operation vary with ventilation requirements; all in operation (summer hot weather) condition was assumed for noise emission estimation.

**Worst-case conditions; at point 1,000 feet on perpendicular from side of building.

TABLE 5.8-3

PREDICTED FUTURE NOISE LEVELS AT NEAREST NOISE SENSITIVE RECEPTORS

Source	Time and Corresponding Impact Standard*			Noise Levels (dBA)					
				Baseline (existing background)		Project Component Only		Total (baseline plus project)	
	Time	L_{50}	L_{10}	L_{50}	L_{10}	L_{50}	L_{10}	L_{50}	L_{10}
Construction:									
Week 1 and 2	day	60	65	35	43	53	53	53	53
Weeks 3 and 4	day	60	65	35	43	51	51	51	52
Week 5 and	day	60	65	35	43	50	50	50	51
Operation:									
Fans**	night	50	55	25	33	44	44	44	44
	day	60	65	35	43	44	44	45	47
Fans and 1 truck at 1,000 feet**	day	60	65	35	43	54	54	54	54
1 truck at 1,000 feet only	day	60	65	35	43	54	54	54	54
Manure haul past residences 50 feet from road+	day	60	65	35	43	47	61	47	61

Note: Noise-sensitive receptors at 0.5 miles from acoustic center of the facility site, except manure hauling as noted.

*Based on NAC-1 (residential) noise area classification.

**Fans at maximum ventilation capacity.

+Based on tractor passby speed of 15 mph, 3 round-trips per hour (6 passbys per hour), and tractor reference noise level at 50 feet of 83 dBA. This is considered a worst-case (maximum noise) condition based on 1 tractor and load unit, loading and unloading times of 2- and 15-minutes, respectively, and 3-minute travel time (Schroeder 1979).

5.8.3 Noise Impacts

Noise impact may be judged with reference to two criteria: (1) noise levels must not exceed government standards and (2) the degree of change in noise above ambient level.

The only community noise standard pertaining to the proposed project are MPCA regulations NPC-1 and NPC-2 (MPCA 1974). NPC-1 contains definitions, severity, and variance provisions for the MPCA noise pollution control regulations. (Under certain circumstances, including problems involving practicality and feasibility of compliance with these standards, the MPCA may grant a variance.) The MPCA regulation NPC-2 limits L_{10} and L_{50} (hourly) exterior noise levels with a day-night distinction according to a three-tier noise area classification (NAC) scheme. The most restrictive noise area classification is NAC-1, which represents various forms of human habitations, ranging from single family dwelling units to camping areas and hotels. NAC-2 generally represents nonresidential, public area activity spaces, such as transportation terminals and commercial establishments. NAC-3 pertains to manufacturing, industrial, and agricultural land uses. (A fourth category, NAC-4, generally represents undeveloped land; there is no standard applicable to this category.) These noise standards are shown in Table 5.8-4. The land activities nearest the confined swine facilities site are agriculture (included under NAC-3) and household units and farmhouses (included under NAC-1).

Comparison of the predicted noise levels with the strictest standards (NAC-1) shows that predicted noise levels caused by the proposed projects would not exceed MPCA noise standards.

5.8.4 Changes in Existing Noise Levels

The impact of the noise level caused by the proposed action would be determined by the degree of increase and the number of people affected. However, the degree of impact is difficult to assess because of the highly subjective character of people's reaction to changes in noise. Studies have shown that people outdoors can begin

TABLE 5.8-4

MPCA NOISE STANDARDS

(dBA)

NAC	Day (7:00 A.M. to 10:00 P.M.)		Night (10:00 P.M. to 7:00 A.M.)	
	L_{50}	L_{10}	L_{50}	L_{10}
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

to distinguish noise level changes of approximately 5 dBA (ERT 1979e). Thus, changes in noise levels less than this amount (at a given point) may generally be considered insignificant. For changes above 5 dBA, it is difficult to quantify the impact, however, the greater the change in noise level and the greater the number of people exposed, the greater is the impact. Other factors associated with people's reaction to noise are the duration of the noise, previous exposure to similar noise sources, and people's attitudes toward the project. Long-term noise increases of 5 dB to 15 dB are considered to be a significant impact. Long-term noise level increases of more than 15 dB are generally considered very significant.

Based on these latter considerations and the low population density in the project regions, the proposed action will produce some minor noise impact for the brief periods of time during construction and possibly during hot weather nights.

5.9 References

AES undated. Management of Newly Purchased Feeder Pigs. Pork Industry Handbook 20. Agricultural Extension Service. St. Paul: University of Minnesota.

Alexander, M. 1961. Microbial Ecology. New York: John Wiley and Sons, Inc.

Axtell, R. C., D. A. Rutz, M. R. Overcash, and F. J. Humenick 1975. Mosquito Production and Control in Animal Waste Lagoons. Managing Livestock Wastes. Third International Symposium on Livestock Wastes, American Society of Agricultural Engineers.

Barnwart, W. L. and J. M. Bremmer 1975. Identification of Sulfur Gases Evolved From Animal Manures. Journal of Environmental Quality. 4(3)

Buckman, H. O. and N. C. Brady 1969. The Nature and Properties of Soils. New York: MacMillian Publishing Company, Inc.

Ciravolo, T. G., D. C. Martens, D. L. Hallock, E. R. Collin, E. T. Kornegay 1977. Pollutant Movement to Shallow Groundwater Tables from Swine Waste Lagoons. Virginia Water Resources Research Center Bulletin 100. Virginia Polytechnic Institute and State University, Blacksburg, VA.

Concannon, T. J. and E. J. Genetelli 1971. Groundwater Pollution Due to High Organic Manure Loadings. Livestock Waste Management and Pollution Abatement. Proceedings of International Symposium on Livestock Wastes, Ohio State University, April.

Coons, W. 1979. Olmstead County Assessor. Personal communication, April 3.

Donaldson, A. I. 1978. Factors Influencing the Dispersal, Survival, and Dispoosition of Airborne Pathogens of Farm Animals. Vet. Bulletin 48:83.

EPA 1975. Noise Emission Standards For Construction Equipment: Background Document For Portable Air Compressors. EPA 550/9-76-004.

ERT 1979a Air Quality: Related Actions EIS on Confined Swine Facility. TWP 3. Document P3634-150. Environmental Research & Technology, Inc., Concord, MA.

ERT 1979b. Public Health: Related Actions EIS on Confined Swine Facilities. TWP 5. Document P-3634-250. Environmental Research & Technology, Inc., Concord. MA.

ERT 1979c. Socioeconomics: Related Actions EIS on Confined Swine Facilities. TWP 6. Document P-3634-300. Environmental Research & Technology, Inc., Concord, MA.

ERT 1979d. Land Use: Related Actions EIS on Confined Swine Facilities. TWP 8. Document P-3634-400. Environmental Research & Technology, Inc., Concord, MA.

ERT 1979e. Noise: Related Actions EIS on Confined Swine Facilities. TWP 10. Docment P-3634-500. Environmental Research & Technology, Inc., Concord, MA.

ERT 1979f. Geology and Hydrology: Related Actions EIS on Confined Swine Facilities. TWP 7. Document P-3634-350. Environmental Research & Technology, Inc., Concord, MA.

FDA 1978. Draft Environmental Impact Statement: Subtherapeutic Antibacterial Agents in Animal Feeds. Bureau of Veterinary Medicine.

Geyer, H. 1979. Director of Environmental Programs. Agricultural Extension Service, U.S. Department of Agriculture. Personal communication, March 13.

Goodrich, P. R., S. L. Spier, S. L. Diesch, and L. A. Will 1974. Microbiol. Aerosol Monitoring of a Beef Housing Oxidation Ditch. American Society of Agricultural Engineers, SP-0174.

Hague, R. and V. H. Freed 1975. Environmental Dynamics of Pesticides. Plenum Press.

Hail, N. E. 1970. Structure and Corporations - Economics and Emotions. Corporate Farming and the Family Farm. Ames, IO: Iowa State University Press.

Hartung, L. D., E. G. Hammond, and J. R. Miner 1971. Identification of Carbonyl Compounds in a Swine - Building Atmosphere. Livestock Waste Management.

Howard, M. A. 1979. Assistant to State Archeologist. Personal communication, February 28.

Hubbert, W. T., W. F. McCulloch, and P. R. Schnurrenberger 1975. Diseases Transmitted from Animals to Man. C. C. Thomas, Springfield, IL.

Huey, N. A., L. C. Broering, G. A. Jutze, and L. W. Gruber 1960. Objective Odor Pollution Control Investigations. Journal of Air Pollution Control Association 10:441.

Institute of Agricultural Medicine 1974. State-of-the-Art Report on Occupational Safety and Health in Agriculture. University of Iowa.

Irgens, R. L. and D. L. Day 1965. Aerobic Treatment of Swine Waste. Illinois Research 7(4), Fall.

Katz, S. H. and D. J. Talbert 1939. Technical Paper No. 480. U.S. Bureau of Mines.

Kingston, L. 1979. Hormel, Inc. Personal communication, March 26.

Kreis, R. D. 1978. Control of Animal Production Odors: The State-of-the-Art. EPA 600/2-78-083. U.S. Environmental Protection Agency, Ada, OK.

Lebeda, D. L. and D. L. Day 1965. Waste-Caused Air Pollutants Are Measured in Swine Buildings. Illinois Research, Fall.

Leman, A. 1979. Personal communication, April.

Leonardos, G. 1974. A Critical Review of Regulations For the Control of Odors. Journal of the Air Pollution Control Association 24: 456-468, May.

Lund, Z. F. 1978. Root Development in Dairy Manure - Treated Soil. Journal of Environmental Quality 7(4):473-477.

McIntosh, J. L. and K. E. Varney 1972. Accumulative Effects of Manure and Nitrogen on Continuous Corn and Clay Soil. Growth, Yield, and Nutrient Uptake of Corn. Agronomy Journal 64:374-381.

Manufacturing Chemists Association 1968. Research on Chemical Odors. Part 1: Odor Thresholds for 53 Commercial Chemicals. Washington, D.C., October.

Martin, J. H., W. H. Leonard, and D. L. Stamp 1976. Principles of Field Crop Production, 3rd ed. New York: MacMillan Publishing Company, Inc.

Merkel, J. A., T. E. Hazen, and J. R. Miner 1969. Identification of Gases in a Confinement Swine Building Atmosphere. Transaction of the American Society of Agricultural Engineers. 12(3):310-315

Miller, M. H., J. R. Robinson, and D. W. Gallagher 1976. Accumulation of Nutrients in Soil Beneath Hog Manure Lagoons. Journal of Environmental Quality 5(3).

Miner, J. R. and T. E. Hazen 1969. Ammonia and Amines: Components of the Swine Building Odor. Transactions of the American Society of Agricultural Engineers. 12(6):772-774.

Miner, J. R., M. D. Kelly, and A. W. Anderson 1976. Identification and Measurement of Ammonia Evolution Rate From Manure Covered Surface. Technical Paper No. 3972. Oregon Agricultural Experiment Station, Oregon State University.

Minnesota Department of Agriculture 1976. Statistical Summary of Annual Agricultural Reports.

Minnesota Department of Agriculture 1977. Statistical Summary of Annual Agricultural Reports.

Minnesota Department of Agriculture 1978. Statistical Summary of Annual Agricultural Reports.

Minnesota Historical Society 1979. Selected Data from Minnesota Historic Places Survey, Minnesota Inventory of Historic Places, National Register of Historic Places, Minnesota State Historic Sites Registry. Compiled and Transmitted by S. Queripel, Environmental Assessment Officer, Minnesota Historical Society, February 28.

Moore, J. A., C. A. Onstad, M. A. Otterby, H. L. Person, and D. B. Thompson 1977. Preliminary Identification of Literature Models and Data for Evaluating Rural Nonpoint Nutrient Sediment, and Pathogen Sources. Agriculture Engineering Department, University of Minnesota.

Mosier, A. R., S. M. Morrison, and G. K. Elmund 1977. Odors and Emissions From Organic Wastes. Soils For Management of Organic Wastes - and Waste Waters. ASA-CSSA-SSA, Madison, WI.

MPCA 1974. Minnesota Pollution Control Agency Noise Regulation NPC-1 and NPC-2, filed with Secretary of State and Commissioner of Administration, November 27.

MPCA 1975. A System For Evaluating the Potential Pollution Hazard of Animal Lots. Minnesota Pollution Control Agency.

Muehling, A. J. 1970. Gases and Odors From Stored Swine Waste. Journal of Animal Science 30 (4):526-531.

Midwest Plan Service 1975. Livestock Waste Facilities Handbook 18. Iowa State University.

Olsen, S. R. and S. A. Barber 1977. Effect of Waste Application on Soil Phosphorous and Potassium. Soils for Management of Organic Wastes and Waste Water, L. F. Elliot and F. J. Stevenson, eds. Madison WI. Soil Science Society of America.

Patton, L. L. 1978. Health Effects of Animal Wastes Used for Land Application. U.S. Environmental Protection Agency, Robert S. Kerr Environmental Research Laboratory.

Powers, W. L., G. W. Wallingford, and L. S. Murphy 1975. Research Status on Effects of Land Application of Animal Wastes. EPA-660/2-75-010 (NTIS PB-243-472). National Environmental Research Center, Office of Research and Development, U.S. Environmental Protection Agency, Corvallis, OR.

Robertson, A. M. 1971. Effect of Ventilation on the Gas Concentration in a Part-Slotted Piggery. Farm Building R & D Studies, May.

Rapp, V. 1979. Goodhue County Assessor's Office. Personal communication, April 3.

Russell, E. W. 1973. Soil Conditions and Plant Growth, 10th ed. London: Longman Group Limited.

Ryazanov, V. A. 1952. Limits of Allowable Concentrations of Atmospheric Pollutants. Book I. B. J. Levine, trans. NTIS, U.S. Department of Commerce, Washington, D.C.

Sanders, G. R., R. A. Umbraco, S. Twiss, and P. K. Mueller 1976. The Measurement of Malodors in a Community by Dynamic Olfactometry. Air and Industrial Hygiene Laboratory Report No. 86. California Department of Health.

Schaefer, J. 1977. Sampling, Characterization, and Analysis of Malodours. Agriculture and Environment 3:121-127.

Schroeder, Darwin 1979. Personal Communication, April 24.

Sheehy, J. P., W. C. Achinger, and R. A. Simon undated. Handbook of Air Pollution. Environmental Health Series, Air Pollution 99-AP-44:A-17.

SIGMA Associates, Inc. 1979. Problems Relating to Safe Water Supply in Southeastern Minnesota. Minnesota Department of Health, Minneapolis, MN.

Skarp, S. 1975. Manure Gas and Air Currents in Livestock Housing. Proceedings of International Symposium on Livestock Wastes. St. Joseph, MI: American Society of Agricultural Engineers.

Sobel, A. T. 1969. Measurement of the Odor Strength of Animal Manures. Proceedings of Cornell Conference on Agricultural Waste Management.

Sullivan, R. J. 1969. Air Pollution Aspects of Odorous Compounds. OH22-68-25. Department of Health, Education and Welfare, National Pollution Control Administration, Consumer Products and Environmental Health Services, Washington, D.C.

Sutton, A. L., D. W. Nelson, V. B. Mayrose, and J. C. Nye 1978. Effects of Liquid Swine Waste Application on Corn Yield and Soil Chemical Composition. Journal of Environmental Quality 7:325-333.

Thompson, D. B. and J. A. Moore 1978. Predicting Potential Nutrient and Pathogen Loss in Minnesota Agricultural Nonpoint Source Pollution. Agricultural Engineering Department, University of Minnesota.

Travis, T. A. and L. F. Elliot 1977. Quantitation of Indole and Skatole in Housed Swine Unit. Journal of Environmental Quality 6(4).

U.S. General Accounting Office 1978. Changing Character and Structure of American Agriculture: An Overview.

USDA SCS 1976. Soil Resource Information. Sections 14.23, 14.24 14.25, Haverhill Township, Minnesota. Upper Zumbro Soil and Water Conservation District. Department of Agriculture and Soil Conservation Service. Washingto, D.C.: U.S. Government Printing Office.

USDA SCS 1977. Inventory and Evaluation of Soil Resources. Farmington Township, Minnesota, Section 25. Upper Zumbro Soil and Water Conservation District. Department of Agriculture and Soil Conservation Service. Washington, D.C.: U.S. Government Printing Office.

USGS 1974. Water Resources of the Cannon River Watershed, Southeastern Minnesota. U.S. Geological Survey, Washington, D.C.

USGS 1975a. Water Resources of the Zumbro River Watershed, Southeastern Minnesota. U.S. Geological Survey, Washington, D.C.

USGS 1975b. Water Resources of the Root River Watershed, Southeastern Minnesota. U.S. Geological Survey, Washington, D.C.

White, R. K., E. P. Taiganides and G. D. Gole 1971. Chromatography Identification of Malodors From Dairy Animal Waste. Proceedings of International Symposium on Livestock Wastes. St. Joseph, Michigan: American Society of Agricultural Engineers.

Williams, W. F. and J. A. Clover 1978. How and Where is Price Established? Pork Industry Handbook. Agricultural Extension Service. St. Paul: University of Minnesota.

6. METHODS FOR MINIMIZING SIGNIFICANT IMPACTS

6.1 Air Quality

6.1.1 Confined Swine Operations

State-of-the-art techniques for controlling swine building and anaerobic settling/storage basin odors are broadly grouped into seven categories:

- aeration,
- storage basin design,
- routine waste disposal management,
- direct treatment or processing of wastes by (primarily) nonchemical means,
- direct treatment of wastes with externally applied chemical additives,
- modification of the basal (normal) animal diet with chemical additives or by adjusting the food ration, and
- swine facility exhaust control.

A summary of specific measures, along with probable costs and control effectiveness, is provided in Table 6.1-1. Oxidation ditch techniques are treated as an alternative to the proposed action (Section 10). A discussion of each of these alternatives is given by ERT (1979a). Those measures that would appear to afford the greatest benefits and that are technologically and economically feasible are discussed below.

Aeration

Of all control measures investigated for swine odor, aeration is probably the technique for which a high degree of effectiveness has been most firmly established through repeated experience in the United States and abroad (Muehling 1974; Cooper, Ketcheson, and Webber 1969;

TABLE 6.1-1

SUMMARY OF MITIGATIVE MEASURES FOR CONFINED SWINE FACILITY ODOR CONTROL

Measure	Applicable Facility*	Effectiveness (based on prior application)**	Relative Cost (based on prior application)**	Comments
Mechanical Aeration				
Floating aerators	All	H	L-M	
Submerged and plunging jet-type aerators	All	H	M-H	High operating costs and foaming problems reported for some devices.
Storage Basin Design				
Increase total capacity of outdoor storage system (to greater than 1/3 ft^3/lb live weight)	All	M	M	
Decrease surface area of storage basin while maintaining total capacity (i.e., increase depth)	All	L-M	M	
Two or more storage basins, maintaining total capacity	All	1	M	
Routine Waste Disposal Management				
Hourly flushing of gutters and channels (using self-tipping buckets)	All	L-M	L	
Prevention of accumulation of wastes at pipe inlets	All	L-M	N	Note: Many of the housekeeping techniques listed under this category are recognized as desirable "first steps" to reduce unnecessary odors.
More frequent cleaning-out of settling basins	PF, DS	L-M	L	
Fill storage basin 1/3 to 1/2 full of water before adding wastes	All	L-M	N	
Avoid shock loading of storage basins	All	M-H	N	
Placement of watering troughs near slotted portions of building floors to induce excretion in this area	PF, DS	L	N	
Nonchemical Treatment of Wastes†				
Liquid/solid separation	All (esp. HP)	H	M-H	Also permits control of landspray rates.
Anaerobic digestion	All	H	H	Based on limited application.
Complete treatment system	All	H	H	Based on limited application.
External Chemical Treatment of Wastes				
Adsorbents	All	N-L	L-M	
Counteractants	All	N-L	L-M	
Digestive agents	DS, HP	N-L	L-M	
Masking agents	All	N-M	L-M	Most effective during pit or storage basin agitation.
Germicides	All	N-M	L-M	

TABLE 6.1-1 (Continued)

Measure	Applicable Facility*	Effectiveness (based on prior application)**	Relative Cost (based on prior application)**	Comments
Feed Additives and Ration Control				
Five percent charcoal	All	L	L	
Charcoal plus wet lacto	All	L	L	
Five percent sagebrush	All	L	L	
Other additives	All	N	L	
Swine Building Exhaust Control				
Dust suppression filters	All	M	H	Frequent replacement required.
Chemical adsorption	All	M	H	
Chemical absorption	All	M-H	H	
Direct and catalytic combustion	All	M-H	H	Not tested for swine buildings.
Ozoniation	All	M-H	H	Potential for adverse physiological effects for prolonged exposure of swine.

*HP = Hilltop Pork Producers
PF = Penz Farms Company
DS = Darwin Schroeder

**N = Negligible
L = Low
M = Moderate
H = High

†Treatment systems that are primarily nonchemical.

Irgens and Day 1965; Hawkins 1977). The basic principle of aeration is the enhancement of aerobic microbial activity (which does not release hydrogen sulfide and other malodorous gases) by supplying oxygen (air) to the storage basin waste contents.

Aeration devices range from simple floating or "plunging jet" type apparatus to oxidation ditches and complete treatment plants. The more elaborate systems, such as oxidation ditches, are discussed in Section 10.

A floating aerator virtually eliminated odors from a 70-cubic-meter slurry tank used to store wastes from a British swine operation with 5,000 head (that is, larger than the one proposed by Hilltop Pork Producers) (Evans et al. 1975). Excellent results have also been reported for plunging jet (Sneath and Hepherd 1976) and submerged T-bar type devices (Irgens and Day 1965). The major problems cited in these studies appear to have been associated with foaming and high energy requirements (primarily for cattle and poultry). Other devices have been described, however, that purport to provide a high degree of control (in warm or cold climates)at minimal investment or operational expense (George, Fulhage, and Matthews 1976; Frankl 1979).

Outdoor Storage Basin Design

Storage capacities of one-third cubic foot per pound live weight (or greater) have been recommended for swine waste storage systems (Barker 1978), with odors virtually eliminated at 3.3 to 6.6 cubic feet per pound live weight (Kreis 1978). Capacities of the storage basins proposed by the applicants are at or above the recommended minimum, although increasing the capacities would reduce peak odorant emissions by increasing the amount of dissolved oxygen relative to the chemical oxygen demand of the stored wastes.

Equipping basins and/or tanks with covers, such as plastic sheets, can potentially reduce odors by limiting the quantity of odorant gases that can escape into the atmosphere. Such covers cannot be airtight because of the buildup of methane and other gases under anaerobic conditions. Therefore, some odoroant gases would still be

released, although presumably at a lower rate because of the greatly reduced liquid/air interface (Loehr 1979). Problems that may be encountered with covers include maneuverability of the large sheets and the susceptibility to wind and mechanical damage. For these reasons, operators of existing facilities have generally preferred other measures for odor control (Leohr 1979).

Routine Waste Disposal Management

There is a variety of "housekeeping" practices recommended by EPA and various investigators for odor control. Most of them are based on the principal of avoiding unnecessary accumulations of stagnant manure and the subsequent promotion of anaerobic activity. They include regular (hourly) flushing of gutters and channels, daily scraping and cleaning of underhouse wastes, prevention of accumulation of wastes at pipe inlets and outlets (formation of solids delta), and frequent cleaning of settling basins (Kreis 1978; Goodrich 1978; Midwest Plan Service 1975). It has also been recommended that the storage basin be filled one-third to one-half full of water before adding the wastes, and that one-quarter of the storage basin volume be replaced annually (Kreis 1978; Barker 1978). Miscellaneous control measures include maintenance of a steady, continual effluent supply to the outdoor storage system (as opposed to shock loading, which suddenly agitates the wastes and releases relatively large amounts of odorous gases) (Kreis 1978).

Many of these housekeeping measures are regarded as desirable and relatively inexpensive "first steps" towards eliminating unnecessary sources of swine waste odor and resultant community complaints. Because of the routine nature of these approaches, none have been authoritatively quantified in terms of expected odor reduction.

External Chemical Treatment of Wastes

There are many chemical agents currently on the market that purport to control livestock waste odors via direct application to the manure. These agents fall into five broad categories: digestive

agents (containing bacterial cultures or enzymes), counteractants (agents that react chemically with odorants to neutralize their effects or change the quality of the odor from unacceptable to acceptable), masking agents (compounds having a strong but acceptable odor to "mask" the characteristic odor of the wastes), adsorbents (such as charcoal that adsorb odorant gases) and miscellaneous agents (oxidants, germicides, etc.).

Numerous investigations have concluded that the success of such agents in mitigating swine odors is, at best, limited (Warburton et al. 1979; Cole et al. 1976). In view of the limited and largely negative test results obtained to date, chemical additives are not considered to be a proven or cost-effective means of controlling swine odors on a routine basis. Certain agents, however, (particularly masking agents) may be partially effective in reducing odors under "upset" conditions (such as during agitation of storage basins prior to land application or during clean-out) if applied in sufficiently large quantities.

Feed Additives

Test results of several feed additives (Miner 1974) showed slight reductions in odor potential for charcoal, a mixture of charcoal and wet lacto, and sagebrush. For the first two additives, the reduction reported was about one-half an odor unit on a scale of 0 to 10. Another study by Ingram et al. (1973) that added 5% (by weight) charcoal to the basal swine diet reported a significant reduction in odors.

Swine Building Exhaust Control

Swine building exhaust air can be modified to reduce odor potential in much the same manner as scrubbers or electrostatic precipitators are used to abate pollutant emissions from industrial stacks. Odor control techniques in this category that have been investigated for swine and poultry houses include dust suppression

filters, adsorption, absorption, direct combustion, catalytic combustion, and ozoniation.

Suppression filters are designed to remove dust particles in the "odor-bearing" range of 5 to 20 microns (Burnett 1969), with a system using viscous impingement filters in connection with electrostatic precipitators and activated carbon reported as the most efficient for swine buildings (Abercrombie 1971). Problems with filtration involve clogging and, hence, the costs associated with frequent replacement (Eby and Wilson 1969).

6.1.2 Land Application of Swine Manure and Aerosol Spray Containment

Odor and aerosol problems are not normally associated with the injection method of manure application proposed by Darwin Schroeder and Hilltop Pork Producers. Therefore (except for recommendations for abating odors arising from storage basin agitation), the control measures described below are applicable only to Penz Farms Company, for which a spray system has been proposed. A summary of the measures considered is provided in Table 6.1-2.

Application Methods and Techniques

The most common methods of odor control for land application of manure effluent include spray hoods, rate control, and rapid plow-cover systems. Spray hoods retard odorant and aerosol transport by physically restricting the diffusion of emissions from spray systems and have been used successfully in connection with cattle, sheep, and poultry manure (Turnbull, Hore, and Feldman 1971). Maintaining the rate of fertilizer application at about 10 to 30 tons per acre per day has been recommended (Kreis 1978) as an effective means of eliminating odor complaints associated with fieldspreading in most communities. Rapid plow-cover systems reduce the duration of odor impact, although not necessarily the intensity (Turnbull, Hore, and Feldman 1971).

TABLE 6.1-2

SUMMARY OF MITIGATIVE MEASURES FOR CONTROLLING ODORS AND AEROSOL IMPACTS FROM MANURE APPLICATION AND STORAGE BASIN WITHDRAWAL OPERATIONS

Manure Application Methods and Techniques

- Injection 8 to 10 inches below soil surface followed by disking or plowing (nearly 100% effective).
- Use of spray hoods.
- Controlled rate of application (10 to 30 tons per acre).
- Rapid plow cover system to minimize odor duration.

Meteorological Control/Optional Timing of Operation

- Confinement of effluent withdrawal and landspreading to dry periods with moderate wind and high turbulence.
- Avoidance of damp, foggy days.
- Confinement to days when a minimal number of residences are downwind of operations.
- Early morning spreading to maximize drying time and enhance vertical mixing.
- Avoidance of traditional periods of outdoor recreational activity.

Miscellaneous

- Establishment of buffer zones.
- Use of odor control chemicals during effluent withdrawal.*
- Minimization of storage basin agitation during withdrawal.*
- Liquid/solid separation.*

*See Table 6.1-1.

Meteorological Control and Optimal Timing

Although it is obviously impossible for the applicant to control the various meteorological factors that govern the diffusion and transport of aerosols and odorants from landspreading, attention to weather forecasts and judicious avoidance of certain adverse conditions can reduce both the overall and worst-case impacts. This involves such practices as avoiding damp, foggy days, periods of stagnant air (calm or light winds) or stable atmospheric conditions, and selecting periods when a minimal number of residences situated within the "impact zone" are situated downwind of the facility. In addition, spraying in the early morning reduces potential odor buildup by maximizing the time available for drying (Barker 1978) and enhancing vertical mixing (because the greatest atmospheric turbulence normally occurs in the 7 A.M. to 11 A.M. period). Finally, traditional periods of outdoor recreational activity, such as weekends and summer evenings, should be avoided.

Miscellaneous Measures

Miscellaneous techniques for controlling manure application odors and aerosol impacts include the establishment of buffer zones, use of odor-control chemicals, minimizing the degree of storage basin agitation during effluent withdrawal, and liquid/solid separation. Liquid/solid separation controls the odors from the facility directly and from the landspray operation indirectly by permitting lower rates of application. Storage basin agitation associated with land application is a potentially severe source of high odorant emissions, but, because of its short-term nature, may be partially abated by using masking agents. Buffer zones are simply areas on which no spraying would take place (possibly during certain times, such as when people are outdoors) to minimize aerosol and odorant impact on nearby receptors by increasing the separation distance.

6.2 Water Quality

6.2.1 Groundwater

Groundwater Monitoring

Regular monitoring of the upper groundwater system would detect any seepage or leakage from the proposed waste management facilities. Should the water quality of the surface aquifer deteriorate, corrective measures could be applied.

Soil Borings

Deep soil borings at each facilities site would provide further information regarding sinkhole potential, thus minimizing the degree of uncertainty associated with this potential threat to water quality (see Section 6.5).

Protection of Basin Liners

The following measures could be implemented to reduce the potential for rupture of the plastic liners proposed for the Penz Farms Company and Darwin Schroeder manure storage basins.

- Concrete pumping bays could be installed such that all pumping and agitation activities would take place over a concrete base.
- The sideslopes of earthen basins could be reduced to 4:1 to increase the stability of the soil layer overlying the plastic liners.

Above-Ground Storage Tanks

The potential for release of stored manure from the Penz Farms Company and Darwin Schroeder facilities would be minimized by the use of above-ground storage tanks. Such tanks would provide greater protection in the event of sinkhole dvelopment and would minimize the potential for leakage during normal operation.

Reduced Manure Application Rates

As discussed in Section 5.2.2, proposed nitrogen-based agronomic manure application rates could result in increased quantities of salts leaching to groundwater. If the manure application rates were reduced such that phosphorous and potassium loading rates approximated crop needs, this effect could be minimized. As discussed in Section 6.5, phosphorous- and potassium-based application rates would require a greater land area than nitrogen-based rates. Nitrogen loadings could be supplemented by application of commercial fertilizer.

6.2.2 Surface Water

Run-off

Although run-off effects associated with the proposed action are not predicted to degrade water quality over baseline conditions, certain measures may be implemented to improve existing water quality conditions. To mitigate the effects of run-off, buffer strips of hay or grass can be established adjacent to all operations where possible. In cultivated areas with a slope greater than 4% (MPCA 1975), contour farming could be instituted where not currently practiced.

Surface Monitoring

Because the project sites are surrounded by intermittent streams, there should be no transport of materials from the sites to receiving streams for most of the year. Monitoring at selected areas during spring run-off and in the summer storm month of June would detect any changes in surface water quality. If degradation of water quality occurs, control measures can be applied. These control measures would ensure crop yields by eliminating transport of nutrients to receiving waters.

6.3 Public Health

6.3.1 Swine Health Maintenance Measures

As mentioned in Section 4.3.1, it is in the best interests of the swine confinement facility owner/operator to use good health maintenance practices. In addition to those items previously mentioned, there are procedures that should be available in case of epidemic or a lesser degree of sickness within the swine population. Examples of such procedures are: isolation areas for those pigs showing clinical signs of disease, isolation of new breeding stock before mixing with the existing stock, vaccination of all workers within the buildings, use of respiratory masks, and prompt reporting of disease outbreaks to local health officials.

6.3.2 Disease Transmission Measures

With proper management, the operations as proposed would create a minimal threat to public health. Administration of vaccines to swine to control diseases, such as leptospirosis, would further minimize any health risks. Parasite control measures would reduce the disease potential created by parasite eggs (such as ascarids) that may persist in applied manure. Additionally, avoidance of manure application under adverse meteorological conditions (that is, avoidance of surface run-off immediately after application) would minimize any potential for disease transmission by this vector. Inspection by appropriate local health agencies and development of emergency plans in the event of epidemics would further minimize the disease transmission potential.

6.3.3 Feed Additive Measures

Three measures may be considered to mitigate impacts related to feed additives:

(1) elimination of the use of feed additives,
(2) improvement of management practices, and

(3) use of substitute antibacterials to achieve the same benefits but fewer impacts.

Although alternative 1 would eliminate the creation of drug-resistant organisms amd eliminate possible residue effects, this benefit is outweighed by adverse impacts. Without subtherapeutic doses of antibacterials, the swine would show both a slower rate of weight gain and a less efficient gain per feed quantity. These two factors would result in greater feed costs, slower production of marketable pigs, and a higher cost of pork to the consumer. Aside from adverse economic impacts, there would also be adverse health impacts. Without the subtherapeutic levels of antibacterials to control pathogens in confinement facilities, the potential for the spread of pathogens within the facility and among humans, wildlife, and the environment would increase. The vectors through which the pathogens could spread (for example, soil, air, water, animals) are very difficult to control.

Improved management practices include greater care in the use of medicated feeds; greater control over sufficient periods of medicated feed withdrawal prior to marketing the pigs; and better sanitation to prevent contamination of water, nonmedicated feeds, or other swine. These three methods would help maintain the proper use of subtherapeutic antibacterials and provide controls to ensure that their use is not abused.

Alternative 3 can be implemented since there are substitutes for all the proposed subtherapeutic swine antibacterials. Some of the available substitutes for each of the antibacterials proposed for use by the applicants are shown in Table 6.3-1. A substitute, virginiamycin, results in better weight gain and feed efficiency than the more commonly used chlortetracycline.

The characteristics of the six previously mentioned substitutes are shown in Table 6.3-2 and 6.3-3. The health and environmental impacts of the substitutes when compared to similar data in Table 5.3-1 and 5.3-2 indicate that the substitutes would create fewer impacts. It is important to note that resistant bacteria are rarely excreted, toxic effects are highly unlikely, and only two of the six substitutes are used in human medicine.

TABLE 6.3-1

SUBSTITUTE ANTIBACTERIALS

Proposed Drug	Substitute
ASP (chlortetracycline, sulfamethazine, penicillin)	Bacitracin Carbadox Erythromycin Bambermycins Oleandomycin Virginiamycin Tylosin
Tetracycline Chlortetracycline & Oxytetracycline	Carbadox Bambermycins Erythromycin Bacitracin Virginiamycin Oleandomycin Tylosin
Tylan*	Information not available

Source: Adapted from FDA 1978.

*Other substitutes mentioned could also be used in place of tylosin.

TABLE 6.3-2

CHARACTERISTICS OF ANTIBACTERIAL SUBSTITUTES

Substitute	Percentage of Swine Oral Dose Exerted as Active Compound	Resistant Bacteria Excreted	Environmental Half-life (days)	Soil Mobility	Bioaccumulation Potential	Inhibition of Soil and Fecal Bacteria
Bacitracin	95	None to infrequently	4-10	Adsorbed and released in active form from most soils.	Unlikely	Possible, not demonstrated
Carbadox	0	None	-	-	-	-
Erythromycin	High	Infrequently	-	Adsorbed strongly to some soils.	Short-term possible, long-term unlikely**	Possible, not demonstrated
Bambermycins	90	None	20	Adsorbed strongly to some soils.**	Unlikely	Possible, not demonstrated.
Oleandomycin	Little	Infrequently	-	Adsorbed strongly to some soils.	-	Possible, not demonstrated.
Virginiamycin	0-31	None to infrequently	7	-	Unlikely	unlikely, not demonstrated.

Source: FDA 1978.

*Insufficient data.

**Based on indirect physical and chemical data.

TABLE 6.3-3

TOXICITIES AND USAGE OF ANTIBACTERIAL SUBSTITUTES

Substitute	Algal and Phytotoxicity	Fish Toxicity	Mammalian and Avian Toxicity	Selection for Drug Resistant, Nonenteric Bacteria	Usage
Bacitracin	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Human use for skin infections and superficial wounds.
Carbadox	Highly unlikely	Highly unlikely	Carcinogen	Highly unlikely	Greatest use with swine; no human use.
Erythromycin	Highly unlikely	Highly unlikely**	Highly unlikely	Possible, not demonstrated	Used for many human infections; frequent substitute for penicillin.
Bambermycin	Highly	*	Highly unlikely	Highly unlikely	Used only in chickens and swine; no human use.
Oleandomycin	*	*	*	*	No human use in United States.
Virginiamycin	Highly unlikely	Highly unlikely	Highly unlikely	Unlikely, not demonstrated	Used only in swine.

Source: FDA 1978.

*Insufficient data.

**Based on indirect physical and chemical data.

6.3.4 Air Quality Control Measures

Harmful or lethal concentrations of project-generated gases are not predicted to occur in the community surrounding the proposed confined swine facilities. Thus, no measures to mitigate air quality-related health effects are presented. Measures to mitigate annoyance or nuisance effects of odors are presented in Section 6.1.

6.4 Socioeconomics

The analysis of the social and economic impacts indicates that there are few potential adverse impacts. Specifically, the analysis has identified the following issues.

- The potential temporary reduction of farm residential property values adjacent to the facilities sites.
- Potential competition for smaller, more marginal farming operations in the area.
- Potential long-term reduction of farm residential property values within a short distance of the facilities. This impact is related to the odors produced by the operations.

The issue that arouses most concern locally is the extent of competition with other farms. However, it would be unreasonable to expect the applicants to avoid competition with others. If problems occur, the solution depends largely on the initiative of other farm operators.

The effect on property values can be more easily mitigated. Odor impacts can be reduced resulting in less potential for changes in property values.

6.5 Geology and Hydrology

Adverse impacts identified in Section 5.5 are related to soil erosion and sinkhole potential at the Hilltop Pork Producers facilities site. Soil erosion during construction activities can be minimized by the following procedures:

- disturbing and exposing the least area feasible for construction,
- exposing disturbed areas for the shortest time reasonably possible, and
- stabilizing exposed slopes with temporary mulching.

Although the potential for adverse effects caused by sinkhole development at each facilities site has been determined to be low, a degree of uncertainty is associated with any projection of sinkhole potential in karst regions owing to the complicated nature of karst hydrology. This uncertainty can be minimized by conducting soil borings at each site to determine the type and thickness of geologic materials overlying carbonate bedrock. Such borings would help identify the potential for sinkhole development (since such features are generally associated with carbonate formations at or near the land surface) and would provide information regarding the ability of on-site surficial materials to mitigate or prevent contamination of underlying aquifers in the event of leakage from waste storage systems.

No borings have been conducted at the Hilltop Pork Producers facilities site. Borings conducted at the Penz Farms Company and Darwin Schroeder sites were shallow and did not penetrate the entire thickness of surficial materials. No guidelines are currently available regarding the level of geologic data necessary to adequately ascertain site suitability in southeastern Minnesota. However, in a letter to MPCA regarding site requirements for the protection of groundwater resources, the director of the Minnesota Geological Survey has suggested that test holes be drilled until at least 40 feet of permeable materials have been penetrated or until bedrock is

encountered (Walton 1977). It was further suggested that a suitable site for location of feedlots and waste disposal sites in karst areas of the state should contain at least 20 feet and preferably 40 feet of poorly permeable geologic materials overlying carbonate formations.

Soils testing at the Hilltop Pork Producers site would also be necessary to determine the load bearing capacity of on-site soils and thus prevent manure leakage caused by ground settlement below the proposed storage tanks.

As discussed in Section 5.5.2, nitrogen-based agronomic rates for manure application would result in a long-term buildup of phosphorus, potassium, and salt levels in soils. A buildup of phosphorous, potassium, and salt levels on the proposed parcels could be prevented by basing manure application rates on phosphorous and potassium needs. This would result in application over a larger land area. The lower nitrogen loadings from the manure application could be supplemented with commercial fertilizer.

The proposed manure application parcels with the exception of the Penz Farms Company parcel F are large enough to permit applications based on phosphorous and potassium loadings that would correspond to crop requirements. This would correspond to 114 lb/acre and 82 lb/acre nitrogen loadings for Penz Farms Company parcels A, B, and F, respectively. However, approximately 171 acres are required for the 82 lb/acre nitrogen for parcel F, which is only 80 acres. The Darwin Schroeder operation could apply current phosphorous and potassium levels with 100 lbs/acre nitrogen loadings on 329 acres. Hilltop Pork Producers could supply 175 lb/acre nitrogen and maintain current potassium application rates but slightly increase phosphorous levels.

6.6 Land Use

No significant land use impacts related to transportation, cultural resources, or visual aesthetic character were identified. Thus, no mitigation measures would be required.

The only impact to land use control consistency is the Hilltop Pork Producers proposed on-site manager's residence. In this case, a Conditional Use Permit is required. Although an application has been submitted, it is currently tabled, pending EIS completion. As proposed, the residence would not comply with the zoning requirements (ERT 1979b).

The Hilltop Pork Producers application currently before the Planning Commission indicates the residence would be located on cropland. Hilltop Pork Producers could alter its application by one of the following actions to comply with the ordinance:

(1) withdraw the proposed residence from the application,

(2) locate the proposed residence on noncropland, or

(3) enlarge the legal parcel size for the confined swine facilities to at least 40 acres, thereby making the proposed facilities operation a bona fide "farm unit" under the ordinance, and allowing one residence as an allowed use.

Action 1 or 3 would be most easily accomplished. The Goodhue County Zoning Administrator would probably require that the current application be withdrawn and a new application for Conditional Use Permit submitted, incorporating project changes (Bucher 1979).

Impacts to land use compatibility would be generally minor. Potential major impacts are associated with noxious odor dispersal to adjoining properties. Any actions that can reduce odor dispersal would mitigate impact. For a more detailed discussion, see Section 6.1.

6.7 Ecology

Since impacts on vegetation and wildlife are not expected to be significant, major mitigative measures are not necessary for protection of terrestrial and aquatic environments. Losses of terrestrial vegetative and wildlife habitat will be minor relative to the amount of available habitat of similar quality throughout the study area.

Some soil erosion may occur on the facilities sites during construction as a result of vegetation removal. These sensitive areas can be mulched and reseeded to minimize erosion and reduce soil run-off to streams. Native plant species that become quickly established could be selected for the reseeding program. A maintenance program is necessary to ensure that adequate vegetative cover is maintained.

6.8 Noise

The proposed actions would not produce significant adverse impacts on the community. Therefore, noise mitigation measures for the proposed projects would not be required.

6.9 References

Abercrombie, J. C., 1971. An Investigation of Odor Control for Swine Buildings. M.S. Thesis. University of Guelph, Guelph, Ontario, Canada.

Barker, J. C. 1978. Putting the Lid on Odor. Hog Farm Management 6.

Bucher, J. W., 1979. Goodhue County Zoning Administrator. Personal communication, Febraury 7.

Burnett, W. E., 1969. Air Pollution From Animal Wastes, Determination of Malodors by Gas Chromatographic and Organoleptic Techniques. Environmental Science and Technology. 3(8): 744-740.

Cole, C. A., H. D. Bartlett, D. H. Buckner, and D. E. Yorkin 1976. Efficacy of Certain Chemicals and Biological Compounds For Control of Odor From Anaerobic Liquid Swine Manure. Journal of Animal Science 42(1): 1-7.

Cooper, G. S., J. W. Ketcheson, and L. R. Webber 1969. Agriculture as a Contributor to Pollution. AIC Review 24(3): 9-15.

Eby, H. J., and G. B. Wilson 1969. Poultry House Dust, Odor, and Their Mechanical Removal. Proceedings of Agricultural Waste Management, Cornell University, Ithaca, NY.

ERT 1979a Air Quality: Related Actions EIS on Confined Swine Facilities. TWP 3, ERT P-3634-150. Environmental Research & Technology, Inc., Concord, MA.

ERT 1979b Land Use: Related Actions EIS on Confined Swine Facilities. TWP 8, ERT P-3634-400. Environmental Research & Technology, Inc., Concord, MA.

Evans, M. R., R. Hesset, D. F. Ellam, and S. Baines 1975. Aerobic Treatment of Piggery Waste Prior to Land Treatment: A Case Study. Proceedings of the Third International Symposium on Livestock Wastes. American Society of Agricultrual Engineers, University of Illinois.

FDA 1978. Draft Environmental Impact Statement: Subtherapeutic Antibacterial Agents in Animal Feeds. Bureau of Veterinary Medicine.

Frankl, T. 1979. Personal Communication.

George, B., C., Fulhage, and S. Matthews 1976. Odors: The Next Big Pollution Battle. Beef 12 (8):26.

Goodrich, P. R. 1978. Odor Control in Animal Management. Unpublished paper prepared for Minnesota Pollution Control Agency.

Hawkins, J. C. 1977. Investigations in the U.S. into Methods of Odor Control, for Farms. Agriculture and Environment 3: 277-286.

Ingram, S. H., R. C. Album, C. D. Jones, A. M. Lenox, L. F. Tribble, L. B. Porter, and C. T. Gaskins 1973. Swine Fecal Odor as Affected by Feed Additives. (abstract). Journal of Animal Science. 36 (1): 207.

Irgens, R. L. and D. L. Day 1965. Aerobic Treatment of Swine Waste. Illinois Research 7(4), Fall.

Kreis, D. Control of Animal Production Odors: The State-of-the-Art. EPA 600/2-78-083. U.S. Environmental Protection Agency, Ada, OK.

Loehr, R. C., 1979. Personal communication with W. K. Olender.

Midwest Plan Service 1975. Livestock Waste Facilities Handbook.

Miner, J. R. 1964. Orders From Confined Livestock Production. EPA-550/2-74-023. Washington, D.C.: U.S. Government Printing Office.

MPCA 1975. A System for Evaluating the Potential Pollution Hazard of Animal Feed Lots. Minnesota Pollution Control Agency.

Muehling, A. J. 1974. Good Animal Waste Management Reduces Odors and Complaints. Paper No. 74-11-110. Presented at VIII International Congress of Agricultural Engineering, Flevohof, the Netherlands, September 23-29.

Sneath, R. W. and R. Q. Hepherd 1976. Pig Slurry Teatment Using a Plumbing Jet Aerator. Report No. 15, N.I.A,E, Silso, Bedord, UK.

Turnbull, J. E., F. R. Hore and M. Feldman 1971. A Land Recycling Liquid Manure System for a Large - Scale Confinement Operation in a Cold Dlimate. Proceedings: International Symposium on Livestock Wastes. St. Joseph, Michigan: American Society of Agricultural Engineers, April 19-22.

Walton, M. 1977. Minnesota Geological Survey. Letter to S. Gardebring of Minnesota Pollution Control Agency, August 1.

Warburton, D. J., J. N. Scarborough, D. L. Day, and A. J. Muchling 1979. Evaluation of Commercial Products For Odor Control and Solids Reduction of Liquid Swine Manure. Paper presented at Illinois Livestock Waste Management Conference, Champaign, Illinois, March 6.

7. UNAVOIDABLE ADVERSE IMPACTS

The analysis of potential environmental impacts presented in Section 5 indicates that certain adverse effects would be associated with construction and operation of the proposed confined swine facilities. Some of these impacts are possible despite implementation of reasonable mitigating measures (described in Section 6). This section identifies the significant adverse impacts that cannot be avoided if the proposed action is implemented.

- As discussed in Section 5.1, the proposed action would result in adverse odor effects in the communities surrounding each facilities site. Proven techniques are available to substantially reduce or eliminate odors (Section 6.1). However, odor effects would persist in the event of mechanical failure of mitigating devices (such as aerators) or failure to satisfy the operational or maintenance requirements of such devices. Thus, although it is possible to eliminate odors, unforeseeable factors such as the operator's adherance to management and maintenance schedules make the possibility of odor effects unavoidable.
- Significant water quality impact could occur through catastrophic or accidental release of stored or transported manure. Mitigating measures are available to reduce the potential for such occurrences or to provide early detection of water quality effects (Section 6.2). However, an increased potential for water quality contamination would be created by implementation of the proposed action. This potential is considered to be low.
- As in the case of odor and water quality effects, public health impacts are not projected to occur as a result of the proposed action, but some increased potential for their occurrence is unavoidable. Again, the probability of impact is considered low but the actual effects of each operation will depend on each operator's management practices.

8. SHORT-TERM USES OF THE ENVIRONMENT VERSUS LONG-TERM PRODUCTIVITY

This section briefly describes the trade-offs involved between the short-term and long-term benefits and costs associated with use of the environment for the proposed confinement facilities. In this discussion, short-term refers to the period during which construction and operation of the facilities would take place; that is, the five-month construction period and the 25 years of expected operation. Long-term refers to the period subsequent to the 25-year useful life of the facilities.

The primary short-term benefit of the proposed action is the efficient and relatively low cost production of vital consumer products (meat). Additional short-term benefits include small increases in employment opportunities and local tax revenues. No long-term benefits would be associated with the proposed action.

As discussed in Section 7, the proposed action could be implemented without significant environmental costs. However, since it is not possible to guarantee that accidental or catastrophic release of stored manure would not occur or that proper management practices would be followed at all times, the benefits of the proposed action must be contrasted to the possibility of adverse odor, water quality, and public health effects. If mitigation measures were implemented (see Section 6.1), odor effects would only occur in response to mechanical or operator failure and, thus, would be of short duration (that is, the time it takes to repair or modify the operating system). Water quality effects could occur in the event of unforeseen rupture of storage facilities, flushing pipes, or manure transport tanks. The potential for such occurrences is low, however, their possible effects would be significant: short-term contamination of surface water (used predominantly for livestock watering) and groundwater (used for domestic water supply). Any threat to public health is significant. However, the potential for disease transmission to humans could be minimized by good management practices. Maintenance of swine health (which is economically advantageous to each operator) would have the effect of minimizing the

potential for transmission of disease to humans. Similarly, the management practices necessary to minimize potential health effects related to land application of manure (such as preventing or minimizing run-off or aerosol transmission of applied manure) are in most cases economically advantageous to the operator in that they result in maximum utilization of manure nutrients.

The only long-term adverse effect potentially associated with the proposed action would be related to groundwater quality. If seepage from manure storage basins occurred as a result of liner rupture, ammonium may accumulate in underlying soils. Emptying basins at the end of the project life may promote aerobic conditions in these soils and release nitrates to surficial aquifers beyond the 25-year useful life of the proposed action.

9. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The construction and operation of the proposed confined swine facilities would result in the commitment of various natural and man-made resources. The following section describes the various resources that would be irreversibly or irretrievably committed to the project.

- A variety of natural resources would be used to construct the facilities, including sand, gravel, clay, and other materials used to make concrete. These materials are virtually irretrievable, however, they are readily available in large quantities. Steel, other metals, and plastic may be used in facility structures and equipment. At the end of the project's useful life, some of these materials may be recovered and recycled to create new products. Those materials that could not be recycled would be disposed of in landfills and would thus commit land resources to this use.
- It is estimated that each operation would have an annual energy requirement of approximately 6,000 gallons of propane and 125,000 kwh of electricity. Implementation of various mitigating measures (Section 6) or manure management alternatives (Section 10) would increase energy requirements. Additionally, fossil fuels would be consumed by farm equipment hauling manure, construction equipment, trucks making deliveries to or from the site, and workers commuting to the site.
- The proposed facilities would have a combined water demand of approximately 15,500 gpd. The majority of this daily demand would be consumed by swine. Losses to the system include that portion consumed by swine and not returned to the manure storage system and evaporative losses. Water lost to evaporation or returned to the ground via manure application would remain in the earth's water cycle.
- Each operation would require 80,000 to 100,000 bushels of feed per year. The nutrient value of this feed would be transferred to the swine or retained in the swine manure.

Of the three major nutrients in the manure, virtually all of the phosphorous and potassium would be recycled as fertilizer used for plant growth.. Approximately 25% (Hilltop Pork Producers) to 65% (Penz Farms Company and Darwin Schroeder) of the nitrogen content would be irretrievably lost, predominantly through formation of ammonia gas.

- Finally, construction and operation of the proposed facilities would involve an irretrievable commitment of labor. Construction would require a total of approximately 25 workers for five months. During operation, the three facilities would require approximately 13 workers.

10. ALTERNATIVES

10.1 Introduction

This section develops a list of reasonable alternatives to the major components of the proposed action and describes those alternatives in sufficient detail to provide a basis for comparison with the proposed action. The following categories of alternatives are considered: no action, reduced operation, alternative manure application areas, and alternative manure management systems.

This analysis will identify and evaluate only those alternatives that are practical technologically and/or logistically and that are available to the applicants. The no-action alternative simply involves continuation of the current use of the project sites. The reduced operation alternative entails implementation of the proposed action as planned, but at a limited scale in terms of swine population and hog production.

In addition to the proposed manure application parcels, the project applicants have identified other areas available for this purpose. The analysis of alternative manure application areas examines the merits of these additional parcels as potential manure application sites.

The analysis of alternative manure management systems involves the following three sequential tasks: (1) identification of available waste management techniques, (2) application of alternative selection criteria, and (3) identificaton and description of reasonable alternatives; that is, those that satisfy the established alternative selection criteria. Important criteria applied to the selection of reasonable alternatives include technological feasibility, operating costs, and environmental benefits.

10.2 No Action

The no-action alternative involves continuation of the current use of the project sites. The proposed confined swine operations would not be implemented, and current agricultural use of the project sites would continue unchanged. Current farming practices and existing livestock operations on the project sites are described in Section 3.

This alternative would eliminate all adverse and beneficial impacts associated with construction and operation of the proposed swine facilities. Adverse impacts of the proposed action, described in Sections 5 and 7, include odor effects during operation and the potential for water quality contamination and disease transmission. The magnitude of odor impacts would depend on the mitigation measures implemented (Section 6) as well as management techniques. Mitigation measures may significantly minimize the potential for water quality or public health impacts; however, some increased potential for such effects would be associated with the proposed action. Thus, the major advantage of the no-action alternative would be the elimination of this increased possibility of identified adverse effects.

The major disadvantage of the no-action alternative is that it would eliminate new sources of consumer products (meat). An additional disadvantage of this alternative is that it would preclude beneficial effects of the proposed action, including those related to run-off control from an existing cattle feedlot, local tax and employment benefits, and enhancement of soil properties (see Section 5).

10.3 Reduced Operation

10.3.1 Penz Farms Company and Darwin Schroeder

Under this alternative, Penz Farms Company and Darwin Schroeder would independently operate two 150-sow farrow-to-finish confined swine facilities. A typical high-intensity 150-sow operation can be expected to produce approximately 2,246 market hogs per year (AES undated a). Each operation would have a maximum capacity of approximately 1,308 swine, or approximately 31% of the capacity of the proposed facilities.

The quantities of raw swine manure that would be generated by each facility are given in Table 10.3-1. Each project would generate approximately 190 cubic feet of swine manure per day, or approximately 32% of that generated by the proposed facilities. Given similar operating and manure management systems, the reduced operation alternative for the Penz Farms Company and Darwin Schroeder operations would involve an approximate 68% reduction in odorant emissions and in land area required for manure application.

Because of the attendant reduction in swine capacity and manure quantities, the reduced operation alternative would result in reduced operational effects such as those related to transportation requirements, noise, and, most significantly, odors. As shown in Table 10.3-2, the range of odor perception for both the worst and typical case conditions would be reduced by about 50% in either the Penz Farms Company or Darwin Schroeder project regions. Under worst-case conditions, the number of affected residences would decrease (as compared to the unmitigated proposed action) from 41 to 12 for the Penz Farms Company facilities and from 37 to 8 for the Darwin Schroeder facilities. Furthermore, no houses in the Penz Farms Company study region would be subject to chronic odor problems under this alternative, while only one house adjacent to the Darwin Schroeder operation (the applicant's) would experience chronic effects. The possibility of accidental release of manure to the

TABLE 10.3-1

QUANTITY OF RAW SWINE MANURE GENERATED BY THE REDUCED OPERATION ALTERNATIVE

Swine Capacity	Individual Swine Weight (pounds)	Total Swine Weight (pounds)
Penz Farms Company*		
150 sows	400	60,000
8 boars	400	3,200
1,150 pigs	110	126,500
	Total Swine Weight =	189,700 pounds
	Unit Volume =	1.0 cubic feet per 1,000 pounds per day
	Total Manure Volume =	190 cubic feet per day (1,425 gpd)
Darwin Schroeder*		
150 sows	400	60,000
8 boars	400	3,200
1,150 pigs	110	126,500
	Total Swine Weight =	189,700 pounds
	Unit Volume =	1.0 cubic feet per 1,000 pounds per day
	Total Manure Volume =	190 cubic feet per day (1,425 gpd)
Hilltop Pork Producers**		
510 sows	350	178,500
25 boars	350	8,750
510 pigs	10	5,100
1,020 pigs	35	35,700
	Total Swine Weight =	228,050 pounds
	Unit Volume =	1.0 cubic feet per 1,000 pounds per day
	Total Manure Volume =	228 cubic feet per day (1,710 gpd)

*Farrow-to-finish operation.
**Feeder-pig operation.

TABLE 10.3-2

QUANTITATIVE SUMMARY OF POTENTIAL FACILITY ODOR IMPACTS-

REDUCED OPERATION ALTERNATIVE

Odor Intensity[Δ]	Maximum Range of Facility Odor Perception (miles)*		Maximum Number of Residences Within Range of Odor Stimulus**	
	Worst-Case Meteorological Conditions†	Typical Case Meteorological Conditions††	Worst-Case Meteorological Conditions†	Typical Case Meteorological Conditions††
Penz Farms Company	0.84	0.26	12	0
Darwin Schroeder	0.84	0.26	8	1
Hilltop Pork Procedures	0.63	0.14	10	0

Source: Based on methodology in ERT 1979a.

*Representing the envelope of all possible wind directions.

**At any given instant, the actual number of residences will be only a fraction of this number, depending on the wind direction.

†Wind speed: 1.0 m/sec (2.2 mph), stable atmospheric conditions

††Wind speed: 5.0 m/sec (11.2 mph), neutral atmospheric stability conditions.

ΔRefers to the minimum odor intensity that will be experienced when the receptor is directly downwind of the proposed feeding operation.

environment and the remote possibility of zoonotic disease transmission associated with the proposed action would not be significantly reduced by this alternative.

10.3.2 Hilltop Pork Producers

The reduced operation alternative considered for Hilltop Pork Producers entails a 510-sow confined feeder-pig operation. Feeder pigs weighing approximately 50 pounds would be produced and transported to two existing confined swine finishing operations. The feeder-pig operation would have a maximum capacity of approximately 2,065 swine, with an average weight of approximately 110 pounds, and would produce a maximum of approximately 8,700 pigs per year.

Under this alternative, feeder pigs would be transported to two existing confined swine finishing operations owned and operated by Hilltop Pork Producers. One facility is located approximately 0.7 miles east of the proposed facilities site and has a capacity of approximately 1,200 swine. The second facility is located in Rice County and has the capacity to contain approximately 1,500 swine. Each of the facilities currently purchases feeder pigs. The reduced operation alternative would not result in any change over baseline conditions at these existing facilities as the operator would simply discontinue purchasing feeder pigs and the supply would be provided by the new facilities.

Elimination of the finishing component of the proposed operation would reduce the swine population and the annual quantity of generated waste. The quantity of raw swine waste generated by this alternative is given in Table 10.3-1. Given similar operating and manure management systems, the reduced operation alternative for Hilltop Pork Producers would involve an approximate 62% reduction in odorant emissions and in land area required for application of manure. In the Hilltop Pork Producers study region, the range of worst-case associated odor impacts would be reduced from 0.63 to 0.34 miles, while the typical case (chronic) range would decrease from 0.34 to

0.14 miles. Ten houses in this study region are predicted to experience worst-case associated impacts (versus 13 residences under the proposed action). No residences would be subject to chronic impacts under either the Reduced Operation Alternative or the unmitigated proposed action.

10.4 Alternative Manure Application Parcels

Each applicant has identified land areas proposed for application of swine manure as fertilizer as well as other alternative land areas available for this purpose. All parcels available for application of swine manure are shown in Figures 3.1-5 and 3.1-6 and the tillable acreage within each parcel is given in Table 3.3-1.

Geographic characteristics of available parcels are summarized in Table 10.4-1. The roadway distance between each parcel and the corresponding facilities site is significant practically and environmentally. Roadway distance affects the operator's labor and transportation requirements as well as the potential for environmental effects related to spillage or leakage of transported manure. The number of residences on or adjacent to each parcel is significant because it affects the number of persons potentially exposed to any public health or odor effects associated with manure application activities. As shown on Table 10.4-1, alternative manure application parcels would generally require greater roadway transportation of manure than proposed parcels. Additionally, no significant reduction in the number of residents located near manure application sites would be realized by the use of alternative parcels. In one case, the injection of manure in Penz Farms Company parcel G, rather than parcel F, would result in a reduction in the number of adjacent residences; however, greater roadway transportation of manure would be required.

The quantity of direct run-off per acre generated in response to storm events is a function of the soils types, slopes, and land use of a given parcel. Direct run-off from cropland used for application of manure may contain elevated concentrations of nutrients and bacterial water contaminants. Therefore, run-off characteristics provide a basis for comparing available parcels in terms of the potential for adverse effects to surface water quality. However, run-off calculations performed on the basis of soil type, land cover, and slope features of each parcel, indicate that available parcels do not significantly differ with respect to run-off characteristics (ERT 1979b).

TABLE 10.4-1

GEOGRAPHIC CHARACTERISTICS OF PARCELS

AVAILABLE FOR MANURE APPLICATION

Parcel	Minimum Roadway Distance to Facilities Site (miles)	Number of Residences within 0.25 miles
Penz Farms Company		
A*	0	2
B*	0	5**
C	0.5	2
D	0.8	3
E	0	6
F*	0.3	4
G	0.8	1
Darwin Schroeder		
A*	0	1**
B*	0.1	2**
C*	0.6	1
D*	1.8	1
E	0.9	3
F	1.5	4
Hilltop Pork Producers		
A*	0	1
B*	2.5	5
C*	1.5	4
D*	3.2	3
E*	2.8	4
F	3.0	11

*Proposed.

**Includes applicant's residence.

Parcels identified by Penz Farms Company as available for spray irrigation may be compared on the basis of their calculated maximum allowable irrigation rate (that rate above which surface run-off or ponding would occur). Calculated maximum allowable irrigation rates for available parcels do not vary significantly, with the exception of portions of parcels C and D. Approximately 11% and 18% of parcels C and D, respectively, would require application rate reductions because of relatively high slopes (ERT 1979b).

In summary, comparison of available parcels on the basis of geographic characteristics and hydrologic properties indicates that no environmental or practical benefits would be associated with the use of identified alternative manure application parcels.

10.5 Alternative Manure Management Systems

10.5.1 Alternative Selection Criteria and Methodology

To adequately consider all available options, two levels of alternatives are described. The first level is a comprehensive listing of manure management techniques currently available. These "alternatives" include the proposed actions. The second level is a specific matching of the general options to the specific facilities under question. In this way, one facilities' proposed action may, in fact, be an alternative for another of the facilities.

General Alternatives

Tables 10.5-1 and 10.5-2 list available livestock waste management techniques. The only criteria used in compiling these lists are that the systems are applicable to swine manure and the systems have been tested under field conditions.

Although the alternatives are divided into component unit processes (that is, handling, treatment, storage, disposal), arbitrary selections from each list cannot be made. Selection of one treatment option would exclude certain storage or disposal options. For example, a dewatering treatment option must be evaluated in conjuction with a pile storage and surface spreading option and could not be used in conjunction with tank storage or irrigation. The development of these total system trains are discussed in later sections.

Specific Alternatives and Selection Criteria

The criteria discussed below are applied to the general lists of manure management options to identify reasonable alternatives for each of the facilities.

TABLE 10.5-1

GENERAL ALTERNATIVES FOR MANURE HANDLING, TREATMENT, AND STORAGE

Alternative Handling Systems

1. Flushing (slotted floor)
2. Scraping (slotted floor)
3. Flushing (solid floor or open lot)
4. Scraping (slotted floor or open lot)

Alternative Treatment Systems

1. Settling tanks or basins
2. Oxidation ditches
3. Anaerobic lagoons
4. Dewatering and composting
5. Dewatering only
6. Anaerobic digestion
7. Aerated lagoon

Alternative Storage Systems

1. Storage lagoons
2. Storage tanks, open (deep pit)
3. Storage tanks, closed (deep pit)
4. Pile storage (for dewatering treatment alternatives only)

TABLE 10.5-2

GENERAL ALTERNATIVES FOR DISPOSAL

Land Application Alternatives

1. Liquid or slurry injection
2. Spray irrigation
3. Ridge and furrow irrigation (surface application)
4. Surface spreading and incorporation

Other Disposal Alternatives

1. Landfill
2. Incineration
3. Feed supplements

Technological Feasibility

A reasonable alternative for a commercial swine facility should not require technical skills beyond the capability of the available staff. Livestock facilities do not generally require certified treatment plant operators or highly skilled engineers and scientists for efficient operation. Options that would require such personnel cannot be considered a reasonable alternative.

Second, the equipment needed for a specific option should be readily available in the commercial market. The proposed facilities should not be required to obtain or construct specialized equipment.

Cost/Benefit

This cost/benefit criterion is applied in the following way: increased capital or operating cost alone has not ruled out consideration of an alternative; however, a particular alternative must provide additional environmental benefits or improve resource recovery. This approach may be applied to an option such as methane producton by digestion. This option is more costly than the proposed actions and may not comply with the technological feasibility criterion; however, such a system significantly reduces odor emissions, produces a significant amount of energy, and conserves nitrogen for land application purposes.

The resulting alternatives are summarized in Table 10.5-3 and are described in the following sections.

10.5.2 Penz Farms Company and Darwin Schroeder

Deep Pit Storage

The primary storage alternative for the Penz Farms Company and Darwin Schroeder facilities is deep pits (either earthen or tanks). For this scheme, a collection system consisting of scrapers rather than flushing is advisable to limit the needed storage volumes.

TABLE 10.5-3

SUMMARY OF SPECIFIC ALTERNATIVES

Source	Deep Pit Storage	Oxidation Ditch
Penz Farms Company 4,420 gpd at 8.4% solids	Handling: scraper Treatment: none Storage: 200,000 cubic feet pit or tank Disposal: injection	Handling: none required Treatment: 38,000 cubic feet oxidation ditch Storage: 282,000 cubic feet basin Disposal: injection
Darwin Schroeder 4,420 gpd at 8.4% solids	Handling: scraper Treatment: none Storage: 200,000 cubic feet pit or tank Disposal: injection	Handling: none required Treatment: 38,000 cubic feet oxidation ditch Storage: 282,000 cubic feet basin Disposal: injection
Hilltop Pork Producers 4,520 gpd at 8.5% solids		Handling: none required Treatment: 38,000 cubic feet oxidation ditch Storage: 200,000 cubic feet basin Disposal: injection

This alternative meets both the technological feasibility and cost/benefit criteria. No advanced technologies are involved, and the equipment is readily available on the commercial market. If above-ground tanks are used, the costs (capital) may be higher; however, there are environmental benefits in the form of reduced odorant emissions.

Advantages

The major advantage of this alternative is the reduction in odorant emissions from the tanks or pits owing to the reduction in surface area (AES undated b). As discussed in Section 5.1, odor effects associated with the Hilltop Pork Producers proposed action (tanks) are predicted to be significantly less than those associated with the other proposed facilities (storage basins). Additionally, nitrogen losses are reduced by limiting the surface area of the storage facility, thus allowing for greater economic return to the operation. Deep pits or tanks also require less land area committed to manure treatment and storage. An additional advantage of tank-type deep pit storage is related to the structural integrity of these facilities. The steel construction and concrete base of a tank system affords greater protection against accidental release of stored manure. This advantage may be particularly significant in karst regions.

Disadvantages

The major disadvantage of this alternative is additional capital cost. Although detailed costs for the proposed action are unavailable, a cost comparison of manure storage options for similarly sized operations indicates that the capital investment required for deep pit storage is approximately 7% greater than that for storage basins (White and Forster 1978). Although the capital investment is higher, there is a possibility of larger returns from nutrient conservation (White and Forster 1978). This, however, results in greater land requirements for land application.

Oxidation Ditch

The proposed actions are essentially anaerobic systems. The aerobic system proposed as an alternative is an "in-the-building" oxidation ditch. An oxidation ditch is a continuous open channel with an aeration rotor. The aeration rotor is normally operated continually and supplies the necessary oxygen for aerobic bacteria.

Oxidation ditch systems have been extensively studied and reviewed (Day et al. 1975). In some cases, oxidation ditches have been used for treatment prior to direct disposal. In this case, the system is proposed as an additional mechanism to stabilize the wastes and control odors (Loehr 1974). Oxidation ditches have been used primarily for swine operations (Loehr 1974).

Advantages

The major advantage of an oxidation ditch is odor control. Since all the major odors associated with confined swine facilities are reduced compounds, oxygenating the raw waste minimizes or prevents their formation (Loehr 1974). If proposed oxygen levels are maintained, objectionable odors are reduced in the building and during land application and the total waste volume is reduced through digestion and through evaporation in the building (Midwest Plan Service 1975).

Disadvantages

A major disadvantage of this alternative is increased capital and operating expenses. The oxidation ditch alternative requires the same storage capacity as the proposed action. Therefore, the ditch itself is an added cost above the cost of the proposed action. In addition, the swine buildings themselves are larger than those proposed. Operating expenses are increased because of additional power requirements, pump and rotor maintenance, and personnel. The minimum

additional power requirements for each facility would be approximately 2,700 kilowatt hours per day (ERT 1979a). The costs of operating an oxidation ditch have been estimated to be approximately $0.89 per hog marketed (Kreis 1978).

An additional disadvantage of the oxidation ditch alternative is that operational problems may be encountered (Midwest Plan Service 1975). The major problems have been foaming and mechanical failures. Odors and foaming problems occur if aerobic conditions are not maintained. Additionally, foaming may result from sudden temperature changes or sudden changes in waste quantities added to the ditch (Midwest Plan Service 1975).

Application Techniques

The alternative manure application method considered for the Penz Farms Company proposal is the injection of all manure (that is, elimination of proposed spray irrigation). The advantages of this alternative include nitrogen conservation, odor control, and elimination of the potential for aerosol transmission associated with spray irrigation (see Section 5.1). The primary disadvantage is the increased energy requirements required for hauling and applying manure (Midwest Plan Service 1975).

No alternative application techniques are considered for the Darwin Schroeder operation since the proposed technique (injection) minimizes offensive odors and nutrient loss (Midwest Plan Service 1975).

10.5.3 Hilltop Pork Producers

Oxidation Ditch

Since the Hilltop Pork Producers proposed action is a deep pit (tank) storage system, the primary alternative is an in-building oxidation ditch. The system would be basically the same as the

system described for the Penz Farms Company and Darwin Schroeder facilities. The advantages and disadvantages of this system are described in Section 10.5.2.

Earthen Storage Basins

Although this alternative does not meet one of the alternative selection criteria established in Section 10.5.1 (that is, it would not afford greater environmental benefits than the proposed action), it is briefly considered here since the applicant has indicated that he is considering this option. Detailed evaluation of this alternative would require onsite test borings and additional information regarding design and operation of the system.

Assuming that test borings indicated that onsite geologic conditions were suitable for implementation of a storage basin system, the environmental effects of this alternative would be similar to those described for the Penz Farms Company and Darwin Schroeder proposed action (see Section 5). The range of odor effects under worst-case and typical-case conditions would be increased because of increased surface area of the storage facilities. Additionally, the potential for release of stored manure would be increased in that earthen storage basins would not afford the degree of safety associated with the proposed tanks. This alternative would not significantly affect projected impacts unrelated to the above factors (see Section 5).

10.5.4 Options Not Evaluated

The treatment options not evaluated include:

- settling tanks or basins (Hilltop Pork Producers only),
- anaerobic lagoons,
- dewatering and composting,
- dewatering,
- anaerobic digestion, and
- aerated lagoons.

Settling tanks or basins are the proposed action for the Penz Farms Company and Darwin Schroeder facilities. It was not considered a reasonable alternative for the Hilltop Pork Producers facilities because no environmental advantage would be gained. Also, settling tanks constitute an additional cost. Similarly, anaerobic lagoons were not considered for any of the facilities.

Dewatering, composting, and anaerobic digestion have all been tested and proven at full-scale experimental facilities. However, none of these alternatives meet the technological feasibility criterion. The operation of such facilities would require capabilities and training beyond that encountered at most operating swine facilities.

Disposal options not considered include:

- spray irrigation,
- ridge and furrow irrigation,
- landfill,
- incineration, and
- feed supplements.

Incinerators are commercially available only for the disposal of dead animals. The use of swine wastes as feed supplements is currently an experimental procedure. Spray irrigation and ridge/furrow irrigation provide maximum opportunity for odors, aerosol transmission and nitrogen losses; therefore, this application technique is not as environmentally sound as direct injection or surface spreading.

10.6 References

AES undated a. Pork Production Systems with Business Analyses. Pork Industry Handbook 15. Agricultural Extension Service. St. Paul: University of Minnesota.

AES undated b. Fertilizer Value of Swine Manure. Pork Industry Handbook. Agricultural Extension Service. St. Paul: University of Minnesota.

Day, D. L., D. D. Jones, A. C. Dale, and D. Simons 1975. Oxidation Ditches for Livestock Wastes. Managing Livestock Wastes. Proceedings of Third International Symposium, American Society of Agricultural Engineers.

ERT 1979a. Air Quality: Related Actions EIS on Confined Swine Facilities. TWP 5. Document P-3634-250. Environmental Research & Technology, Inc., Concord, MA.

ERT 1979b. Geology and Hydrology: Related Actions EIS on Confined Swine Facilities. TWP 7. Document P-3634-350. Environmental Research & Technology, Inc., Concord, MA.

Kreis, R. D. 1978. Control of Animal Production Odors: The State-of-the-Art. EPA 600/2-78-083. U.S. Environmental Protection Agency, Ada, OK.

Loehr, R. C. 1974. Agricultural Waste Management. New York: Academic Press.

Midwest Plan Service 1975. Livestock Waste Facilities Handbook. Ames, IO: Iowa State University.

White, R. K. and D. L. Forster 1978. A Manual on Evaluation and Economic Analysis of Livestock Waste Management Systems. U.S. Environmental Protection Agency, Office of Research and Development.

11. COORDINATION OF THE EIS EFFORT WITH OTHER GOVERNMENT AGENCIES AND INTERESTED GROUPS

11.1 Impact on State Government of Any Federal Controls Associated with Proposed Action

Federal regulatory agencies directly involved with the proposed action include the U.S. Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA).

The Federal Water Pollution Control Act of 1972 (FWPCA) established a uniform nationwide water pollution control program, within which MPCA programs operate. The MPCA administers this program while the EPA retains approval and supervisory control. The principal mechanism used to achieve the water quality goals of FWPCA is to reduce the discharge of pollutants by new and existing point sources. This program, called the National Pollutant Discharge Elimination System (NPDES) is administered in Minnesota by the MPCA. The MPCA will determine whether each proposed confined swine facility will require an NPDES permit and, if so, would issue or deny the permit. The EPA reviews each NPDES permit.

The FDA is responsible for regulating animal drugs, feeds, and related products. Of particular interest to this EIS are the FDA regulations concerning the safe subtherapeutic use of antibacterials in animal feeds. FDA's authority covers the distribution of medicated feeds by only approved feed mills, the on-farm distribution of medicated feeds, required submission of drug efficacy data and other product data, the approval of efficacy claims, the setting of dosages for specific species, and approval of new animal drugs. The authority given to FDA stems from the Food, Drug, and Cosmetic Act and powers granted to the Commissioner of FDA and the Director of the Bureau of Veterinary Medicine.

The Food, Drug, and Cosmetic Act also gives FDA authority to set tolerance for allowable residues of animal drugs in food-producing animals. Periodic meat inspections are carried out by the U.S. Department of Agriculture to check for violations of the residue tolerance levels.

11.2 Multistate Responsibilities Associated with Proposed Action

Because the proposed facilities sites lie well within Minnesota borders, there are no formal multistate responsibilities associated with the proposed action. Moreover, any environmentl effects of the proposed action would not extend to neighboring states. Multistate implications of the proposed action are restricted to the purchase of construction materials or equipment from neighboring states and the possible distribution of the ultimate meat products to neighboring states.

11.3 Coordination Effort

The following groups were consulted in the development of the draft EIS.

11.3.1 State Agencies

Mark Seetin - Commissioner, Department of Agriculture

Howard Casmey - Commissioner, Department of Education

George Petterson, M.D. - Commissioner, Department of Health

Joseph Alexander - Commissioner, Department of Natural Resources

Dick Graun - Commissioner, Department of Transportation

Al Johnson - Director, Minnesota Energy Agency

Arthur Sidner - Director, State Planning Agency and Environmental Quality Board

David Printy - Commissioner, Department of Economic Development

Marijo Olson - Acting Commissioner, Department of Economic Security

Soil and Water Conservation Board

Matt Walton - Minnesota Geological Survey

Bill Morrissey, Angela Anderson - Minnesota Department of Natural Resources - Recreation Planning Section

Roy Romero, Bill Becker - SCORP, Minnesota Department of Natural Resources

Gerry Jensen, Robin Fox - Division of Parks and Recreation - Scientific and Natural Areas Program, Minnesota Department of Natural Resources

Minnesota Department of Natural Resources, Division of Fish and Wildlife

Minnesota Department of natural Resources, Division of Forests and Lands

Cliff Archinger, Jason Jentzsch, Vic Moore, Jim Ramstrom, Neil Gustafson - Minnesota Department of Natural Resources - State

Planning Agency

Ann Purrington - Labor Market Information Center

Dave Kjomee, Minnesota Agricultural Extension Service

Dr. Philip Raup - University of Minnesota Department of Agriculture and Applied Economics, St. Paul

Lyle Pratt, Minnesota Crop and Livestock Reporting Service

Mel Hogstead, Bill Thorn, Bruce Hawkinson, Dick Sternberg, Arthur Peterson - Minnesota Department of Fisheries Division of Fisheries

Minnesota Department of Natural Resources, Publications Division

Carol Henderson - Minnesota Department of Natural Resources, Non-Game Supervisor

Jack Heather - Olmsted County Wildlife Area Manager, Minnesota Department of Natural Resources

Nick Gulden - Wabasha County Wildlife Area Manager, Minnesota Department of Natural Resources

Dave Millis, Bob Djupstrom - Division of Waters, Minnesota Department of Natural Resources

Dr. Tom F. Waters - University of Minnesota

Stephen Masten - Attorney General's Office

Jim Nye - Minnesota Department of Health

11.3.2 County Agencies

Olmsted County Soil and Water Conservation District

Goodhue County Soil and Water Conservation District

Bill Poblete - Olmsted County Health Department

Phillip Wheeler - County of Olmsted Consolidated Planning Department

Marilyn Gillespie - Olmsted County Auditor

Dave Dunn - Olmsted County Park and Recreation Department

Ron Livingston - Olmsted County Zoning Administrator

Mr. Joyce Bucher - Goodhue County Zoning Administrator

Helen Possehl - Goodhue County Auditor Office

Bill Coons, Hazel Pearson - Olmsted County Assessor

Virgil Rapp - Goodhue County Assessor's Office

Mike Pinsonneault - Goodhue County Highway Engineering

Mike Sheehan - Olmsted County Highway Engineering

11.3.3 Federal Agencies

Geological Survey - Water Resources Division
U.S. Fish and Wildlife Service - Region III
Clarence Oster - U.S. Environmental Protection Agency
Agricultural Stabilization and Conservation Service
Jerry Hildebrandt - USDA Soil Conservation Service

11.3.4 Miscellaneous Agencies

Agricultural Extension Service
Metropolitan Council
Upper Midwest Council
Upper Midwest Waste Control Commission
Curt Taylor - City of Rochester Park and Recreation Department
Karen Back - Elgin Township Zoning Administrator
Southern Minnesota Rivers Basin Board

Interest Groups

Clear Air Clear Water Unlimited
The Environmental Agribusiness Resources Technologies and Horticultural Association
Environmental Balance Association of Minnesota
Sid Chase - The Izaac Walton League of America, Inc. - Rochester, Minnesota
Christy Kalass - The Izaac Walton League of America, Inc. - Zumbrota, Minnesota
Minnesota Public Interest Research Group
Save Hiawathaland Inc.
Sierra Club - Wasioja Group
Water Research Foundation

Interested Persons

Mary Ellen Kersch
Susan Rohl
Mrs. James Podolske
Dick F. Flores
John Scanlan
Ken Kruger
Karen Back
Robert Rohl
Richard Brennan
Laura Perrett
Darrell Nesseth
Ed Kaehler
John Fetuedt
Mrs. Maurice E. Kyllo
LaVerne Nesseth
Paul K. Gerber
Kenneth and Betty Henderson
Mr. and Mrs. Earl Reckard
Sanford K. Flaten

11.4 References

Federal Water Pollution Control Act 1972. Public Law No. 92-500, 86 Stat. 816, 33 U.S. Code §§ 1251 et. sef.

GLOSSARY

Adsorption	(1) The adherence of dissolved, colloidal, or finely divided solids on the surfaces of solid bodies with which they are brought into contact. (2) Action causing a change in concentration of gas or solute at the interface of a two-phase system.
Aeration	The bringing about of intimate contact between air and a liquid by: (a) spraying the liquid in the air, (b) bubbling air through the liquid, (c) agitating the liquid to promote surface absorption of the air.
Aerobic bacteria	Bacteria that require free elemental oxygen for their growth. Oxygen in chemical combination will not support aerobic organisms.
Aerobic decomposition	Reduction of the net energy level of organic matter by aerobic microorganisms.
Aerosol	Dispersion of solid or liquid particles of microscopic size in gaseous media.
Agitation	The turbulent remixing of liquid and settled solids.
Anaerobic bacteria	Bacteria not requiring the presence of free or dissolved oxygen for metabolism. Strict anaerobes are hindered or completely blocked by the presence of dissolved oxygen and sometimes by the presence of highly oxidized substances such as sodium nitrates, nitrates, and perhaps sulfates.
Anaerobic decomposition	Reduction of the net energy level and change in chemical composition or organic matter.
Aquifer	A formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.
Bacteria	A group of essentially unicellular microscopic organisms lacking chlorophyll. Bacteria are usually regarded as plants.
Carbonate	1. A compound containing the radical CO_3^{2-}, such as calcium carbonate, $CaCO_3$. 2. A rock consisting mainly of carbonate minerals, such as limestone or dolomite.
Composting	Present-day composting is the aerobic decomposition of organic wastes to a relatively stable humus subject to further, slower decay but sufficiently stable not to reheat or cause odor or fly problems.

Confining bed	A body of impermeable material stratigraphically adjacent to one or more aquifers.
Digestion	Commonly, the anaerobic breakdown of organic matter in water solution or suspension into simpler or more biologically stable compounds, or both. Organic matter may be decomposed to soluble organic acids or alcohols and subsequently converted to gases such as methane and carbon dioxide. Bacterial action alone cannot complete destruction of organic solid materials.
Dilutions to threshold (D/T)	The number of times a given volume of odorous air must be diluted to the threshold of perception.
Dissolved oxygen	The oxygen dissolved in a liquid, usually expressed in milligrams per liter.
Fertilizer value	The potential worth of the plant nutrients in the wastes and available to plants when applied to soil. It is the cost of obtaining the same nutrients commercially.
Infiltration	The process whereby water enters soil through the surface.
Infiltration rate	The rate at which water enters soil under a given condition expressed as depth of water per unit time, usually inches per hour.
Karst	A terrain, generally underlain by limestone, in which topography is chiefly formed by the dissolving of rock, and which is commonly characterized by channeling, closed depressions, subterranean drainage, and caves.
Leaching	The removal of soluble constituents from soil or other material by water.
Livestock wastes	Manure with added bedding, rain, or other water, soil, etc. It also includes wastes such as milkhouse or washing wastes not particularly associated with manure. It also includes hair, feathers, and other debris.
Loam	A rich, permeable soil composed of clay, silt, and sand and usually containing organic matter.
Loess	A fine, well-sorted wind-blown deposit derived from glacial outwash. Much of the fertile farmland in the Midwest is blanketed by loess.

Manure	The fecal and urinary defecations of livestock and poultry. Manure does not include spilled feed, bedding, or additional water or run-off.
Odorant	A single, identifiable gaseous compound (for example, hydrogen sulfide) which contributes to the odor from a source as perceived by a community receptor.
Organic matter	Chemical substances of animal or vegetable origin containing carbon.
Oxidation	The combination of oxygen with a substance, or the removal of hydrogen from it or, more generally, any reaction in which an atom losses electrons.
Oxidation ditch	A treatment unit in which an aerator supplies oxygen and circulates the liquid.
Pathogen	An organism responsible for the transmission of communicable diseases.
Permeability	A measure of the relative ease with which a porous medium can transmit a liquid under a potential gradient. It is a property of the medium that is dependent upon the shape and size of the pores.
pH	The reciprocal of the logarithm of the hydrogen-ion concentration. A pH of 7 is neutral; pH = 0.7 is acidic; pH = 7-14 is alkaline.
Redox potential (Eh)	A measure of the tendency of chemical compounds to become oxidized (high Eh) or reduced (low Eh); quantified in millivolts.
Reduction	The removal of oxygen from a substance, or the addition of hydrogen to it, or, more generally, any reaction in which an atom gains electrons.
Settleable solids	Matter in wastewater that will not stay in suspension during a preselected settling period but either settles in the bottom or floats to the top.
Sinkhole	General term for closed depressions formed in karst regions. They may be basin, funnel, or cylindrical shaped.
Slotted floors	The floor surface of a building that has opened spaces or grooves to allow material to drop below the floor surface.

Solids content	The residue remaining after water is evaporated from a sample at a specified temperature, usually 103°C.
Synergism	An action where the total effect of two active components in a mixture is greater than the sum of their individual effects.
Threshold	The lowest level at which an odor is perceived by a human subject. The threshold value is generally determined by an odor panel.
Till	Unsorted and unstratified debris deposited directly by glacial ice; contains particles from clay size to boulders.
Total solids	The sum of dissolved and undissolved constituents in water or wastewater, usually stated in milligrams per liter.
Volatile solids	The quantity of solids in liquids lost in ignition of the dry solids at 600°C.