Draft Environmental Impact Statement
on the
Hancock Pro Pork Feedlot Project, Stevens and Pope Counties

Minnesota Pollution Control Agency
Responsible Government Unit

Contact for Responsible Government Unit:

William J. Lynott, Project Manager
Operations and Environmental Review Unit
Minnesota Pollution Control Agency
520 Lafayette Road
St Paul MN 55155
651/296-7794

Contact for Hancock Pro Pork:

David Paul
Rt. 2 Box 88
Hancock MN 56244
320/392-5507

ABSTRACT: Hancock Pro Pork is a multisite hog feedlot project located in Stevens and Pope Counties. The project includes a hog farrowing and nursery site, which is jointly owned by the members of Hancock Pro Pork. This site produces feeder hogs, which are then distributed to the members either for feeding out to market weight at their own facilities or sale on the open market. An Environmental Assessment Worksheet (EAW) was prepared on this project in 1997, and the MPCA concluded the EAW process with a negative declaration (no Environmental Impact Statement (EIS) required). This decision was reversed in late 1998 by the Pope County District Court, which ordered the preparation of an EIS. This draft EIS addresses the potential for environmental and socioeconomic impacts from the farrowing and member sites. In particular, the potential for impacts on ground water, surface water, air, human health, wildlife, and habitat are assessed, as well as manure management practices, appropriate alternatives, and mitigation. The draft EIS is being made available for public review pursuant to Minn. R. 4410.2600, and will be on public review for 45 days, during which two public meetings will be conducted in the area of the project. Written comments on the draft EIS will be responded to in a written response document that will in turn be distributed to all on the mailing list. Any needed revisions will be incorporated into the final EIS, which will be publicly distributed and then brought to the MPCA Citizens Board for the adequacy decision. All on the mailing list will be notified in advance of the public meetings and the Board adequacy decision meeting.

List of Preparers

The following were the primary preparers of the Hancock Pro Pork Feedlot Project Environmental Impact Statement.

Pollution Control Agency

William J. Lynott
BA Biology, University of Minnesota, Duluth
Graduate work, Idaho State University
20 years experience
Project Manager

Dean Fundine
BS Secondary Ed., University of Minnesota, Duluth
33 years experience
Air monitoring and standards

Gregory Pratt
PhD Plant Physiology, University of Minnesota
20 years experience
Air modeling and standards

James Stockinger
BS Conservation, University of Wisconsin
4 years experience
Hydrology and hydrogeology

Gary Lackey
BS Geological Engineering, South Dakota School of Mines and Technology
4 years experience
Feedlot engineering and manure management

Gantzer Environmental Software and Services

Charles J. Gantzer
BS Ecology, Ethology, and Evolution; University of Illinois (Urbana- Champaign)
MS Environmental Science in Civil Engineering University of Illinois (Urbana- Champaign)
PhD Environmental Science in Civil Engineering University of Illinois (Urbana- Champaign)
15 years experience

Liesch Associates, Inc.

Kenneth P. Olson
BS Geology - University of Minnesota, 1980
Graduate Work, Hydrogeology
Minnesota Professional Geologist #30102
Private consulting since 1980.

Bruce Rehwaldt
BA Chemistry - Gustavus Adolphus St. Peter, MN, 1981
MS Civil Engineering - University of Minnesota, 1985
Minnesota Professional Engineer # 19042
Private Consulting since 1985

Margaret Nelson
BS Geology - University of North Dakota, Grand Forks, 1998
MS Geological Engineering - University of Wisconsin, Madison, 2001
EIT
Private Consulting since 2001

Bryan Hassing
BS Geology - Winona State University, 1990
Wisconsin Professional Geologist #885
Private Consulting since 1990

Michael Reisinger (No longer with Liesch)
BS Land-Use Management - University of Wisconsin, River Falls, 1997
MS Environmental Engineering - University of Minnesota - In Progress
Private Consulting since 2000.

Impact Planning, Inc.

Kenneth Nimmer:
BS Environmental Administration - University of Wisconsin, Green Bay, 1989
MS Public Administration - University of Colorado, Colorado Springs, 1994
University of Nevada, Las Vegas, 1996
Planner for Government Entities 1989-1997
Private Consulting 1998-Present

SIGNATURE PAGE

This draft EIS was prepared by me or under my direct supervision

Kenneth P. Olson, PG
Liesch Associates, Inc.

Bruce Rehwaldt, PE
Liesch Associates, Inc.

Margaret Nelson
Liesch Associates, Inc.

This air modeling and impact assessment of the draft EIS was prepared by me or under my direct supervision

Charles J. Gantzer Environmental, Ph.D.
Gantzer Environmental Environmental Software and Services, Inc.

The socio-economic assessment of the draft EIS was prepared by me or under my direct supervision

Kenneth Nimmer
Impact Planning

The draft EIS was reviewed and approved for public notice and distribution by me on behalf of the Minnesota Pollution Control Agency

William Lynott
Minnesota Pollution Control Agency

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ACRONYM LIST

AMA - American Medical Association
bgs - below ground surface
BAH – Minnesota Board of Animal Health
BOD - Biological Oxygen Demand
BP – Before Present; used in geological time scale descriptions.
CDC - Centers for Disease Control
CFU – colony forming units; used to describe levels of fecal coliform bacteria in a water sample
CRWP - Chippewa River Watershed Project
CSAH - County State Aid Highway
CWI - County Well Index
DNR – Minnesota Department of natural Resources
EAW – Environmental Assessment Worksheet
EIS – Environmental Impact Statement
EPA - Environmental Protection Agency
EQB Environmental Quality Board
EU - European Union
FDA - Food and Drug Administration
GPS - Global Positioning Systems
HPP - Hancock Pro-Pork
HRL - Health Risk Limit
HVAC - Heating, ventilation, and air conditioning
iHRV - inhalation Health Risk Value
ISC - Industrial Source Complex
MDNR -Minnesota Department of Natural Resources (also DNR, MN DNR)
MDNR NHNRP - MDNR Natural Heritage and Nongame Research Program
MGS - Minnesota Geological Survey
MMP - Manure Management Plan
MN DNR – Minnesota Department of Natural Resources (also DNR, MDNR)
MPCA - Minnesota Pollution Control Agency
MPP - Minnesota Pork Producers
MSDS - Material Safety Data Sheet
NCH - North Central Hardwood Forest (Ecoregion)
NGP - Northern Glaciated Plains (Ecoregion)
NPDES - National Pollutant Discharge Elimination System
NRMRL - National Risk Management Research Laboratory
PM - Particulate Matter
PPR - Prairie Pothole Regions
SDC - State Demographic Center
TI - Tile Inlet
TPR - Tallgrass Prairie Region
TSS – total suspended solids
tVOOCs - Total Volatile Odorous Organic Compounds
UWN – Unique Well Number

USDA - United States Department of Agriculture
USDA/FSIS - Food Safety and Inspection Service
VFAs - Volatile Fatty Acids
VOOCs - Volatile Odorous Organic Compounds
(v/v) - volume per volume

GLOSSARY

The sources of this section are the Glossary of Soil Science Terms (SSSA, 1997), the Resource Conservation Glossary (NRCS, 1982), Dictionary of Geologic Terms (American Geological Institute, 1994), Livestock Waste Handbook (Midwest Plan Service, 1993), various technical work papers prepared for the Animal Agriculture Generic EIS, and the publication, Manure Management Practices for the Minnesota Pork Industry (Schmidt and Jacobson, 1994). Terms and definitions used in this document are used with particular reference to the Hancock Pro Pork feedlot project and its environmental analysis.

Acute iHRV: The concentration of a pollutant in air below which immediate health effects on humans will probably not occur.

Aerobic: Occurring in the presence of molecular oxygen (said of chemical or biochemical processes such as aerobic decomposition).

Agronomic rates: The calculated rate of manure application based on the nutrient needs of the next crop, the amount of nutrients available in the manure and the amount of nutrients present in the soil.

Algal bloom: A proliferation of living algae in lakes, streams or ponds. Algal blooms are stimulated by enrichments of phosphates or other nutrients.

Ammonia: The gas (chemical formula: NH_3) released by the microbiological decay of plant and animal proteins. Loss of ammonia to the atmosphere is commonly referred to as "**ammonia volatilization**".

Ammoniacal: Of or pertaining to ammonia, or possessing its properties; as, an ammoniacal salt; ammoniacal gas.

Ammonium: the positively charged ionic form of ammonia.

Amphibolite facies: Rocks produced by medium- to high-grade regional metamorphism.

Anaerobic digestion: The breakdown with no oxygen available into simpler or more biologically stable compounds or both. Organic matter may be decomposed to soluble organic acids or alcohols and then to gases such as methane and carbon dioxide. Bacterial action alone cannot complete destruction of organic solid materials.

Animal composting: The process of placing carcasses in layers with a carbon source and manure to allow the natural decomposition process to break down the carcass and stabilize its mass.

Animal unit (AU): Taken from Minn. R. 7020.0300 subp. 5: "Animal Unit" means a unit of measure used to compare differences in the production of animal manure that employs a as a standard the amount of manure produced on a regular basis by a slaughter steer or heifer for an animal feedlot or a manure storage area, calculated by multiplying the number of animals of each type in items A to I by the respective multiplication factor and summing the resulting values for the total number of animal units. For the purposes of this chapter, the following multiplication factor shall apply:

A. dairy cattle:

(1). One mature cow (whether milked or dry):

(a) over 1000 pounds, 1.4 animal unit; or

(b) under 1000 pounds, 1.0 animal unit;

B. beef cattle:

(1) one slaughter steer or stock cow, 1.0 animal unit;

(2) one feeder cattle (stocker or backgrounding) or heifer, 0.7 animal unit;

(3) one cow and calf pair, 1.2 animal units; and

(4) one calf, 0.2 animal unit;

C. one head of swine:

(1) over 300pounds, 0.4 animal unit;

(2) between 55 pounds and 300 pounds, 0.3 animal unit; and

(3) under 55 pounds, 0.05 animal unit;

D. one horse, 1.0 animal unit;

E. one sheep or lamb, 0.1 animal unit;

F. chickens:

(1) one laying hen or broiler, if the facility has a liquid manure system, 0.003 animal unit; or

(2) one chicken if the facility has a dry manure system:

(a) over five pounds, 0.005 animal unit; or

(b) under five pounds, 0.003 animal unit;

G. one turkey:

(1) over five pounds, 0.018 animal unit; or

(2) under five pounds, 0.005 animal unit;

H. one duck, 0.01 animal unit; and

I. for animals not listed in items A to H, the number of animal units is the average weight of the animal in pounds divided by 1000 pounds.

Aquifers: Stratum or zone below the ground surface capable of storing water.

Artesian aquifer: An aquifer that contains ground water that is under sufficient pressure to rise above the level at which it is encountered by a well, but which does not necessarily rise to or above the ground surface.

Bioaccumulate: To accumulate in a biological system. This term is commonly used to describe the uptake over time of toxic substances that persist in biological systems. If the input of a toxic substance to an organism is greater than the rate at which the substance is lost from the organism, that substance is said to be bio-accumulating.

Bioaerosols: A cloud of biologically active particles that may exhibit infectivity, allergenicity, toxicity, or other adverse health effects.

Biofilters: A filter able to remove biological matter from gases passing through it.

Biological oxygen demand (BOD): The quantity of oxygen used in the biochemical oxidation of organic matter in a specified time, at a specified temperature, and under specified conditions. A standard test used in assessing wastewater pollution strength.

Broadcasting: Method of applying manure on agricultural fields. Typically followed by disking or incorporation.

Buffer zone: Area of agricultural field in which solid or liquid manure application is prohibited.

Calcareous: Containing calcium carbonate.

CALPUFF: A non-steady-state computer modeling system being used for a wide variety of air quality modeling studies. This model was used in this EIS to assess air emission impacts from the feedlot sites.

Chlorophyll-a: The chemical in plants that captures the sun's energy and uses that energy to make food, usually carbohydrates. The volume of chlorophyll-a is measured in a water sample and is used as an estimate of the amount of algae in water.

Chronic iHRV: The level of an airborne contaminant below which chronic (ie, long-term) health symptoms or disease in humans will probably not occur.

Clastic strata: Subsurface rock layer that consists of sediment composed mainly of fragments of rocks and minerals that have been transported from their place of origin.

Clay basin: (See earthen storage basin)

Cohesive soils: Soils whose particles adhere to one another, forming a ball when squeezed in a moistened state; generally said of clay soils; typically having relatively low permeability to water movement. *See also* granular soil.

Coliforms: bacteria related to *Escherichia coli* that inhabit the gut of animals.

Cretaceous: A geologic time period thought to have covered the span of time between 135 and 65 million years ago. This term is also used to describe a system of rocks that were formed during that time period.

Crop available (or plant available) nitrogen: Nitrogen in fertilizer that is actually usable by plants. May originate in fertilizer, legumes grown the last two years, or nutrients present in the soil.

Delegated county: Taken from Minn. R. 7020.0300 subp. A: A county that has applied for and received authorization pursuant to Minn. R. 7020.1600, subp.3a, item C to implement an animal feedlot program.

Denitrification: The transformation of oxidized forms of nitrogen (such as nitrate ion) to nitrogen gas.

Devonian: The name of a geologic time period thought to have covered the span of time between 400 and 345 million years ago. The term is also used to describe a system of rocks that were formed during that time period.

Die-off rate: The calculated average rate at which specific pathogens die and no longer remain viable.

Earthen storage basin (clay basin): A basin, typically lined with clay, a synthetic material, or a combination, in which manure is stored. The structure is not designed for treatment, only storage.

Ecoregions: Areas of relative homogeneity that are described based on mapped information based in turn on land use, soils, land and surface forms, and potential natural vegetation.

Endocrine disruptor: An exogenous (originating outside the body) agent that interferes with the synthesis, secretion, transport, binding, action, or elimination of natural hormones in the body that are responsible for the maintenance of homeostasis, reproduction, development, and/or behavior. (Synonym: environmental hormones, estrogen mimics)

Endotoxin: A portion of the outer wall of a gram-negative bacteria that can cause respiratory infections or allergic reactions.

Eutrophication: Aging of lakes, whereby aquatic plants increase in abundance and waters become deficient in oxygen. The process is usually accelerated by enrichment of water with surface runoff containing nitrogen, phosphorus and other pollutants.

Farrowing: Process of birthing pigs

Fecal coliforms (fecal bacteria): A subgroup of total coliform bacteria. Fecal coliforms are bacteria that live only in the intestines of warm-blooded animals. Fecal coliforms are used as indicators of the presence of other manure-borne pathogens in surface water and ground water.

Finisher: Hogs that are almost to market weight, typically considered 150 lbs. to 250 lbs.

Gastroenteritis: Inflammation of the stomach and intestines, caused by *Salmonella enteritidis.*

Glacial outwash: Sand and gravel deposited by meltwater streams at the front of an active glacier. Parent material for granular soils.

Glacial till (or drift): Unstratified earthen material deposited directly by a glacier without reworking by meltwater; may consist of a mixture of clay, silt, sand gravel, and boulders ranging widely in size. For EIS purposes, glacial till is generally regarded as relatively resistant to large scale water movement, as opposed to glacial outwash, which is not.

Gneisses: A foliated rock formed by regional metamorphism, in which bands of granular minerals alternate with bands of flaky or elongate minerals. It is typically feldspar and quartz rich.

Granular soil: Soil that is sandy or gravelly rather than clayey, characterized by relatively high permeability to water movement. *See also* cohesive soil.

Granulite facies: Metamorphic rock unit that is typical of deep seated, high heat, regional metamorphism.

Grower: Hogs that are no longer considered nursery hogs (over 55 lbs.) but have not reached finishing weight (150 lbs).

Half-life: The length of time it takes for half an original population of microbes to die.

Health risk Limit: Concentration levels of compounds defined by the Minnesota Department of Health above which human health may be adversely affected.

Hormones: Natural, secretory products of endocrine glands (ductless glands that discharge directly into the bloodstream) that travel in the blood in very small concentrations and bind to specific cell sites called receptors in distant target tissues and organs, where they exert their effects on development, growth, and reproduction in addition to other bodily functions.

Hydrogeologic Units: See aquifers.

Impervious pad: A surface that is resistant to water movement, typically compacted soil, compacted clay, plastic or concrete. Used to protect ground water from contamination by materials stored on the surface of the earth.

Incorporation (immediate): The tilling of the soil after the broadcasting of manure to move the manure from the surface of the soil to under the soil surface. "Immediate" incorporation usually means tilling within 24-48 hours of manure spreading.

Injection: The application of manure beneath the soil surface.

Isopleth: Line representing a singular value of a compound concentration in the air.

Leaching: The removal of soluble materials, such as nitrates or chlorides, from soils or other material via water movement.

Mafic: Describes igneous rock that contains dark, iron and magnesium rich minerals.

Mesic prairie: Moderately moist prairie grassland.

Methemoglobinemia: Also called "Blue Baby" Syndrome. Nitrates consumed are converted to nitrite. The nitrites reach the bloodstream and begin oxidizing the iron in hemoglobin (oxygen carrying compound). This produces methemoglobin. Methemoglobin does not have oxygen carrying ability. Typically, enzymes present within the bloodstream convert the methemoglobin back to hemoglobin and no side effects occur. However, infants do not produce enough of the enzyme and, as methemoglobin is produced in greater quantities, oxygen availability to the cells is reduced and the baby can become ill and may die if not treated.

Moraine: A mound or ridge of unstratified glacial drift till, deposited by direct action of glacier ice.

Mutagens: A natural or human-made agent (physical or chemical) that can alter the structure or sequence of DNA.

Nitrate (NO_3^-): The nitrogen component of the final decomposition product of the organic nitrogen compounds. Nitrate is extremely water-soluble and its negative charge prevents its adsorption onto soil particles. This characteristic renders it highly susceptible to leaching. Nitrate moves readily through the soil with water movement, and is readily available to plants.

Nitrite (NO_2^-): Nitrite is an intermediate product in the conversion of ammonium to nitrate. Nitrite is extremely unstable in the presence of oxygen (nearly immediately converting to nitrate) and therefore is rarely detected in ground water.

Nitrogen cycle: The succession of biochemical reactions that nitrogen undergoes as it is converted to organic or available nitrogen from the elemental form. Organic nitrogen in waste is reduced by bacteria into ammonia (NH_3). If oxygen is present, ammonia is bacterially oxidized, first into nitrite (NO_2^-) and then into nitrate (NO_3^-). If oxygen is not present, nitrate and nitrite are bacterially reduced to nitrogen gas, completing the cycle.

Nitrification: The transformation of nitrogen or reduced nitrogen compounds to oxidized forms of nitrogen (such as nitrate ion).

Nutrients: Elements or compounds essential as raw material for organism growth and development. For plant growth, seventeen elements have been found to be universally essential, three mostly from air and water (carbon, hydrogen, oxygen) and fourteen from soil solids (nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, boron, molybdenum, copper, zinc, chlorine, and cobalt)(Brady, 1984). Six of the fourteen (nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur) are used in relatively large amounts by plants and so called **macronutrients**. The other eight, even though as essential as the macronutrients, are required in much smaller quantities, and thus are called **micronutrients**

Overland flow: A sheet or rivulets of water that flow over land rather than infiltrating. This occurs when the precipitation rate exceeds the infiltration rate of the ground's surface.

Organic nitrogen: nitrogen combined in organic molecules such as amines and amino acids. Urea is an example.

Oxidation/reduction (redox) reactions: Reactions that involve a change in the oxidation state of the atoms or ions involved. This change in oxidation state is due to the "loss" or "gain" of electrons. The loss of electrons from an atom produces a positive oxidation state, while the gain of electrons results in a negative oxidation state. Typically, chemicals that are oxidized are combined with oxygen; chemicals that are reduced, lose oxygen.

Pathogens: Agents that cause disease in humans, animals, or plants. There are numerous types, including but not limited to bacteria, fungi, viruses, and parasites.

PCRAMMET: A meteorological preprocessing computer program used to convert National Weather Service data for use in air dispersion models.

Perimeter tile drains: Drains that surround manure pits to lower the water table and reduce ground water pressure on the pit walls.

Phosphorus: One of the primary nutrients required for the growth of plants. Phosphorus is often a limiting nutrient for the growth of aquatic plants or algae in lakes and rivers.

Phytoestrogens: A group of naturally occurring chemicals derived from plants, having structure similar to estrogen and forming part of animal and human diets. Plant hormones are similar to but weaker than human estrogens

Pit additive: Chemical or natural compounds added to manure storage areas in efforts to reduce odor, break down solids, and to minimize clogging in land application equipment.

Pleistocene: The name of the subdivision of geologic time within the Quaternary Period spanning between two million years ago to approximately 8,000 years ago. It also describes sedimentary rocks and other geologic deposits during that time.

Prairie Pothole Region (PPR): An ecoregion extending from North Dakota into South Dakota and Minnesota, characterized by grasslands and wetlands concentrated around glacial "potholes" or depressions left in the landscape from glacial movement.

Precambrian: All geologic time and rocks formed during the time prior to 570 million years before present (BP).

Premix: Hog food supplement typically containing additional nutrients and vitamins for hog health and growth.

Quaternary: The name of a subdivision of a geologic era that began 2-3 million years ago and extends to the present, and rocks and deposits formed during that time.

Regolith: Fragmented and unconsolidated rock material that forms the surface of the land and overlies the bedrock. It includes rock debris, volcanic ash, glacial drift, alluvium, loess, and soil.

Schists: Strongly foliated rock formed by dynamic metamorphism that has well developed parallelism.

Scrape and haul: Method of removing and applying solid manure to agricultural fields. Typically used in small operations that house animals on concrete floors, and performed daily or every several days.

Slatted floors: Floor in a facility that has open spaces to allow manure and other waste material to pass through.

Sub-basin: Division of a larger watershed basin.

Subtherapeutic use: The practice of using pharmaceuticals to prevent or decrease the incidence of bacterial diseases and to increase weight gain in food-producing animals.

Surface tile intake: (see Tile Inlet)

Surficial aquifer: Water-bearing geologic unit that is close to the ground surface.

Tallgrass Prairie Region: Ecosystem defined by formerly dominant tallgrass species such as big bluestem. Now largely agricultural, with only remnants of the original vegetation remaining.

Tile inlet: Structure that connects the tile line to the surface so ponded water can be drained from a field.

Tile Line(s): Structure(s) that carries water from agricultural fields through a series of connections to either a field that needs to be irrigated or to a surface water. Extensive installation of tile lines can convert wetlands into farmable fields.

Turbid: Water that is cloudy or opaque due to having sediment or foreign particles stirred up or suspended in it.

Unique Well Number: A number assigned to individual wells by the state Health Department.

Undifferentiated: Geological material formed from a common source and not sorted by weathering or other geophysical forces.

Vertical gradient: The rate of change of head pressure per unit of flow distance at a given point in the vertical direction.

Watershed: A region or area draining into a particular river, stream, or other body of water.

Weathering-residuum: Accumulation of decomposed rock debris remaining in place after all but the least soluble constituents have been removed.

Zeolites: A generic term for a large group of rocks that contain aluminum and silica in differing percentages. They are characterized by their easy and reversible loss of water of hydration and by their ready fusion and swelling when strongly heated.

Zoonoses: Diseases that have the ability to be transmitted between animals and humans.

Zooplankton: Aquatic microorganisms, sometimes counted in water samples to determine surface water clarity.

EXECUTIVE SUMMARY

Introduction

A draft Environmental Impact Statement (EIS) has been prepared on the Hancock Pro Pork feedlot project in Stevens and Pope Counties. Preparation of this EIS was ordered by the Pope County District Court.

Hancock Pro Pork, Inc. is a group of feedlot operators in the vicinity of Hancock, MN who individually own hog finishing facilities and who have joined together to build and operate a farrowing/nursery facility to supply their finishing facilities with feeder hogs. The group also includes two individuals who own no facilities for feeding hogs and sell their shares of feeder hogs on the open market.

The Hancock Pro-Pork (HPP) Project is a multi-site hog farrow-to-finish feedlot project consisting of one farrowing/nursery facility (five total confinement barns) located in Stevens County that is jointly owned by the Hancock group, and nine finishing facilities individually owned by HPP members and located in Stevens and Pope Counties. Six of the HPP members built new deep pit barns to accommodate their HPP feeder hogs. One of these latter members at one time proposed to add a third barn to the two he built initially, but has now stated that he does not intend to do so. Two other members utilize older, scrape-and-haul barns as their primary facilities for housing HPP hogs. Finally, one member initially planned to build a new barn, but has not yet done so, and has now stated that he may not do so, and may in fact leave the Hancock group. He currently feeds his shares of hogs at custom feeders in various locations.
The issues addressed in the EIS include the following:

- Impacts of the project on ground water and surface water;
- Impacts of the project on wildlife and wildlife habitat;
- Assessment of the air emissions and odors anticipated from the project; and
- Potential impacts associated with the proposed manure management practices.

Project Overview

The project initially consisted of the farrowing/nursery facility, fourteen existing or proposed finishing sites, and one member who planned on buying hogs and subsequently selling them on the open market for finishing. This configuration of the project was the subject of an Environmental Assessment Worksheet (EAW) in 1997. The project was subsequently modified, with some members withdrawing from the project, to the current project of the farrowing/nursery site, nine existing or proposed finishing sites, and two members who will sell hogs on the open market for subsequent finishing.

The EAW process ended with a determination by the Minnesota Pollution Control Agency (MPCA) that no EIS was required. This decision was reversed by the Pope County District Court, which ordered the preparation of an EIS.

The project is completely built with the exception of the two barns proposed by two of the group's shareholders (see above). These proposed new barns are discussed in greater detail below. The current configuration of the project was constructed after the EAW and prior to the court order that an EIS be completed. An EIS is required on the entire project--the farrowing facility and all nine finishing facilities associated with the project--because the project was proposed at a time when the Environmental Quality Board (EQB) connected action rule applied to animal agriculture projects. Under the rules, projects are connected actions and must be assessed as a single project if: (a) one project would directly induce the other, (b) one project is a prerequisite for the other, or (c) neither project is justified by itself.

The connected actions rule still exists in the EQB rules, but subsequent modification of the EQB rules in October 1999 eliminated the rule's applicability to animal feedlots. Nonetheless, this EIS assesses the individual and cumulative effects of the project in accordance with the connected action rule in place at the time of the project application and construction, and as ordered by the court.

The Minnesota feedlot rules (Minn. R. ch. 7020) were revised after the farrowing and finishing sites submitted permit applications to Stevens County and the MPCA. The new rules changed the animal unit (AU) calculations for hogs being finished at the finishing sites. The old AU calculation assigned an AU factor of 0.4 for each hog between 55 and 300 pounds. The new AU factor for this weight of hog is 0.3 (meaning, for example, that a 1000-hog finishing barn has a 300 AU capacity). The new AU factor has been applied to the HPP project hog numbers for consistency.

The project components evaluated for this EIS are: farrowing/nursery site (5 new barns – 1393.6 Animal Units (AU); Alan Charles (1 new barn – 300 AU; not yet built); Gary and Darby Greiner (1 new barn – 300 AU); Jon Nohl (2 new barns – 600 AU); Mike Olson (older barns, no new construction – 68 AU); David Paul (1 new barn – 300 AU); Stanley Schaefer (3 new barns, one not yet built – 900 AU); Jere Solvie (1 new barn – 300 AU); Wayne Spohr (1 new barn – 300 AU plus 165 HPP AU in two older barns); John Zeltwanger (older barns, no new construction – 180 AU). The project also includes two members (Chad Solvie and Craig Swenson) who have no facilities and sell their shares of HPP hogs on the open market.

The current HPP-related capacity for the project (assuming the Charles barn and the third Schaefer barn are not constructed) is 4206.6 AU. If those barns are both built (which is not their currently stated intention), the total would be 4806.6 AU.

It should be noted that animal unit totals at feedlots can vary over time depending on market conditions, operator decisions, and other factors, and they may be limited by applicable rule and permit provisions. The above figures were accurate at the time of site data gathering and compilation for this EIS.

Hancock Pro Pork Farrowing Facility

The farrowing facility site is located in Section 34, T123N, R41W, Moore Township, in Stevens County, Minnesota.

The farrowing facility consists of five total confinement barns (one farrowing, one nursery, three gestation), built in 1998, with slatted floors that drain into concrete pits of various depths beneath the barns. The farrowing facility houses a total of 8000 piglets, 2424 sows, and 60 boars. The total Animal Unit (AU) capacity for the site is 1393.6. The shallow concrete pit beneath the farrowing barn drains by gravity to the three gestation barn pits through connecting piping. The manure management plan (MMP) for the farrowing/nursery facility provides that manure is pumped and land applied during the spring and fall of every year. Fall application is the norm, but spring application is required if manure is applied on granular soils, in order to maximize nutrient uptake by crops and minimize loss of nitrate to ground water. Full capacity of the concrete underbarn storage pits is approximately 4.2 million gallons. Land available for land spreading is approximately 1560.7 acres.

Alan Charles Feedlot

Charles has proposed construction and operation of a feedlot facility in Section 4, T123N, R41W, Moore Township, in Stevens County, Minnesota.

One barn was initially proposed for the Charles project site. Charles has recently withdrawn his permit application and notified the MPCA that his plans have changed and he currently does not intend to build this barn. Nevertheless, this EIS includes this barn in the analysis in case Charles changes his mind again later on. As proposed, the barn would be built south of the house (only intermittently occupied) and shed that currently occupy the site (this is not the Charles home site). If built, the new barn would have slatted floors that drain into an 8-foot concrete pit under the barn, and would house 500 grower and 500 feeder hogs, for a total of 300 AU. The pit would be pumped annually and the liquid manure land applied on the approximately 1183 acres of fields available to Charles. Manure storage capacity would be approximately 435,000 gallons.

Gary Greiner Feedlot

The Greiner site is located in Section 2, T123N, R40W, Hoff Township, in Pope County, Minnesota.

One total confinement barn was constructed in October 1997 by the Greiners to house HPP hogs. This barn has slatted floors over an 8-foot concrete pit. The barn houses 1000 grower and feeder hogs for an AU total of 300 for the site. The pit is emptied and pumped once a year and the liquid manure is applied to approximately 448 acres. Manure storage capacity is approximately 435,000 gallons.

Jon Nohl Feedlot

The Nohl site is located in Section 24, T123N, R42W, Moore Township, in Stevens County, Minnesota.

Nohl has built two new total confinement barns on his home place to house HPP hogs. The north barn was built in 1997 with slatted floors over an 8-foot deep concrete storage pit. The south barn was built in 1998 with slatted floors over an 8-foot concrete storage pit (41x204 feet). Each barn houses 500 grower/feeder hogs and 500 finishing hogs for an AU total of 600 for the site. Each barn has a maximum manure capacity of 426,500 gallons each, for a site maximum manure storage capacity of 853,000 gallons. The liquid manure from the two barns is land applied on approximately 1,032 acres.

Mike Olson Feedlot

The Olson site is located in Section 26, T123N, R42W, Moore Township, in Stevens County, Minnesota.

No new construction was performed on this site, which employs older, existing facilities to house the HPP hogs. Two of the three existing barns currently house an average of 180-230 finishing hogs. The remaining barn on the site will not be used for livestock. The total AU capacity for the site is approximately 68. The open lots and barns are scraped and cleaned as needed, which currently is approximately every three days. The manure is hauled in a 180-bushel manure spreader, at a rate of approximately 415 to 480 cubic yards per year, and spread in solid form on the approximately 200 acres.

David Paul Feedlot

The Paul site is located in Section 14, T123N, R42W, Horton Township, in Stevens County, Minnesota.

The total confinement barn with concrete underbarn pit and a house were built on a virgin site in 1998. The barn currently houses 500 grower/feeder hogs and 500 finishing hogs for an AU total of 300 for the site. Maximum manure storage capacity for the site is approximately 435,000 gallons. Acreage for land application totals approximately 630 acres.

Stanley Schaefer Feedlot
The Schaefer site is located in Section 21, T123N, R41W, Moore Township, in Stevens County, Minnesota.

Schaefer built two new total confinement barns with concrete underbarn pits to house HPP hogs in 1998. Schaefer subsequently informed Stevens County that he was considering building a third barn having the same dimensions and physical characteristics as the two barns built in 1998, but he has more recently reconsidered, and this barn may never be built. This EIS considers both scenarios, in case he decides in the future to move forward with the third barn. The two built barns currently house a total of 1000 grower/feeder hogs and 1000 finishing hogs (600 AU). There are also two older barns on the site that intermittently house culls and slow growers. Maximum manure storage capacity for the site (including the proposed third new barn) is approximately 1.3 million gallons. Acreage for land application totals approximately 1,345 acres.

Jere Solvie Feedlot
The Solvie site is located in Section 5, T124N, R40W, Walden Township, in Pope County, Minnesota.

This site contains a mixture of barn types, including relatively new total confinement buildings (not all of which house HPP hogs) as well as buildings dating to the middle of the last century. A new total confinement barn was built in 1998 with an 8-foot deep concrete underbarn storage pit, and houses 1000 HPP hogs. An older total confinement barn that drains to an outdoor earthen basin was built in 1994 and houses approximately 750 non-Hancock hogs. The barns house a total of 1750 grower/feeder hogs and finishing hogs. Other, older barns on the site sometimes contain hogs from other suppliers, which are not the subject of this EIS. The total HPP AU for the site is 300, and the total for the site taken together is 525. Only manure from the non-Hancock total confinement barn drains to the earthen storage basin. The earthen basin and concrete pit are emptied once a year and the contents land applied. Maximum manure storage capacity for the site is approximately 1.45 million gallons. Acreage for land application of manure is approximately 1040 acres.

Wayne Spohr Feedlot
The Spohr site is located in Section 36, T123N, R42W, Horton Township, in Stevens County, Minnesota.

A pre-existing manure storage basin on this site was closed some time ago, and a new 300-AU total confinement barn with an 8-foot concrete underbarn pit was built in the excavated area in 1998. Currently, the site only accepts hogs from HPP. The total AU capacity for the site is 477, and this total includes some chickens and horses kept at the facility. Manure storage capacity for the site is approximately 477,190 gallons, which includes the new deep pit as well as a shallow pit under an older confinement barn. The concrete pit is pumped once a year and the liquid manure is land spread on portions of the available 1000 acres of fields.

John Zeltwanger Feedlot
The Zeltwanger site is located in Section 1, T123N, R41W, Moore Township in Stevens County, Minnesota.

No construction was performed on this site for the HPP project. Only existing buildings are used. Two of the three barns currently house a total of 600 finishing hogs. The remaining barn and attached lean-to are reportedly empty and are intermittently used to house hogs culled from the primary barns. The total AU capacity for the site is 180. The barns are scraped and cleaned as needed, which is approximately once per week. Approximately 692 acres are available for manure land application.

<u>Findings</u>
The EIS analysis has identified conditions at four facilities that require an assessment of mitigation measures or modifications to operating practices. The four sites that require consideration of mitigation are the farrowing/nursery site, and the Schaefer, Nohl and Solvie finishing sites.

The farrowing/nursery site and the Schaefer finishing site require a review of mitigation and/or monitoring to address modeled violations of air quality standards at their compliance boundaries. The farrowing/nursery site and the Schaefer, Nohl and Solvie finishing sites may utilize fields containing granular (i.e. sandy or gravelly) soils for liquid manure management. Land application of manure on granular soils has the potential to impact surficial ground water in the area. These operators will need to take steps to protect ground water if they plan fall application on fields comprised of granular soils.

Several of the sites where composting was being used to manage animal mortalities were found to be composting incorrectly. This was brought to the attention of the operators and the State

Board of Animal Health (BAH), and the operators are working with BAH to correct the deficiencies.

<u>Mitigation Measures</u>

The measures to be assessed to deal with modeled air emission impacts at the farrowing and Schaefer sites include the following:

- Engineering controls (biofilters; non-thermal plasma; aerobic and anaerobic manure treatment; reduction of pit storage surface area);
- Operational changes (e.g. diet manipulation, pit additives, temperature control);
- Contractual or regulatory mitigation (e.g. easements and/or variances); and
- Institutional mitigation (e.g. right of way relocation and roadway closure--farrowing site only).

The measures to protect shallow ground water from impact from fall application of manure on granular fields at the farrowing, Nohl, Schaefer, and Solvie sites include:

- Operational changes (e.g. move fall application to cohesive soil fields or develop a manure management plan outlining practices to be employed during fall application that will not threaten ground water).

Farrowing Facility

Air. Several alternatives are analyzed for addressing the modeled air emission impacts from the site. The modeling suggests that the majority of emissions emanate from the nursery barn and therefore the measures would likely need to be focused on that barn. The alternatives analyzed are discussed below.

- Engineering controls (biofilters; non-thermal plasma; aerobic and anaerobic manure treatment; reduction of storage pit surface area; shelterbelts; windbreak walls).

HPP could implement engineering controls at the facility to reduce the emissions generated; treat or disperse the emissions; or provide alternative manure management practices. Treatment of emissions with biofilters or windbreak walls would be a viable method of achieving the needed reduction in emissions from the site. Reducing pit storage areas would likely require significant change to the existing structures. There is little scientific evidence that shelterbelts would achieve the desired result of emission impact reduction, either through dispersion or treatment, and would likely also take a number of years to become effective in any case. Alternative manure management practices such as non-thermal plasma and aerobic or anaerobic treatment have the potential to be successful, although they may in some cases require changes to the existing structures and capital expenditures to install and operate the equipment. Anaerobic treatment in a reactor vessel, alone among the mitigations analyzed, has the potential for some cost recovery in the form of space heat, hot water, and electricity generation.

- Operational changes (diet manipulation, pit additives, and temperature control).

The evidence is mixed regarding the potential for success in reducing or otherwise mitigating air emissions by use of these methods.

- Variance

HPP could petition the MPCA for issuance of a variance from the applicable air quality standards. If approved, this would address the issue, not by reducing emissions, but by modifying standards applicable to this site.

- Institutional mitigation (right of way relocation and roadway closure).

HPP could petition Stevens and Swift Counties to either relocate the roadway leading past the site farther to the south or totally closing the roadway in front of the facility and turning it into a private access road. HPP would also likely need to purchase sufficient property to move the compliance boundary south of the roadway or obtain an easement from the current property owner for this purpose.

Ground Water. To address the threat to ground water from fall application of manure to granular fields, the farrowing/nursery site could either commit to conduct fall application only on fields comprised of cohesive (i.e. clayey) soil, or rewrite its Manure Management Plan for MPCA approval to include procedures for fall application on granular fields that would not threaten ground water.

Stanley Schaefer Finishing Facility

Air. Several alternatives are analyzed for addressing the modeled air emission impacts from the site. The modeling suggests that emissions from the barns at the site cause a violation of standards owing to the barns' proximity to the adjacent property. This is true whether or not the third barn is built on this site. It is possible that mitigation measures would need to be focused on all barns at the site, although measures may not be required at all of the barns to achieve the needed reduction in emissions. The series of alternatives is discussed below.

- Engineering controls (biofilters; non-thermal plasma; manure treatment; reduction of storage pit surface area; shelterbelts; windbreak walls).

Schaefer could implement engineering controls at the facility to reduce the emissions generated, treat or disperse the emissions or implement alternative manure management practices. Treatment of emissions with biofilters or windbreak walls is a viable method of achieving the needed reduction in emissions from the site. Reducing the surface area of pit storage areas would likely require significant change to the existing structures. There is little evidence that shelterbelts would achieve the desired result of emission impact reduction, either through dispersion or treatment, and would likely also take a number of years to become effective in any case. Alternative manure management practices such as non-thermal plasma and aerobic or anaerobic treatment have the potential to be successful, although they may in some cases require changes to the existing structures and capital expenditures to install and operate the equipment.

- Operational changes (diet manipulation, pit additives, and temperature control).

The evidence is mixed regarding the potential for success in reducing or otherwise mitigating air emissions by use of these methods.

- Contractual or regulatory mitigation (easements and/or variances).

Schaefer could attempt to obtain an easement from the adjacent property owner. If obtained, this would address the issue, not by reducing emissions, but by obtaining contractual approval for the emissions to migrate onto private property.

Schaefer could alternatively petition the MPCA for issuance of a variance from the applicable air quality standards. If approved, this would address the issue, not be reducing emissions, but by modifying standards applicable to this site.

Schaefer's proposal for a third barn at this site envisioned placing it immediately south of the two new barns that he built in 1998, and oriented in the same direction. Should he in the future build this barn but in some other configuration, this could have a significant effect on the emissions analysis, which could be positive or negative. In this event, the air analysis may have to be repeated for the proposal.

Ground Water. To address the threat to ground water from fall application of manure to granular fields, Schaefer could either commit to conduct fall application only on fields comprised of cohesive soil, or prepare a Manure Management Plan for MPCA approval that would outline procedures for fall application on granular fields that would not threaten ground water.

Jon Nohl Finishing Facility

To address the threat to ground water from fall application of manure to granular fields, Nohl could either commit to conduct fall application only on fields comprised of cohesive soil or prepare a Manure Management Plan for MPCA approval that would outline procedures for fall application on granular fields that would not threaten ground water.

Jere Solvie Finishing Facility

Some of the fields used by Solvie for manure application contain granular soils. While Solvie reports that he does not currently apply to granular soils, he may elect to do so at some future point. In this event, to address the threat to ground water from fall application of manure to granular soil fields, Solvie could either commit to conduct fall application only on fields comprised of cohesive soil, or update his Manure Management Plan for MPCA approval to outline procedures for fall application on granular fields that will not threaten ground water.

Conclusions

The EIS fully analyzes the ten sites included in the HPP feedlot project. At most of the sites, no potential for significant environmental impact was found. The EIS did find that the HPP farrowing site and the Nohl, Schaefer, and Solvie finishing sites may require mitigation to address air and/or manure land application issues. The EIS lists and analyzes a number of mitigation alternatives for regulatory agencies to use in decision making about regulatory requirements.

1.0 PROJECT OVERVIEW

Hancock Pro Pork, Inc. is a group of feedlot operators who individually own hog finishing facilities and who have joined together to build and operate a farrowing/nursery facility to supply their finishing facilities with feeder hogs. The group also includes two individuals who own no facilities for feeding hogs. These members sell their shares of hogs on the open market.

The Hancock Pro-Pork (HPP) Project is a multi-site hog farrow-to-finish project consisting of one farrowing/nursery facility (five total confinement barns) located in Stevens County (**Figure 1-1**) that is jointly owned by the Hancock group, and nine finishing sites individually owned by HPP members and located in Stevens and Pope Counties. The project initially consisted of the farrowing/nursery facility, fourteen existing or proposed finishing sites, and one member who planned on buying hogs and subsequently selling them on the open market for finishing. This configuration of the project was the subject of an Environmental Assessment Worksheet (EAW) in 1997. The project was subsequently modified, with some if the original members withdrawing from the project and others joining it, to the current configuration consisting of the farrowing/nursery facility, nine existing or proposed finishing sites, and two members who will sell hogs on the open market for subsequent finishing. A list of the original fourteen finishing sites and those nine finishing sites that remain in the project is given in **Table 1-1**. This EIS evaluates the currently existing project, made up of the farrowing/nursery facility and the nine finishing sites.

The EAW process ended with a determination by the Minnesota Pollution Control Agency that no EIS was required. That decision was reversed in late 1998 by the Pope County District Court, which ordered the preparation of an EIS.

The project is completely built with the exception of two barns that are proposed by two of the group members and that are discussed in greater detail below. The general location of the individual HPP sites is shown on **Figure 1-2.**

The EIS must address the farrowing facility as well as all nine finishing facilities associated with the project because the project was proposed at a time when the Environmental Quality Board (EQB) connected action rule (Minn. R. 4410.0200) applied to animal agriculture projects. Under the EQB Rules, projects are connected actions and must be analyzed as a single project if: (a) one project would directly induce the other, (b) one project is a prerequisite for the other, or (c) neither project is justified by itself. Although the connected actions rule still exists in the rules, subsequent modification of the EQB rules in October 1999 eliminated its applicability to animal feedlot projects. Nonetheless, this EIS assesses the individual and cumulative effects of the project in accordance with the connected action rule since the rule was in place at the time of the project application and construction, and as ordered by the court.

HPP and its members have reported that they do not have current plans for further expansion or additional construction at this time. Alan Charles, who originally planned to build a barn for finishing but has not yet done so, and Stanley Schaefer, who at one time notified MPCA and Stevens County of his intent to add a third new barn at his site (in addition to the two built in 1998), were the only members who planned on building new barns after completion of the EIS. Both parties have since notified Stevens County and MPCA (in December 2002) that they now no longer intend to construct those new barns. However, although Charles and Schaefer do not currently plan to build the new barns, this EIS nevertheless evaluates conditions as if the barns would be built in order to account for a future situation in which they change their minds.

The Minnesota feedlot rules (Minn. R. ch. 7020) were revised after the farrowing and finishing site operators submitted permit applications to Stevens County and the MPCA. As required by legislation passed in 2000, the new rules changed the animal unit (AU) calculations for hogs being finished at the finishing sites. The old AU calculation assigned an AU factor of 0.4 for each hog between 55 and 300 pounds. The new AU factor for this weight of hog is 0.3 (meaning, for example, that a 1000-hog finishing barn has a capacity of 300 AU). The new AU factor has been applied to the HPP project hog numbers for consistency.

Six of the nine finishing sites expanded in 1998 to accommodate feeder pigs supplied by HPP. The shareholders who constructed new barns are Greiner, Nohl, Paul, Schaefer, Solvie and Spohr. Charles initially planned to, but did not. If the Charles barn and the third Schaefer barn are constructed, the HPP project would have a capacity of 4806.6 AU. If those barns are not built, the HPP project would have (and now has) a total capacity of 4206.6 AU.

Three of the six expanding finishing sites (Nohl, Greiner, and Solvie) received Certificates of Compliance or permits prior to the issuance of the EAW negative declaration decision on the need for an EIS by the MPCA on October 28, 1997. The Schaefer, Paul and Spohr sites were issued Certificates of Compliance in 1998, after the negative declaration by MPCA.

Two finishing sites, Olson and Zeltwanger, have not expanded and report no plans for expanding operations. The only change at these sites is that HPP would be the source of feeder pigs.

The remaining shareholders, Craig Swenson and Chad Solvie, have no facilities and do not finish their shares themselves, but instead sell their shares of hogs on the open market.

1.1.1 Chronology of Events

A chronology related to the HPP project since 1997 is shown on **Table 1-2**. A brief summary of the project history is given in this section.

MPCA began receiving information on the HPP project in April 1997. That information included a faxed map from Stevens County showing the proposed farrowing/nursery site and those HPP finishing sites located in Stevens County. The project triggered the mandatory EAW category for the farrowing and finishing facilities based on the EQB connected action rule. In late June of 1997, HPP submitted design documents to the MPCA, as well as an EAW "completed data portion" and a "finisher supplement," which for the first time brought the sites located in Pope County to MPCA's attention.

MPCA issued Certificates of Compliance to four of the project's finishing sites during this same time period, despite the fact that there was an environmental review process pending and the rules prohibit final permitting decisions until it is completed. One was issued because MPCA determined, in response to a query from the proposer, that the project in question had been planned, and substantial steps taken toward its construction, well before the Hancock project was organized, and was therefore not a connected action. Two others were issued early because at the time of issuance MPCA staff did not know that the sites in question (located in Pope County) were part of the Hancock project. The fourth was issued shortly before the negative declaration because, although MPCA Environmental Review staff then knew that the site was part of the Hancock project, the MPCA permitting staff had not been so informed. The latter site is no longer a part of the Hancock project.

Following submittal of the HPP documents, the MPCA distributed an EAW on the project for public comment on August 7, 1997. The MPCA Citizens Board issued a negative declaration on October 28, 1997, indicating that an EIS on the project was not required. In November 1997 Pope County Mothers and Others Concerned for Health (PCMOCH) and Peters Sunset Beach, Inc. filed suit against the MPCA, challenging the negative declaration decision by the MPCA Citizens Board in October of 1997. HPP intervened in the court action and participated in all briefings and oral arguments.

Subsequent to the negative declaration by the MPCA Citizens Board, the MPCA completed initial computer modeling of air emissions from the farrowing/nursery site and concluded that emissions of hydrogen sulfide would potentially exceed state air quality standards.

Since no order was sought or obtained prohibiting project construction and operation pending the outcome of litigation, HPP proceeded to obtain regulatory approvals and construct the jointly owned farrowing/nursery site while the litigation was in process. Likewise, most members completed construction of new barns at their sites to house feeder hogs they planned to obtain from the farrowing/nursery site. On February 19, 1998, the MPCA issued Interim Permit MPCA-I 2358(A) to HPP for planning, construction, and operation of the five total confinement barns at the HPP farrowing/nursery site. Construction of the first gestation barn was completed in August 1998 and hogs were delivered to start the farrowing operation at that site. By December 1998, all of the barns at the farrowing/nursery site were completed and all of the expanding finishing sites had completed construction, with the exception of the single barn at the Charles site and the third barn at the Schaefer site.

1.1.2 Decision to Prepare EIS

On September 30, 1998 the Pope County District Court issued a decision indicating that an EIS was required for the site. On November 23, 1998, the Court amended its order, but still required that an EIS be completed. On January 11, 1999, HPP appealed the District Court ruling to the Minnesota Court of Appeals, and on May 25, 1999, the appeals court affirmed the original decision that remanded the matter to the MPCA for the preparation of an EIS.

The court concluded that the MPCA erred in issuing the negative declaration and ordered an EIS be completed based on the reasoning listed below. The court found that:

- a substantial portion of the project was issued certificates of compliance or permits in violation of Minnesota law;
- the negative declaration relied upon pollution prevention measures that were not applicable to each of the finishing sites; and
- substantial evidence did not support MPCA's conclusions that hydrogen sulfide did not present a potential for significant environmental effect.

While the Appeals Court was reviewing the HPP appeal, the MPCA developed and released a draft EIS scoping document and held public meetings to discuss the scope of the EIS that would be prepared if the appeal of the EIS order were to fail. On July 27, 1999, the final Scoping Decision Document was approved by the MPCA Citizens Board with the guidance to staff to minimize EIS costs to HPP by making maximum use of the Generic Environmental Impact Statement on Animal Agriculture (GEIS) that was being developed by the EQB, in lieu of the usual EIS data gathering activities, wherever possible. The Scoping Decision Document defined the project that would be reviewed in the EIS as including the original farrowing/nursery site and nine finishing sites. The Notice of Intent to Prepare an EIS was published in the EQB Monitor on September 6, 1999.

The Scoping Decision Document was used to solicit competitive proposals from private sector consulting firms. Based on those proposals, a consultant team consisting of Liesch Associates, Inc. (Liesch), Impact Assessment, Inc., and Gantzer Environmental Software and Services, Inc. (Gantzer Environmental) was selected to assist with writing the EIS. The MPCA subsequently negotiated with the Liesch/Gantzer Environmental team to revise their costs to remove all overlap in the services to be provided by the two firms. Contracts to retain these two consultants were then prepared.

The final negotiated cost and scope were then incorporated into a draft contract document that was the basis of the development of the MPCA Cost Agreement with HPP. The draft Cost Agreement was sent to HPP by the MPCA on May 3, 2000.

1.1.3 Cost Dispute

Minn. R. 4410.6000-6200 provides that the project proposer is to be assessed the RGU's reasonable costs for EIS preparation. Minn. R. 4410.6410 provides for the resolution of disagreements between RGU and proposer regarding project costs and assessments.

MPCA staff worked with Hancock representatives from May through August 2000 to negotiate an EIS cost agreement between MPCA and HPP. At the end of that negotiation period, HPP informed the MPCA that a disagreement existed. In mid-August, the MPCA served HPP with a copy of its request to the EQB for resolution of the dispute in accordance with the administrative procedure that is prescribed in the EQB rules for resolving cost disagreements. The EQB considered the matter in their September, October and December regular meetings without coming to a conclusion. On December 20, 2000, HPP petitioned the MPCA to terminate the EIS and concurrently requested that EQB defer further action on the cost agreement dispute until the EIS termination request was resolved. A key issue that HPP based the request on was the October 1999 change in the EQB rules that eliminated the connected action rule's applicability to animal feedlots.

The MPCA Citizens Board item on the HPP petition was mailed to all interested parties on January 12, 2001. HPP filed a Memorandum in Support of Request to Terminate EIS on January 18, 2001. The January 18 memorandum was followed by a supplemental memorandum from HPP dated January 29, 2001. A revised Board item was then developed and mailed to interested parties on February 1, 2001.

At a special meeting on February 7, 2001, the MPCA Citizens Board denied HPP's request to terminate the EIS and denied an accompanying request for a contested case hearing.

Following the denial of the HPP request, the EQB adopted an Order dated April 9, 2001 outlining the estimated costs that MPCA could assess to HPP for EIS preparation. As part of the resolution of this issue, EQB agreed to provide the funding for the air impact assessment analysis to be completed by Gantzer Environmental. EQB also ordered that MPCA reduce its assessment to Hancock for the Project Description, Socioeconomic, and Alternatives portions of the EIS.

Ultimately, Hancock Pro Pork paid $19,614; EQB paid $51,628; MPCA paid $95,030; and a special legislative appropriation of $192,000 paid the rest.

With the final EQB order in hand, MPCA executed a contract with Gantzer Environmental for the air impact assessment in April 2001. However, although Gantzer Environmental began the air assessment immediately, a number of factors prevented this work from proceeding to completion at that time.

First, the funding made available by EQB for the air assessment work extinguished at the end of the fiscal year, on June 30, 2001. Gantzer Environmental was able to spend only about half of this money before the fiscal year ended, and another source for the rest did not, for the moment, exist. Second, shortly after this work was started, the State of Minnesota was forced to begin preparations for a statewide government shutdown due to the failure of the legislature to pass an appropriations bill in the 2001 regular session. Third, the $192,000 appropriation to fund the remainder of the EIS work—including the work to be done by Liesch Associates, the other MPCA consultant in this case--was in the appropriations bill that failed in the regular session; without knowing for sure that this appropriation would be available, MPCA was prevented from executing the Liesch contract, and was similarly forced to suspend the Gantzer Environmental contract as of the end of the fiscal year.

Although passage of funding legislation in the 2001 Special Legislative Session narrowly averted a state government shutdown and provided the funding needed to continue the EIS work, the legislation appropriated the air money to EQB and the remainder to the state Department of Agriculture, rather than MPCA. In both cases, Interagency Transfer Agreements (ITAs) had to be worked out between MPCA and the other agencies to provide for transfer of the funding to MPCA.

HPP executed the final cost agreement with MPCA on September 13, 2001, and the ITAs were completed at about the same time. This cleared the way for MPCA to restart the Gantzer Environmental contract and complete the Liesch contract. The consultants' work on the EIS then moved forward.

1.2 SCOPE OF EIS

The major issues that emerged during the environmental review process and the associated judicial review included the following:

- Impacts of the project on ground water and surface water;
- Impacts of the project on wildlife and wildlife habitat;
- Assessment of the air emissions and odors anticipated from the project; and,
- Potential impacts associated with the proposed manure management practices.

To address these major issues, the EIS includes a review and assessment of the following:

- A project description that provides sufficient detail to identify the project purpose, size, scope, environmental setting, location, and anticipated phases of development;

- A review of resources and other impact receptors that are present in the area and could be affected by the project;

- A review of the laws, rules and regulations pertinent to the project and the associated governmental approvals required for the project;

- An assessment of the potential impact associated with the individual facilities of the project and the associated cumulative effect from the project and other sources;

- An assessment of past and current compliance with rules and requirements, considering that the majority of the project is built and operating;

- A review of mitigation measures that could be implemented to reduce or eliminate any potentially significant adverse effects of the project;

- A review of alternatives that could be implemented at individual facilities to address environmental effects from the project (by EQB Order, the review of alternatives excluded a review of alternative sites for project facilities); and,

- A review of the socio-economic effects that the project may have in the area (by EQB Order, the cost, and thus scope, was limited to a review of the GEIS information on the socio-economics of animal agriculture and, generally, how those findings may be related to the project).

1.3 DATA SOURCES USED FOR THE EIS

At the initiation of the EIS work, data on characteristics, makeup, management, size, configuration, location, future plans, and other attributes were collected and compiled for each of the project locations. The existing and planned design and operation of each element of the project were identified for use in defining the project for review. These data were used as the basis of the analysis and assessment work in the preparation of the EIS as provided in the final Scoping Decision Document and Final Draft Workplan, as amended by the EQB Order.

Relevant background water and air quality data from MPCA staff, local government agencies, published literature and other sources were compiled during this project. This includes the air monitoring and ground water sampling that were performed at HPP sites by MPCA staff. The GEIS was extensively utilized as a data source to assess the socioeconomic effects that the project may have and was also used as a resource for considerable other pertinent information for the project. Applicable local and state organizations provided information used to define the natural habitat of the project area.

The data sources used are summarized below:

<u>Ground Water and Surface Water</u>
Information was collected from the Minnesota Geological Survey, Minnesota Department of Health, Natural Resource Conservation Service (NRCS), MPCA, United States Geological Survey (USGS), Minnesota Department of Natural Resources, and Pope and Stevens Counties. A literature search of pertinent information was completed which included a review of GEIS documents, as well as Internet and library searches for articles covering information lacking in the GEIS. Information provided by HPP members and area residents was also utilized for the EIS.

<u>Facility Design and Operation</u>
Information from MPCA files, a project tour, and subsequent follow up work provided most of this information. The tour was taken on November 19-20, 2001, and included contacts with most of the HPP members and others to seek information and discuss the overall project. The consultants also initiated numerous follow-up contacts with project members. The State Board of Animal Health inspected each site for compliance with animal mortality management requirements and provided information on its mortality management rules, programs, and policies.

<u>Air Quality</u>
The CALPUFF air quality computer model (*see* **Section 4.1.1)** was used to assess the potential air quality impacts associated with the Hancock project. In addition to the spatial coordinates provided by the Liesch project group, the required model inputs included feedlot gas emission rates and meteorological data. Gantzer Environmental determined the hydrogen sulfide and volatile odorous organic compound (VOOC) emission rates for the hog barns based on measured gas concentrations inside the barn and on calculated air exchange rates. Ammonia emission rates for the hog barns were based on published ammonia emission factors. For manure basins, Gantzer Environmental calculated the hydrogen sulfide, ammonia, and volatile odorous organic compound emission rates as a function of wind speed by means of established emission algorithms based on the measured liquid-phase chemical concentrations in the basin.

The required meteorological input file was developed from several types of weather data including on-site wind data, surface weather conditions, and upper air conditions. The on-site wind direction and wind speed data were obtained from the meteorological station operated by the MPCA at the Hancock farrowing site. The air temperatures and other surface weather data were for the Minneapolis weather station. The upper air data used for the analysis were from the

Chanhassen, MN weather station. The on-site wind data, the Minneapolis surface weather data, and the Chanhassen upper air data were combined into the required meteorological input file.

Both on-site and regional climatological information was also collected for use in the modeling efforts.

Socioeconomic analysis
Project staff reviewed socioeconomic data in the GEIS on feedlots and compared it to the project to assess the applicability of the findings in the literature to the Hancock project.

Wildlife Habitat
Information obtained from the Minnesota Department of Natural Resources and US Fish and Wildlife Service was collected to identify and characterize wildlife habitat in the project area. Information was also sought from Internet and University of Minnesota literature searches for information regarding impacts associated with hog facilities.

1.4 OVERVIEW OF EIS

This draft EIS is comprised of eight Sections as described below:

Section 1.0 Introduction
This section summarizes project history, identifies the scope of the project, and identifies the data sources utilized for the project.

Section 2.0 Project Description
The project description identifies the pre-project operational characteristics of each of the ten HPP facilities. It also presents a description of the project as built, highlighting those new elements that were added to the pre-project facilities. The section reviews the feed and pharmaceuticals used at each site and the status of the various permits for the facilities, although reviewers are cautioned that use of chemicals at feedlots is never constant, but changes in response to operator perceptions of efficacy. **Section 2.0** also reviews pertinent laws and regulations that affect this project.

Section 3.0 Environmental Setting
This section reviews the regional and site specific characteristics of the project area, including regional climatological and air quality information, regional geologic and hydrogeologic conditions in the area, regional surface water hydrologic considerations, and the regional ecology of the area. It also reviews public health considerations related to the project and the socioeconomic conditions of the area as outlined in the GEIS, as well as the site-specific environmental setting of each of the ten proposed project sites. This information is used as the basis for assessing environmental impacts of the project.

Section 4.0 Environmental Impact of Project

The computer modeling completed as part of the EIS is presented and discussed in detail. The results of the modeling identify potential violations of air quality standards and identifies the sites that may require mitigation.

The potential for the project to cause environmental impacts on ground water resources is assessed. Existing wells and other ground water features with the potential to be impacted are identified. The types of impacts that may result from improper manure management are briefly discussed, as is the potential for pathogens and toxic contaminants to significantly affect human health and the environment.

The project areas are characterized in terms of existing surface water drainage and receiving waters, especially the Chippewa River, the Pomme de Terre River, and the Danvers Wildlife Management Area, and the potential for the project to cause impacts to surface water resources is assessed. Existing and planned mitigation and other impact control measures are identified and their adequacy assessed. Potential further and more extensive mitigation measures are addressed in **Section 5.0 Mitigation Measures**.

The potential effects on the regional ecology and public health are reviewed and the need for mitigation to address identified impacts is presented. The likely socioeconomic effects of the project are discussed in general terms based on information from the GEIS.

Section 5.0 Mitigation Measures

This section includes an analysis of the anticipated effectiveness of the facilities in achieving environmental protection goals over the operating life and a discussion of current and possible future state and/or federal laws that may have an impact on how the Hancock project and the no-build alternatives are operated. In the event that mitigation measures over and above those planned or in place may be required, such mitigation measures are identified and reviewed.

Section 6.0 Mitigation Alternatives

This section identifies the alternatives that may mitigate pit barn air emissions and water resource impacts, and the appropriate changes to operating practices to protect against violations. The specific alternatives that are applicable to each individual site are presented.

Section 7.0 Alternatives Analysis

This section reviews alternatives that could be implemented if there are existing or potential environmental effects that cannot be mitigated as outlined in Section 6.0 Mitigation Alternatives above. The list of appropriate alternatives for the project includes:

- No Build;
- As-Built; and
- Mitigated As-Built.

Section 8.0 Cited References

This section lists the references cited in the report.

Note: Discussion of any trademarked or other product or service information within the EIS is solely for identification of the products used and their associated characteristics. Any reference to such products or services is not to be considered an endorsement or approval by the MPCA or the authors of this EIS.

2.0 PROJECT DESCRIPTION

2.1 GENERAL PROJECT INFORMATION

The HPP Project is a farrow-to-finish operation consisting of one farrowing/nursery facility, owned by the cooperative members, and nine finishing facilities, eight of which are built and operating and one (Charles) that was at one time proposed. Two additional members obtain their share of hogs from the farrowing operation and re-sell them on the open market. Five of the current finishing sites had pre-existing feedlot operations prior to the HPP project (Solvie, Spohr, Schaefer, Olson, and Zeltwanger). The locations of these pre-existing operations are shown on **Figure 2-1**. Schaefer, Solvie, Spohr, the farrowing facility, Greiner, Nohl, and Paul all built new hog barns as part of the HPP project, some at their existing sites and some on virgin sites. Charles initially proposed to build a new barn on a new site, but has more recently (in December 2002) stated that he may not build this barn, and may withdraw from the group. Schaefer, who built two barns to house HPP hogs in 1998, subsequently proposed to build a third barn on the same site, but has more recently (in December 2002) stated that he may not do so. Nonetheless, this EIS reviews the Charles and Schaefer facilities as if these barns will be built, in order to account for a possible future scenario in which they change their minds. In addition, the MPCA was recently informed (October 2002) that Zeltwanger may also withdraw from the HPP group.

MPCA and Stevens County issued Certificates of Compliance to several HPP finishing facilities in 1997-1998. Under the prior MPCA feedlot rules, MPCA and delegated counties used the certificates as a regulatory tool to acknowledge that the facilities met MPCA requirements based on the feedlot conditions and operational practices known by the regulatory agency at the time the certificate was issued. The certificates were letters from the MPCA or delegated county that typically contained a facility description (e.g. structures, animal types and units, etc) and a list of operational and management practices that existed or would be implemented by the facility owner. Certificates of Compliance are no longer being issued under the amended MPCA feedlot rules. However, a comparison of a prior Certificate (and its incorporated list of operational and management practices or conditions) with current feedlot operations provides some insight into a particular feedlot's potential compliance with current MPCA requirements and conformance with accepted agricultural pollution prevention practices. For the purposes of the EIS, MPCA conducted a review of the operations of the HPP finishing facilities that were previously issued certificates to determine whether the current feedlot operations conform to the certificates' provisions regarding manure application to granular soils. Those reviews are discussed in this EIS.

Under the old feedlot rules, the Olson and Zeltwanger feedlots were also nominally required to obtain Certificates of Compliance, and the operators applied for them, but they were never issued because they were not required at feedlots that were not being modified in some way and had no known pollution hazards. The rules now in force do not require regulatory approvals for facilities of such small size. All operating feedlots in the project are, however, currently registered with either Stevens or Pope County, as required in the new rules.

The farrowing facility and the finishing sites that constructed new barns used similar designs, with concrete pits underlying barns with concrete slatted floors. All of the new barns are of single story, stud wall construction, with steel siding and roofs. Dimensions of the finishing barns and pits may vary slightly from site to site, but are approximately 200 feet long by 40 feet wide. Concrete pits are 8-10 feet in depth and all newly constructed pits were outfitted with perimeter tile drains.

The farrowing facility farrowing barn differs from the other new barns in that it has a shallow pit underneath that drains to the gestation barn pits.

Barn details for each site are discussed in **Section 2.3**. The new buildings are curtained for natural ventilation when weather permits, and are power ventilated in the winter, except for the farrowing site nursery barn, which is hard-sided and is mechanically ventilated year round. **Table 2-1** summarizes the pre-project and post-project site characteristics.

The manure management practices for the sites operating prior to the HPP project included scrape and haul at some sites, liquid manure storage at the others, and land application for all. Approximately 2,082 acres were available for manure spreading prior to the HPP project. The current acreage reported and/or previously utilized by HPP members for manure spreading is approximately 9,130 acres, which represents a net increase of 7,048 acres. The specific details of each project facility are provided below.

It should be noted that animal unit totals at feedlots can vary over time depending on market conditions, operator decisions, and other factors, although they may be limited by applicable rule and permit provisions. The animal unit figures used in this EIS were accurate at the time of site data gathering and compilation for this EIS.

There are numerous pre-existing odor sources in the HPP project area (see **Figure 2-2)**, some of which are feedlot operations. Gantzer Environmental utilized these odor sources in the regional odor assessment that is part of the air-modeling component of the EIS.

2.2 GENERAL PRACTICES

2.2.1 Hog Feed and Additives for Farrowing and Finishing Sites

The farrowing facility and the finishing sites use specific mixtures of feed additives and meal for each hog type. All feed mixtures contain percentages of corn meal and soybean meal. General feed mixes for types of hogs from nursery to finishing hog are included in **Appendix A.**

Each feed type is supplemented with specific ingredients and additions such as fish meal (nursery hogs), white grease for sows and boars, and Land O' Lakes Lean Gain Hog Grower Mix™ and Paylean® for finishing hogs. **Table 2-2** provides a summary of the characteristics and recommended dosage of the feed additions and pharmaceuticals used at the HPP sites. Paylean® is a pharmaceutical product that causes a hog's metabolism to shift nutrients from fat to muscle growth. Premixes are added to the feed containing varying percentages of phosphorus, calcium, copper, selenium, zinc, amino acids such as lysine and methionine, and vitamins A, D_3, and E.

Low dosages of antibiotics are employed to prevent disease outbreaks and increase the rate of weight gain and feed efficiency. If disease does occur, the drug dosage is typically increased until the outbreak is under control. Other pharmaceuticals may be administered over a recommended period to treat affected hogs. This is standard practice in the industry.

All of the HPP facilities use the pharmaceutical Tylosin Phosphate (Tylan®) and most use Chlortetracycline Hydrochloride (Aureomycin®). The remaining pharmaceuticals and additives identified in **Table 2-2** are used at other finishing sites within the project at specific frequencies and dosages. Reviewers are cautioned that chemical use at feedlots is not to be regarded as constant, but variable over time according to operator perceptions of efficacy for the intended purpose. The chemical use addressed in this EIS is that which was known at the time of publication.

2.2.2 Pit Additives

The two pit additives that are or have been proposed for use by the HPP members are Liqui-Blue™ (trademark of Link Agri-Products) and Barrier® (registered by Agriliance). Liqui-Blue™ is currently used at three feedlots within the HPP project to break down solids and reduce odors released from liquid manure. Barrier® is being considered for use in conjunction with Liqui-Blue™. **Table 2-3** gives descriptions, active chemical concentrations, and environmental information on these products.

Liqui-Blue™ is a Canadian product that contains enzymes to break down manure solids for ease of pumping. The chemical reactions performed by the enzymes are said to increase aerobic manure digestion that dislodges the solids from the bottom of the pit, minimizing clogging in land application equipment and maximizing the ability to clean out manure pits. This breakdown of solids is said to help reduce odors when manure is land applied. The active ingredients in Liqui-Blue™ are copper sulfate and sulfuric acid. Liqui-Blue™ is used in conjunction with other products to adjust pH and adjust the counts of bacteria within the manure pit. The manufacturer claims that the mixture is environmentally friendly (Link Agri-Products 2001). However, no data is given to support this claim.

Barrier® is a soy-based product mixed with isopropanol and a chemical mixture containing 1-4 Dioxane and ethylene oxide. Barrier® is said to form a film on the surface of the manure in the pit, thus trapping odors beneath the surface. The manufacturer claims Barrier® can reduce ammonia and hydrogen sulfide emissions up to 40% and 75%, respectively.

Reviewers are cautioned that chemical use at feedlots is not to be regarded as constant, but variable over time according to operator perceptions of efficacy for the intended purpose. The chemical use addressed in this EIS is that which was known at the time of publication.

2.2.3 Manure Application Practices

Animal manure has value as crop fertilizer due to the high nutrient content (nitrogen and phosphorus) necessary for healthy plant growth. All HPP feedlot operators use manure as fertilizer for their crops. Five of the ten sites have or propose to have only liquid manure operations and most contract with one or more certified manure applicators to land apply the liquid manure. Two operations are scrape and haul operations, stockpiling and spreading solid manure onto available acreage. Three sites are "combination sites", either currently or in the past operating scrape and haul operations in conjunction with liquid manure management operations. Site-specific details are discussed in **Section 2.3.**

Manure application rates must be limited by the nutrient needs of the crops and the availability of nutrients in the soil, in order to minimize the potential for environmental impacts. Maximum manure application rates are restricted based on crop-available nitrogen in the soil (MPCA 2001d). Under the rules, the larger HPP operations (greater than 100 AU) must conduct periodic manure and soil nutrient testing to determine the appropriate manure application rates on soils. The smaller operations (less than 100 AU) are allowed to use published agronomic data and expected manure nutrient values to determine nutrient content in soil and manure. At these smaller operations testing is not required. Site-specific practices are discussed in **Section 2.3**.

Minn.R. 7020.0300 subp. 23 defines a 300-foot buffer strip around certain specified wetlands and most intermittent streams and ditches as a “special protection area.” Minn. R. 7020.2225 subp. 6 places restrictions on manure application within special protection areas, including setbacks from the wetland, intermittent stream, or ditch and allowable phosphorus levels in the soil. All HPP operators must observe these requirements as applicable, and they report that they do so.

2.2.4 Mortality Management

The HPP farrowing site and the finishing sites dispose of dead animal carcasses by composting, burying, using a rendering service to pick up the carcasses, or (at the farrowing site only) incinerating animal carcasses (see **Table 2-6**). Operations that compost typically employ practices that include a pile near their barns, adding straw and/or manure in specific proportions to aid in composting, and then applying the finished compost material to a nearby field. Sites that bury the dead animals report excavating a hole in the ground, placing the mortalities in the excavation and covering with soil. Sites that contract with a rendering service temporarily store the moralities outside and call the rendering service for pick up. The farrowing site freezes the mortalities that it has picked up for rendering. Most of the sites have reported using varied animal mortality management practices from time to time. Site-specific practices are discussed in **Section 2.3**.

2.3 SITE SPECIFIC PROJECT INFORMATION

2.3.1 Farrowing Facility

The farrowing facility site is located in Section 34, T123N, R41W, Moore Township in Stevens County, Minnesota. The site is approximately 6 miles south of Hancock, Minnesota off Hwy 1 (**Figure 1-2)**.

The farrowing facility houses 8000 piglets, 2424 sows, and 60 boars. The total Animal Unit (AU) capacity for the site is 1393.6.

2.3.1.1 <u>Pre Project Description</u>

The farrowing facility site was cropland before the HPP project. No buildings were on the site prior to construction. Seven residences lie within a one-mile radius. A site plan of the pre-project condition is shown on **Figure 2-3**.

2.3.1.2 <u>Post-Project Description</u>

The farrowing facility consists of five total confinement barns with slatted floors draining into concrete pits of various depths beneath each barn. The concrete pit beneath the farrowing barn drains by gravity to the three gestation barn pits through piping connecting the pits. Plugs in the piping are manipulated to control manure flow from the farrowing barn pit to the gestation barn pits. Perimeter tile drains are installed around and below the concrete pits, and are designed to lower the water table near the pits. HPP reports that the perimeter tile drains have always been dry. See **Tables 2-1 and 2-4** for facility site characteristics.

Two septic tanks handle the wastewater from the offices, which house toilet and showering facilities, prior to draining into the concrete storage pits beneath the barns. Two wells (Unique

Well Numbers (UWN) 595418 and 595419) used for domestic and operational purposes were installed on the facility property near the parking lot on either side of the driveway. The wells are 208 and 209 feet deep, respectively. The site plan for the facility is shown on **Figure 2-4**.

The manure management plan for the farrowing/nursery facility provides that all storage pit contents are pumped and land applied during the spring and fall of every year. Full capacity of the storage pits is approximately 4.2 million gallons, which is approximately 14 months of storage, based on theoretical manure waste production rates.

In 2000, 4.1 million gallons of liquid manure were land applied to 551 acres in 7 fields. In 2001, 5.86 million gallons of liquid manure were applied to 571 acres in five different fields over two different application periods (spring and fall). The increase in manure generation in 2001 is reportedly due to additional cleaning and disinfection conducted in 2001, and may not represent routine manure generation. The locations of the land application fields are shown on **Figure 2-5**. Refer to **Table 2-5** for yearly land application rates, testing results, and application locations for all sites. The 2002 MMP indicates that the farrowing/nursery facility has approximately 1561 acres available for use for land application of manure.

The farrowing site uses the land of other farmers for manure disposal. If the farrowing site is to continue to use other farmers' fields for manure application (such as Olson's), the farrowing site must have the appropriate field and application information within their MMP, perform field and manure testing, keep the appropriate land application records, and provide the field owners with the appropriate information for their records so that both the farmer and farrowing facility can show that nutrients from all sources were applied at agronomic rates. Therefore, HPP-FF must update their MMP annually and keep the updated MMP and annual manure application records available on site as required. Because HPP-FF has agreed to follow the conditions of the expired Interim Permit, they have been submitting the annual manure application records to MPCA each year.

Summaries of the farrowing facility feed components are included in **Appendix A** and feed additives are summarized in **Tables 2-1** and **2-2** and discussed in Section 2.2.1.

Adult animal carcasses are frozen and picked up by a rendering service. The facility also operates an incinerator for carcass management, but uses it primarily for piglet mortality management. Ashes from the incinerator initially were buried on site. This is not permitted, so MPCA has directed the farrowing site to thin spread the ash on different locations in fields instead. Mortality management for the facility is summarized in greater detail in **Table 2-6**.

2.3.2 Alan Charles Feedlot

Charles submitted two permit applications in 1997 to build one finishing barn on one of two separate properties in Stevens County: Section 32 in Hodges Township or Section 4 in Moore Township. Charles informed the Stevens County Feedlot Officer on February 18, 1999, that he had decided to build the feedlot in Section 4, T123N, R41W, Moore Township in Stevens County, Minnesota. The site is less than 1/2-mile west of Hancock, Minnesota on County Road 8. The above permit applications are now outdated. Charles has not submitted a new permit application or updated construction plans for the feedlot to comply with the new rules and has recently notified the county that he currently does not intend to build. Permission to build cannot be granted until an application is resubmitted and updated plans are approved, and this EIS is completed.

2.3.2.1 Pre Project Description

The Alan Charles proposed feedlot site currently consists of a house and garage that are intermittently occupied. There are no current plans to demolish the buildings. A 110-foot residential well (UWN unknown) is located on this site for household and planned livestock use. Ten rural residences and a portion of the town of Hancock are within a one-mile radius of the site. A site plan of pre-project conditions is shown on **Figure 2-6**.

Currently, Charles contracts for raising his share of hogs at various sites in Minnesota. Most recently, Charles reports that he contracted for his hogs to be raised at two different facilities; one near Dawson, Minnesota, and the other in Swift County. The lightest weight hogs from each of these facilities have been delivered to the farm of Harold Charles, Alan's father.

2.3.2.2 Post Project Description

One barn was initially proposed for the Charles project site and would be built south of the existing house and shed (note that Charles has notified the MPCA that he currently does not intend to build this barn). The facility's general site characteristics are listed in **Table 2-1**. The site plan for the facility is shown in **Figure 2-7**. The proposed barn would, if built, have slatted floors that drain into an 8-foot concrete pit, and would house 500 grower and 500 feeder hogs. The total proposed AU for the site is 300. The pit would have a perimeter tile that would drain to a nearby road ditch. Barn and pit attributes are listed in **Table 2-4**.

The pit would be pumped annually and the liquid manure land applied on some of the 1183 acres of fields available to Charles. Manure storage capacity would be approximately 435,000 gallons, translating into approximately 10 months of storage based on theoretical manure production rates. The site's planned manure land application practices are summarized in **Table 2-5.** The land application loading rates would depend on test results from manure and soil before land application is performed. Land application fields for the Charles feedlot are illustrated on **Figure 2-8**.

Feed, additives, and medications would likely be the same as those discussed in **Section 2.2.1** and **Tables 2-1 and 2-2**.

If he builds his facility, Charles plans to compost animal mortalities on an old concrete bunker using a straw-manure mixture as the bulking material. Charles plans to turn the pile every three months and when composting is finished, apply it to nearby fields. Planned mortality management practices are summarized in greater detail in **Table 2-6**.

2.3.3 Gary Greiner Feedlot

The Greiner site is located in Section 2, T123N, R40W, Hoff Township in Pope County, Minnesota. The site is approximately 9 miles east of Hancock, Minnesota on 350th Avenue. The MPCA issued a Certificate of Compliance for feedlot construction in 1997, and revised it in June 1998.

2.3.3.1 Pre Project Description

Previous to HPP related construction, the site consisted of a house and a storage garage, both of which have since been demolished. A 75-foot residential well (UWN 595404) is located on-site. Three residences lie within a one-mile radius. A site map illustrating the pre-project condition is shown on **Figure 2-9**.

2.3.3.2 Post Project Description

The site plan for the facility is shown on **Figure 2-10**. One total confinement barn with slatted floors over an 8-foot concrete pit was constructed for the HPP project in October 1997. The barn houses 1000 grower and feeder hogs for an AU total of 300 for the site. The pit is emptied and pumped once a year and the liquid manure is applied to the 448 acres available. Manure storage capacity is approximately 435,000 gallons, which translates to 10 months of storage based on theoretical manure production rates. Actual manure production rates from the facility indicate that the facility has approximately 14 months of storage under current management practices. The conservative water use practices at the facility decrease the amount of wash water entering the pit, allowing for longer storage in the pit before the ultimate capacity is reached. **Table 2-1** summarizes the facility's site characteristics and **Table 2-4** lists barn and pit attributes.

The locations of the land application fields are shown on **Figure 2-11**. Greiner estimates manure spreading rates of approximately 4000 gal/acre/yr. on 90 acres since 1998. Manure management operations are summarized in **Table 2-5**.

Feed components are the same as those discussed in **Section 2.2.1**. Greiner pharmaceutical use is listed in **Table 2-2.**

Greiner reports that he uses a rendering service that picks up carcasses as needed. An old compost pile or burial site was noted during the site visit in 2001. When asked about this, Greiner explained that they sometimes bury carcasses because it is more convenient. Mortality management for the site is summarized in greater detail in **Table 2-6**.

2.3.4 Jon Nohl Feedlot

The Nohl site is located in Section 24, T123N, R42W, Moore Township in Stevens County, Minnesota. The site is approximately 6 miles south of Hancock, Minnesota. Stevens County issued a Certificate of Compliance (STEV-C 031) for feedlot construction in 1997, and revised it in February and June of 1998. **Table 2-1** lists the facility's general information and **Table 2-4** lists barn attributes.

2.3.4.1 Pre-Project Description

Before the HPP project, the Nohl site had a house, garage, and an old shed. The pre-project site conditions are shown on **Figure 2-12**. A 98-foot residential well (UWN 595401) is on-site for household and livestock use. It is approximately 200 feet NE of the northernmost new barn. Four residences lie within a one-mile radius.

2.3.4.2 Post-Project Description

The north total confinement barn was built in 1997 with slatted floors over an 8-foot deep concrete storage pit. The south total confinement barn was built in 1998 with slatted floors over an 8-foot concrete storage pit. A passageway connects the north and south barns. Each barn houses 500 grower/feeder hogs and 500 finishing hogs for an AU total of 600 for the site. A site map illustrating the facility's layout is shown on **Figure 2-13**.

The north barn and south barn have approximate capacities of 426,500 gallons each, for a site capacity of approximately 853,000 gallons. This translates to 10 months of storage based on theoretical manure production rates. Actual manure production rates from the facility indicate that the facility has approximately 19 months of storage under current management practices. The conservative water use practices at the facility decrease the amount of wash water entering the pit, allowing for longer storage in the pit before the ultimate capacity is reached. Nohl reports that he uses Liqui-Blue® to help break down the solids and make land application easier. Pit additive details are discussed in **Section 2.2.2**. **Table 2-3** describes Liqui-Blue® and additional products used in conjunction with Liqui-Blue®.

Gravity perimeter tile drains surround the concrete pits. The drains lead to the property perimeter ditch (approximately 100 feet from the north barn) that eventually drains to Judicial Ditch #9 over one mile from the private ditch.

Manure management practices are summarized in **Table 2-5**. The liquid manure from the two barns is land applied on 1,032 available acres. Land application sites are shown on **Figure 2-14.**

Feed constituents were discussed in **Section 2.2.1**. **Table 2-2** summarizes pharmaceutical use at the Nohl feedlot.

Animal mortalities are managed by composting. Nohl began composting approximately one year ago. Previously, Nohl buried the carcasses near the current compost pile location. The composting site is located on the south side of the barns. Mortality management practices are summarized in **Table 2-6**.

2.3.5 Mike Olson Feedlot

The Olson site is located in Section 26, T123N, R42W, Moore Township in Stevens County, Minnesota. The site is approximately 3 miles south of Hancock, Minnesota off County Road 53. Olson completed a permit application in 1997. However, since there was no new construction associated with the HPP project, a Certificate of Compliance was not issued. Facilities that were not being modified did not require them, and permits often were not issued to such facilities.

2.3.5.1 Pre Project Description

Prior to the HPP project, the site consisted of a house, three partial confinement barns and three open lots. A machine shed provides storage space for facility equipment. There are four shallow wells at the site, one of which is for household use. The three others are for livestock use. This is a scrape-and-haul operation. The site plan for the facility is shown on **Figure 2-15.**

The site was a farrow-to-finish unit prior to 1992. The site had no animals from 1992 through 1995, at which time the site began operation as a finishing-only facility. Prior to the HPP project, two of the facility barns contained a maximum of 225 hogs, providing the site with a total AU of 66. The barns are cleaned as needed, on average approximately every three days.

Olson uses the feed and antibiotics discussed in **Section 2.2.1.** **Table 2-2** summarizes the site's pharmaceutical use.

2.3.5.2 Post Project Description

No new construction was completed to accommodate HPP hogs. The current facility layout is shown on **Figure 2-16**. Two of the three barns together currently house an average total of 180-230 finishing hogs. The third barn is currently empty and is not used. All barns are older, naturally ventilated scrape-and-haul facilities. The total AU capacity for the site is approximately 68. The open lots and barns are scraped and cleaned as needed, which currently is approximately every three days. **Table 2-1** lists the facility's general information and **Table 2-4** lists barn attributes.

Acreage for land application is depicted on **Figure 2-17**. According to Olson, since 1998, the volume of solid manure/straw spread has been approximately 50-72 loads per year. The manure was hauled in a 180-bushel manure spreader, at a rate of approximately 415 to 480 cubic yards per year, and spread within his 200 acres. **Table 2-5** details manure management practices.

Manure management data obtained from the farrowing and Olson operations indicate that these two facilities have in the past utilized a common field for land application of manure. This field is part of the Olson farm, and is located immediately south of the Olson feedlot site (*see* **Figures 2-5** and **2-17)**. Available evidence indicates that this has not resulted in overapplication of manure because both have always been required to apply manure at agronomic rates. As required in Minn. R. 7020, if the farrowing site is to continue to use fields on Olson's farm for manure application, the farrowing site must have the appropriate field and application information within their MMP, perform field and manure testing, and keep the appropriate land application records. Olson should also get a copy of the land application records for his files. For each cropping season, field owners (Olson in this case) should keep manure from different farms separate on land application fields as a best management practice and provide that information to the farrowing site for use in their MMP.

Feed, premixes and medications did not change after the HPP project began. Feed and premixes are discussed in **Section 2.2.1** and summarized on **Table 2-2**.

Olson composts animal mortalities using straw and manure from the barns as bulking material. Olson reported using the required thickness of bulking material to the pile, but also reported vermin and fly problems near and around the compost pile. **Table 2-6** details animal mortality management for the facility.

2.3.6 David Paul Feedlot

The Paul site is located in Section 14, T123N, R42W, Horton Township in Stevens County, Minnesota. The site is approximately six miles south of Hancock, Minnesota. Stevens County issued a Certificate of Compliance (STEV-C 039) for feedlot construction on February 2, 1998, and revised it in June 1998.

2.3.6.1 Pre-Project Description

The site consisted of a storage shed prior to HPP related construction. A 120-foot residential well (UWN 587922) is on-site for household and livestock use. The site is approximately 800 feet from an unnamed wetland. The wetland on the Paul property is classified by the DNR National Wetland Inventory map as a semi-permanent, emergent/open water wetland. The pre-project site characteristics are shown on **Figure 2-18**.

2.3.6.2 Post-Project Description

The total confinement barn and house were built in 1998. The storage shed houses equipment for the facility operations. The facility's layout is shown in **Figure 2-19**. **Table 2-4** details barn and storage pit information. The barn currently houses 500 grower/feeder hogs and 500 finishing hogs for an AU total of 300 for the site. Manure storage capacity for the site is approximately 435,000 gallons per year, which translates to 10 months of storage based on theoretical manure production rates. Actual manure production rates from the facility indicate that the facility has approximately 18 months of storage under current management practices. The conservative water use practices at the facility decrease the amount of wash water entering the pit, allowing for longer storage before the ultimate capacity is reached. Gravity perimeter tile drains surround the concrete pit. A sump pump lifts the accumulated water into the discharge pipe that currently drains to a grassy area near the barn. Previously, the tile drainage was directed into the wetland approximately 800 feet away. The perimeter tiles typically drain during wet periods. No water quality testing is performed.

Available acreage for land application totals approximately 630 acres and is depicted on **Figure 2-20**. Manure management practices are described in **Table 2-5**. The amount of manure Paul applied to his fields increased from 120,000 gallons in 1998 to 290,000 gallons in 2001.

Feed mixes are the same as those discussed in **Section 2.2.1**. **Table 2-2** summarizes the site's pharmaceutical use.

Paul buried dead animal carcasses at the north end of the yard in the past, but reports that he stopped that practice in the fall of 2001 when a compost pile was started adjacent to the surface water, on the north side of the property. This pile was subsequently removed and dead animals were again buried for a time. The MPCA subsequently advised Paul in 2002 not to bury his animals due to the close proximity of the water table. Currently, Paul reports rendering his animal mortalities as summarized in **Table 2-6**.

2.3.7 Stanley Schaefer Feedlot

The Schaefer site is located in Section 21, T123N, R41W, Moore Township in Stevens County, Minnesota. The site is approximately 4 miles southwest of Hancock, Minnesota. Stevens County issued a Certificate of Compliance (STEV-C 038) for feedlot construction in February 11, 1998, and revised it in May and June of 1998.

2.3.7.1 Pre-Project Description

Prior to HPP-related construction, the site consisted of the house, one total confinement barn, one partial confinement barn, and an open lot. The total confinement barn has a concrete floor, using scrape and haul as the manure management method. The site's general characteristics are listed in **Table 2-1.** The facility's pre-project layout is shown on **Figure 2-21**. **Table 2-4** details barn information before construction of the two new barns for the HPP Project. The storage shed houses equipment for the facility operations. A 90-foot residential well (UWN unknown) located approximately 65 feet from the old barn, is on-site for household and livestock use.

Prior to the HPP project, the site was a nursery with approximately 120 piglets housed in the total confinement barn.

The feed and additives for the hogs do not differ from the general description in **Section 2.2.1**, except that the facility also uses Lincomycin to treat hog intestinal problems such as dysentery. **Table 2-2** summarizes antibiotic use at the feedlot.

2.3.7.2 Post-Project Description

Two new total confinement barns were built in 1998. **Table 2-4** details barn information. The north barn was built first and initially housed hogs from HPP and other sources. Currently the site only accepts hogs from HPP. Schaefer some time ago informed Stevens County that he was planning to build a third barn having the same dimensions and physical characteristics as the two barns built in 1998, but has since reconsidered. The barns currently house 1000 grower/feeder hogs and 1000 finishing hogs, for a site total of 600 AU. The older barns on the site are used occasionally to house slow growers culled from each shipment, averaging 60 hogs every two months. The manure tonnage hauled from the old barn has reportedly been reduced from 5 tons in 1998 to 0.5 tons in 2001. The facility's layout is illustrated on **Figure 2-22**.

The MPCA received an additional feedlot application from Schaefer in October 1998 proposing two more barns, in addition to the two new barns he had recently built. The application was later withdrawn in 1999. Schaefer more recently submitted a completed application to Stevens County, with a Manure Management Plan (MMP), for the proposed construction of only one additional barn for the site. Schaefer subsequently withdrew this latest request. Nonetheless, the analysis considers the effect of a three-barn operation at the Schaefer site, as noted earlier.

Use of the state's revised 0.3 animal unit conversion factor for finishing swine between 55 pounds and 300 pounds results in a different permit application requirement than if one used the April 14, 2003 US EPA criteria (2500 swine rather than 55 pounds) for CAFOs and Schaefer elects to build the third barn. If the third barn is constructed, Schaefer would have 3000 swine and meet US EPA's criteria for a definition for CAFO. MPCA would inform Schaefer of the difference between Minnesota's animal units and EPS's definition for CAFO and that under federal regulations Schaefer would be required to submit an NPDES permit application before the third barn is constructed. See also **Section 2.4.5.3.**

Manure management operations are summarized in **Table 2-5**. Manure storage capacity for the site (including the proposed third barn) is approximately 1.3 million gallons, which translates to 10 months of storage using theoretical manure production rates. Actual manure production rates from the facility indicate that the facility has approximately 17 months of storage. The conservative water use practices at the facility decrease the amount of wash water entering the pit, allowing for longer storage before the ultimate capacity is reached. Available acreage for land application totals approximately 1,345 acres, which is shown on **Figure 2-23**. Since 1999, manure land application increased from 270,000 gallons to the 2001 total of 606,000 gallons from the current two-barn system.

Feed, premixes, and medications have not changed since the HPP project began. The pharmaceuticals and their uses are discussed in **Section 2.2.1**. **Table 2-2** summarizes the facility's pharmaceutical use.

Schaefer reports operation of a compost site to manage animal mortalities. Schaefer uses only straw as the bulking material. Schaefer indicated that the pile is turned every couple of months and landspread on nearby fields when composting is complete. **Table 2-6** summarizes the site's animal mortality management practices.

2.3.8 Jere Solvie Feedlot

The Solvie site is located in Section 5, T124N, R40W, Walden Township in Pope County, Minnesota. The site is approximately six miles northeast of Hancock, Minnesota. A Certificate of Compliance (MPCA-C 6895) was issued to Solvie for construction of one new barn with an underbarn concrete pit. In addition, certification of the pre-existing clay basin was included in the Certificate of Compliance. A revised Certificate of Compliance (MPCA-C 6895R) was issued in June of 1998.

2.3.8.1 Pre Project Description

The pre-project site layout is shown on **Figure 2-24**. Prior to HPP-related construction, the site consisted of the house, one total confinement barn built in 1994, a 1 million gallon earthen basin to which it drained, and an older scrape and haul barn approximately 45 years old. General facility information is listed on **Table 2-1**. Two wells, one approximately 45 feet deep (UWN 577133), and another of unknown depth (UWN unknown), are on-site for household and livestock use.

Prior to the HPP project, the site typically had approximately 250 grower/feeder hogs and 500 finishing hogs in the total confinement barn. The old barn sometimes housed hogs culled from the total containment barn. The total AU for the site was 225.

The feed and additives used at the site are discussed in **Section 2.2.1. Table 2-2** summarizes the facility's pharmaceutical use.

2.3.8.2 Post-Project Description

The post-project layout of the site is shown on **Figure 2-25**. The pre-Hancock total confinement barn is still in use along with the existing earthen basin. One new total confinement barn was built for HPP hogs in 1998 with an 8-foot deep concrete storage pit. Gravity drain tile is installed and discharges at a wooded area near the barns. The site's barn summary is given in **Table 2-4**. Currently, the site accepts hogs from HPP and other sources. The barn built in 1994 houses approximately 750 non-Hancock hogs. The new total confinement barn houses 1000 HPP hogs (300 AU). This is the current HPP total. The barns together house a total of 1750 grower/feeder hogs and finishing hogs. The total AU--Hancock plus non-Hancock--for the site is 525.

Manure management practices are detailed in **Table 2-5**. Manure from the 1994 non-Hancock barn drains to the earthen storage basin. The earthen basin and the concrete pit under the HPP barn are emptied once a year, not necessarily at the same time, and the liquid manure is applied on fields owned or rented by Solvie. The manure from the HPP and non-HPP sources are mixed when pumped and land applied on fields. Manure storage capacity for the site is approximately 1.45 million gallons, which translates to 18 months of storage using theoretical manure production rates. Actual manure production rates from the facility indicate that the facility has approximately 19 months of storage under current management practices.

Available acreage for land application of liquid manure is approximately 1040 acres and is shown on **Figure 2-26**. Solvie reports that approximately 900,000 gallons have been land applied every year since 1998. The manure is incorporated within 24 hours.

Discussion of use and dosage of the pharmaceuticals is included in **Section 2.2.1** and summarized in **Table 2-2**.

Animal mortality management for the site is summarized in **Table 2-6**. Solvie has composted and buried mortalities in the past, but now reportedly uses a rendering service for mortality management.

2.3.9 Chad Solvie

Chad Solvie is a shareholder in the HPP project. He obtains 1000 hogs three times a year. Chad Solvie does not have a feedlot to finish his hogs. He sells his shares on the open market.

2.3.10 Wayne Spohr Feedlot

The Spohr site is located in Section 36, T123N, R42W, Horton Township in Stevens County, Minnesota. The site is approximately 8 miles southwest of Hancock, Minnesota. Stevens County issued a Certificate of Compliance (STEV-C 042) for the site on March 3, 1998, and revised it in March and June of 1998.

2.3.10.1 Pre-Project Description

Prior to HPP related construction, the site consisted of the house, two total confinement barns with concrete floors, one partial confinement barn, and one earthen manure storage basin. The earthen basin was included in the Certificate of Compliance indicating the basin was certified by Stevens County. One residential well (UWN unknown), between 75 and 100 feet deep, is on-site for household and livestock use. The pre-project facility layout is shown on **Figure 2-27**.

Prior to the HPP project, approximately 550 grower/finisher hogs were housed in the two total confinement barns. The site also housed 200 broiler chickens and five horses. The total AU capacity for the site was 176. The general site characteristics are listed in **Table 2-1**.

No records were kept of manure storage and land application prior to the HPP project.

The feed, additives, and antibiotics are the same as those discussed in **Section 2.2.1** with the additional usage of injectable penicillin for control of erysipelas, an irritating skin infection.

2.3.10.2 Post Project Description

The manure storage basin was closed and a new 1000-hog total confinement barn was built in the former earthen storage basin in 1998 to house HPP hogs. A contractor excavated the earthen storage basin, and the clay and manure removed from the basin were placed in manure spreaders and landspread on fields owned or leased by Spohr. The new barn with an eight-foot deep concrete pit beneath it was then built in the excavation. The facility's barn summary is included in **Table 2-4**. Currently the site only accepts hogs from HPP. Spohr continues to maintain chickens and horses on-site. The barns currently house 1,550 grower/feeder hogs and finishing hogs (550 of which are housed in the old barns), 150 chickens, and 6 horses. The new HPP capacity is 300 AU and an additional 165 HPP AU are housed in two older barns. With the horses and chickens, the total AU capacity for the site is 477. The site plan for the facility is shown on **Figure 2-28**.

Manure management practices are summarized in **Table 2-5.** The floor of the new barn is partially slatted, and drains to the concrete pit beneath. The pit is pumped once a year and the liquid manure is landspread on portions of the available 1000 acres of fields. Manure storage capacity for the barn is approximately 477,190 gallons, which translates to approximately 9 months of storage using theoretical manure production rates. Under current management practices facility has approximately 18 months of storage. The conservative water use practices at the facility decrease the amount of wash water entering the pit and allow for longer storage before the ultimate capacity is reached.

Manure from the concrete floors in the other barns is scraped periodically and directly applied to land application acres. The manure is landspread and incorporated within 24 hours. Spohr has been scraping and hauling approximately 152 tons of manure (12.7 tons/month), and has applied a range of approximately 240,000 to 296,000 gallons of liquid manure, every year since 1999.

The identified manure land application sites for the facility are shown on **Figure 2-29** and is summarized in **Table 2-5**.

Feed, premixes, and medications are the same as those discussed in **Section 2.2.1** with additional use of injectable penicillin. The pharmaceutical use and dosage data is summarized in **Table 2-2**.

The composting site is on the south side of the pre-existing barn on a concrete open lot. Mortality management practices are summarized in **Table 2-6**. Spohr uses a straw/manure mixture as the bulking material and turns the pile with a skid loader when it steams. The finished material is applied to adjacent fields.

2.3.11 Craig Swenson

Craig Swenson's share of the HPP project consists of 1000 hogs, three times a year. Swenson does not have a feedlot to finish his hogs. He sells his share on the open market.

2.3.12 John Zeltwanger Feedlot

The Zeltwanger site is located in Section 1, T123N, R41W, Moore Township in Stevens County, Minnesota. The site is slightly over one mile east of Hancock, Minnesota. Zeltwanger completed a permit application in 1997. However, no new construction was proposed by Zeltwanger for the HPP project, and it had no documented pollution hazard. Therefore, a Certificate of Compliance was not issued since they were not required for facilities without documented pollution hazards or new construction.

2.3.12.1 Pre-Project Description

Prior to the HPP project, the site consisted of a house, a Quonset, two total confinement barns, one partial confinement barn, and a lean-to structure. The barns on site house 600 hogs, for a an AU of 180. A machine shed is at the site for equipment storage. The general site characteristics are summarized in **Table 2-1,** and barn attributes are given in **Table 2-4**. Two wells, UWN 450069 and 541890, are on-site for household and livestock use (70' and 100' feet deep). One well is 70 feet south of the machine shed and the second well is located in the northwest corner of the barn. The site's barn summary is in **Table 2-4**. The site plan for the facility is shown on **Figure 2-30**.

Zeltwanger hauled approximately four loads of manure/straw (scraped from the barn floors) in an eight-ton manure spreader per week (on average) and landspread it throughout the 692 acres available. The locations of the manure land application sites are shown on **Figure 2-32**. Land application practices are summarized in **Table 2-5**. Zeltwanger spreads manure year round. However, if fields are unsuitable for land application of manure, due to excessive snow cover or frozen soil, he temporarily stockpiles the manure before spreading it. An old concrete platform on the feedlot is used for temporary stockpiling. Once conditions allow for land application of manure, Zeltwanger removes all manure from the stockpile site and spreads it in his fields.

The antibiotics Tylan®, Aureomycin® and injectable penicillin are used at the Zeltwanger feedlot, in addition to injectable Excenel® (for treatment of swine bacterial respiratory disease) and Lincomycin (for hog dysentery and ileitis). Discussion of use and dosage of the pharmaceuticals is included in **Section 2.2.1** and summarized in **Table 2-2**.

2.3.12.2 Post Project Description

No construction was completed for the HPP project. A site plan of the current facility is shown in **Figure 2-31**. Two of the three barns currently house 600 finishing hogs. The remaining barn and attached lean-to are reportedly empty and are intermittently used to house hogs culled from the primary barns. The total AU for the site is 180. The barns are scraped and cleaned as needed, which is approximately once per week.

Zeltwanger reports that he has not changed his land application practices from pre-project operations discussed in **Section 2.3.12.1.** However, Zeltwanger does not have records for the acreage that he has spread for the last four years.

Feed, premixes and medications do not differ from pre-HPP project practices discussed in **Section 2.1.13.1.**

The Zeltwanger site uses a rendering service to pick up mortalities as necessary.

Zeltwanger has recently put his HPP hog share on the market. His operation may cease operating as a HPP feedlot site.

2.4 PERTINENT LAWS AND REGULATIONS

2.4.1 Air Quality Standards and Inhalation Health Risk Values

The emissions from feedlots must comply with the Minnesota Ambient Air Quality Standards (Minn. R. 7009.0080) and should not exceed the inhalation Health Risk Values (iHRVs) developed by the Minnesota Department of Health (Minn. R. 4717.8000). A feedlot must comply with the ambient air quality standards at its property lines or at the property lines for an adjoining parcel of land whose owner has granted an air quality easement to the feedlot (MN Stat. 116.0713). Feedlots are exempt from the ambient air quality standards while manure is being agitated and for seven days after manure is removed from barns or manure storage facilities. Feedlots with more than 300 AU are limited to 21 total days of exemption in a 12-month period. Feedlots that claim temporary exemption from the state ambient air quality standards during manure removal must provide prior notice to the MPCA or the County (Minn. Stat.116.0713).

Minnesota has two ambient air quality standards for hydrogen sulfide. The first standard provides that the one-half hour time-averaged hydrogen sulfide concentration of 30 ppb by volume (42 $\mu g/m^3$) shall not be exceeded more than twice in any 5 consecutive days. The second standard is that the one-half hour time-averaged hydrogen sulfide concentration of 50 ppb by volume (70 $\mu g/m^3$) shall not be exceeded more than twice per year. The Minnesota ambient air quality standards are designed to protect public health and welfare from adverse effects or anticipated adverse effects. Adverse effects include subjective and physiological symptoms that are likely to interfere with normal activity in healthy or sensitive individuals. Adverse effects also include those symptoms and physiological changes that are likely to interfere unreasonably with the enjoyment of life and property (Minn. R. 7009.0010). The 30-ppb standard, which was promulgated in 1969, corresponds with the annoyance threshold concentration for hydrogen sulfide based on the scientific literature available in the late 1960s. More recent research suggests that hydrogen sulfide concentrations less than or equal to 30 ppb should protect the public from the physiological symptoms of headache and nausea.

If a feedlot's emissions exceed the ambient air quality standards, the MPCA may initiate enforcement actions, which may result in monetary penalties, the requirement of corrective actions, or both (MPCA 1999). Each enforcement action is decided on a case-by-case basis to determine monetary penalty and corrective action requirements. If air quality complaints are lodged with the MPCA, the complaint is referred to the appropriate MPCA regional staff, who is responsible for follow-up of the complaint.

The inhalation Health Risk Values (iHRVs) developed by the Minnesota Department of Health (MDH) are air-phase chemical concentrations below which a significant health risk to humans exposed to those concentrations for the specified time (hourly, 13-week, or annual) is not expected to occur. Moreover, because of the MDH's conservative approach in developing the iHRVs, exposure to chemical concentrations above the iHRV does not necessarily pose a human health risk. Public health refers to the protection of the most sensitive portions of the population, which includes children, pregnant women and their fetuses, individuals compromised by pre-existing diseases, and elderly persons. However, iHRVs may not be protective of every individual, *e.g.*, hypersensitive individuals who may respond unpredictably to chemical exposures.

State rules and statutes do not specify how the iHRVs should be used. MDH and MPCA use the iHRVs to assist in the assessment of potential human health risks associated with atmospheric chemical exposure. The iHRVs are used as an assessment tool in the environmental review process, issuing of air permits, and risk assessments. State statutes do not provide feedlots with the ability to claim an exemption from the iHRVs during manure removal.

The MDH has developed one iHRV for hydrogen sulfide and two iHRVs for ammonia. The subchronic (13-week time-averaged) iHRV for hydrogen sulfide is 10 $\mu g/m^3$ or 7 ppb by volume (Minn. R. 4717.8150). The acute (hourly) iHRV for ammonia is 3200 $\mu g/m^3$ (Minn. R. 4717.8200) and the chronic (annual time-averaged) ammonia iHRV is 80 $\mu g/m^3$ (Minn. R. 4717.8100).

2.4.2 Certificate of Compliance

A Certificate of Compliance was a written statement from the regulatory authority that a feedlot was in compliance with state requirements as of the date of issuance. At first, all Certificates of Compliance were issued by MPCA. When the Delegated County program was initiated, counties took over issuance for certain types of feedlots. Certificates of Compliance are no longer used in the feedlot regulatory program, since the new feedlot rules were adopted.

Certificates of Compliance were administered and issued by Stevens County for the HPP sites located in Stevens County. Since Pope County was not delegated, MPCA issued the Certificates of Compliance for the two sites in Pope County.

Certificates of Compliance were issued to all but the Olson and Zeltwanger finishing feedlots within the HPP Project. Certificates of Compliance were not issued for these two sites because the Zeltwanger and Olson feedlots were not being modified, and they had no known pollution hazards.

The Certificate of Compliance contained standard management or construction practices at each facility to maintain compliance, including record keeping on the manure management practices, Board of Animal Health (BAH) rules regarding dead animal disposal, and concrete pit construction criteria. Each facility may have had additional management practices outlined in the Certificate of Compliance, such as restrictions on land application of manure on granular soils, that established how compliance with applicable rules was maintained. Four finishing site operators, Solvie, Olson, Nohl and Schaefer, were specifically identified as having granular soils in their fields. These feedlot owners could only apply manure to these fields between April 15 and July 15 in order to maintain compliance with Minn. R. 7020 and 7060, according to their Certificates of Compliance. **Table 2-7** summarizes the Certificate of Compliance provisions.

Although certificates of compliance are no longer issued now that the MPCA feedlot rules have been revised, a comparison of practices listed in the certificates with current feedlot operations provides some insight into a particular feedlot's potential compliance with current MPCA requirements and conformance with accepted agricultural pollution prevention practices. For the purposes of the EIS, MPCA staff conducted a review of the operations of the several Hancock finishing facilities that were previously issued certificates. Of particular interest was the best management practice to avoid fall application of manure on granular soils. Those reviews are discussed in **Section 6.0**.

2.4.3 Finishing Site Initial Requirements

Plans and specifications for the barns built at the Stevens County finishing sites were submitted to Stevens County. Operators for the two sites located in Pope County, Solvie and Greiner, submitted manure management plans to the MPCA, since Pope County was not a delegated county at that time. Issuance of Certificates of Compliance to the expanding sites indicated approval of those plans by Stevens County or the MPCA.

2.4.4 Farrowing Facility Initial Requirements

In order to construct and operate the farrowing facility, HPP obtained the following permits in 1998:

- Conditional Use Permit (CUP) from Stevens County
- MPCA Interim Permit
- NPDES General Storm Water Permit for Construction and Erosion Control

The Conditional Use Permit (CUP) for the farrowing facility included requirements for land application setbacks and use of odor control when necessary. See **Appendix B** for a copy of the Stevens County CUP.

An Interim Permit application was submitted to the MPCA that included a Manure Management Plan (MMP), an Air Emissions Plan, an Emergency Response Plan, and construction plans for all the barns. After the EAW process was completed, the farrowing facility was issued an Interim Permit (MPCA-I 2358(A)) in February 1998, with special conditions concerning construction, construction approvals, manure management, manure sampling, manure analysis, and air emissions monitoring. The Interim Permit included conditions for land application setbacks near sensitive features, limiting manure land application on granular soils between April 15 and July 15, manure-testing requirements, air monitoring requirements, and record keeping. A copy of the Interim Permit is included in **Appendix B.** The Interim Permit expired December 13, 1998.

The Interim Permit set specific construction and certification requirements. Construction certification reports were required of manure storage structures with capacities greater than 500,000 gallons. The farrowing and nursery barn pit volumes were beneath that threshold. However, construction certification reports were required of the three gestation barns. The farrowing facility was inspected by the MPCA throughout its construction.

HPP also obtained coverage for the farrowing facility under the General NPDES Permit for Storm Water Discharge During Construction (MN R10000, expiration date of September 3, 1998). Requirements set in this permit were to reduce the amount of sediment/pollution entering surface waters both during and after construction projects.

2.4.5 Revised Feedlot Rule Requirements

2.4.5.1 General Facility Requirements

The Minnesota feedlot rules (Minn. R. ch. 7020) were extensively revised on October 23, 2000. All feedlots must comply with the new rules as applicable.

2.4.5.2 Current Farrowing Facility Requirements

Under the revised feedlot rules, the farrowing site was required to register with Stevens County.

The Interim Permit expired in 1998. Because permits cannot be issued until environmental review is completed, the MPCA has not issued a new permit. However, the farrowing facility is required in the meantime to follow the revised feedlot rules and the conditions established in the Interim Permit.

2.4.5.3 Final EPA Rules Regulating Livestock Wastes

On December 16, 2002, the Environmental Protection Agency (EPA) announced final rules for regulating livestock waste runoff from agricultural feeding operations. The new rules may impact the HPP project in the future. In Minnesota, MPCA is the state NPDES permitting authority that implements the federal NPDES program. The revised feedlot rule (Minn. R. ch. 7020) is the primary rule governing feedlots in Minnesota. At present, MPCA is authorized to implement the NPDES program using the revised feedlot rule. Therefore, all feedlots with more than 1000 animal units are required to obtain an NPDES permit in Minnesota.

2.4.6 Animal Mortality Management Requirements

Feedlots routinely experience some mortality loss, and must manage the dead animals in a way that protects the health of other domestic animals and minimizes adverse effects on human health and the environment. **Table 2-8** summarizes the expectations for animal mortality management established by the state Board of Animal Health (BAH) and the MPCA. The BAH has rules (Minn. R. ch. 1719) governing mortality composting operations, rendering service pickup and storage areas, and cover depth on burial pits. The MPCA makes recommendations for the separation distance between burial pits and the water table, and has established requirements for carcass incineration (Minn. R. Ch. 7011.1215).

2.4.6.1 BAH Program

General Requirements

The BAH mortality management program is codified in Minn. Stat. sec. 35 and Minn. R. ch. 1719. The following guidelines are generally applicable to feedlot mortality management. For further detail, refer to **Table 2-8**.

- Carcasses must be disposed of as soon as reasonably possible, i.e. within 48-72 hours.
- No permit is required for a person to haul the carcass of an animal that was owned by that person before the animal died.
- Persons hauling carcasses or discarded animal parts for disposal (e.g., anyone who moves a dead animal from a feedlot to a compost pile or rendering truck pickup point) must keep the carcasses or discarded animal parts completely covered, in a leak proof container or truck body while transferring the material over any public road.
- Any off-site (meaning away from the feedlot) pickup point must be an animal proof, enclosed area that is at least 200 yards away from any neighbor's buildings, and carcasses must generally be picked up within 72 hours.

Rendering

Several of the HPP sites have their mortalities picked up by rendering companies as a means of managing their death loss. BAH recommends that the mortalities be kept “off-site”--that is, away from the feedlot proper--as a biosecurity measure. Mortalities should be picked up no more than 72 hours later unless refrigerated, in which case seven days is acceptable.

The time period requirements for rendering service pick-up of a carcass are specifically for off-site pick up sites. None of the finishing sites store dead animals for pickup off-site, although the farrowing facility maintains a dead animal freezer for this purpose across the road from the site.

Burial
Minnesota Statutes 35.82 requires that enough soil cover must be used to keep scavengers out. BAH guidelines indicate that three feet is sufficient. No HPP members are currently using burial for mortality management, although some have in the past.

Composting
Several of the HPP finishing sites use this method for mortality disposal. The BAH rules govern construction and operation of the compost piles, and provide specific management guidance to assure successful operation. According to BAH, successful composting requires an impervious pad of some type under the pile, a bulking agent/carbon source, adequate moisture, and periodic turning of the pile. Although manure has some drawbacks as a bulking agent, it is readily accessible to operators, and it is acceptable under the program. The HPP members who compost tend to use manure more than other bulking materials, although Schaefer uses more straw and cornstalks than manure. Properly managed, composting is a convenient and environmentally friendly method of mortality management.

Enforcement of BAH Regulations For Dead Animal Disposal
The BAH mortality management program is primarily complaint driven; ninety percent of BAH mortality management inspections occur as the result of complaints. The remainder is requested by site operators or other regulatory agencies. When complaints are brought against a farm or facility, one of three BAH inspectors visits the site to determine if the site is compliant.

When an inspector arrives at a site, the inspector uses his/her professional judgement and experience to determine the site is in general compliance with BAH requirements. If the practice is composting, the BAH inspector then reviews the practices used at the site including location of compost pile on an impervious pad (compacted soil, clay or concrete pad); use of adequate bulking, litter, and cover material; and general compliance with the requirements listed in Table 2-8. The inspector then determines if the site is compliant, operating deficiently, or is non-compliant. Compliant sites meet all the requirements observed and asked for by the BAH inspector. Sites that are judged as deficient operations are advised on how to fix the problems, i.e. adding more cover to make sure the animal parts are covered.

If the site is determined to be non-compliant, the inspector reviews the BAH regulations with the operator, orders changes, and suggests options that will achieve better operation of the site's mortality management in accordance with the regulations. The operator is given a period of time to comply with the changes required by the BAH inspector. The BAH inspector returns to the site after the prescribed time period has passed to ensure changes were made. If a site's mortality is still not managed correctly, the BAH inspector may levy fines against the operator, dependent on the severity and frequency of the infraction(s). Civil or criminal enforcement actions may also be carried out as the individual case warrants.

For composting, consultation with BAH regulators and inspectors indicate that daily temperature monitoring is required in the rules, but is used primarily as a tool specifically for operators new to composting, in order to assist them in composting correctly (e.g. knowing when to turn the pile between heat cycles). Although temperature monitoring is required in the rules, BAH inspectors do not typically ask to see temperature logs if in their judgment the pile is operating correctly.

The rules require that each composting facility have a written protocol of composting procedures. However, individual feedlots, such as the HPP finishing sites, may use the BAH composting rules as their written protocol. Large feedlots with satellite operations under one ownership (HPP finishing sites are individually owned and operated) are required to have their written protocol posted at all sites to ensure proper operation of the compost piles. If in his judgment the compost pile is being operated correctly, the BAH inspector does not typically ask to see a written protocol.

2.4.6.2 MPCA Program

Incineration
The MPCA regulations that govern emissions from waste incinerators are found in Minn. R. 7011.1215. Only the farrowing facility incinerates, and is therefore subject to these requirements. Incinerators that are used solely for the disposal of animal carcasses are required to follow subpart 3 of these rules, which requires that emissions from the incinerator not exceed 20% opacity and have an operating afterburner that maintains flue gases at 1,200 ^{o}F for at least 0.3 seconds. Transported or stored ash must be handled in such a manner as to prevent particulate matter from becoming airborne.

Burial
Minn. Stat. 35.82, subd. 2 (the BAH program) states that a dead animal shall be buried as soon as reasonably possible at a depth adequate to prevent scavenging by other animals. The MPCA recommends that dead animal burial be at least five feet above the water table. The recommended distance from the water table is based on the industrial solid waste rule MN Rule 7035.1700, adopted by the MPCA for burial of industrial solid waste.

Manure Composting and Stockpiling

Composting is becoming more widely used as a method for mortality disposal. In light of this, it is important to be clear when the composting process is subject to the state feedlot rules (chapter

7020) and when it is subject to the Board of Animal Health regulations (chapter 1719). Both regulations aim to ensure that the composting process is performed in an environmentally sound manner.

MPCA administers rules (in Minn. R. ch. 7020) that govern the process of composting manure. If a compost pile is being managed for this purpose, those rules apply, and MPCA regulates compliance. BAH, on the other hand, regulates (via Minn. R. ch. 1719) compost piles whose aim is to manage animal mortalities. This is an issue because the HPP compost piles are animal mortality compost piles, but they also contain manure used as a bulking agent.

Manure is considered a component of the mortality disposal system when it is used as a bulking agent/carbon source as part of the composting process. Manure also adds some moisture, nitrogen, and microorganisms. But, when manure is used in this way as an aid to the mortality composting process, MPCA considers the process to be one of animal mortality composting that is regulated by BAH. The MPCA manure composting rules do not apply in these circumstances. In such a case, MPCA recommends as a best management practice that the setbacks and location requirements outlined in 7020.2125, Subpart 2.C & D and Subpart 4.C be followed for mortality compost sites, but recognizes that the purpose is to compost mortalities, not manure. Composting systems that compost mortalities are considered mortality management systems and are governed by the Board of Animal Health program.

On the other hand, compost systems that manage the manure (rather than the mortalities) generated at a facility are considered manure management systems and are governed by the MPCA's feedlot rules. None of the HPP facilities manage manure by composting. The composting systems owned and operated by HPP are considered to be animal mortality compost systems regulated by the Board of Animal Health regulations, and compliance status of these systems is determined by Board of Animal Health staff.

3.0 ENVIRONMENTAL SETTING

This section of the EIS reviews the general environmental setting of the three-county area within which the project is located and a more detailed review of the environmental setting at each of the facilities of the project. The regional environmental setting description will characterize the area-wide characteristics of the following: air quality, geology and soils, hydrogeology and hydrology, ecology, public health, and socioeconomic conditions. The detailed environmental setting will review similar characteristics, but will focus on the more detailed situation at each site.

3.1 REGIONAL AIR QUALITY

3.1.1 Climatology of Area

Pope, Stevens, and Swift Counties have a mid-continental climate characterized by warm, moist summers and cold, dry winters. These counties lie in an area of considerable interaction between cold, dry Canadian air and warm, moist Gulf air, which can result in marked daily weather changes. The monthly averages for temperature and precipitation were collected at the Benson weather station (MN0667) for the period 1961-1990 and runoff from the Pomme De Terre River at Appleton (0529400) for the period 1931-1999. The weather station at Benson, Minnesota was used because it provided detailed temperature and precipitation data for the area.

The climate is generally uniform throughout the three county area with some variability in the temperatures and summer precipitation. On calm, clear nights, the temperature in low-lying areas is a few degrees lower than in other areas. Rainfall from showers during the warm months varies considerably from place to place, though seasonal totals are similar.

Temperature

The annual average temperature is 44 degrees Fahrenheit (F) with an annual average daily maximum temperature of 54 degrees F and an annual average daily minimum temperature of 33 degrees F. The extreme maximum and minimum temperatures for the period of record are 104 degrees F and –35 degrees F, respectively. During the winter, the average temperature at Benson is 14 degrees F and the average daily minimum temperature is 5 degrees F. In the summer, the average daily temperature is 70 degrees F and the average daily maximum temperature is 82 degrees F.

Precipitation

The average annual precipitation at Benson for the period of record is 27.39 inches of water, including melted snow. For the months of May through September, the average rainfall is 17.1 inches or 62% of the annual precipitation. The heaviest 1-day rainfall for the period of record, 5.57 inches, occurred on August 18, 1990. Most thunderstorms occur from May through August, with an average annual total of 35 days. The average seasonal snowfall depth for the period of record is 43.0 inches. The greatest daily snow depth at any time during the period of record was 27 inches, occurring on February 22, 1969. On average, at least one inch of snow covers the ground for 100 days each year. The greatest one-day snowfall for the period of record was 18.7 inches, occurring on March 3, 1985.

Stream Flow

The Pomme de Terre River at Appleton discharges 2.05 inches of runoff and ground water discharge base flow from the 905 square miles of the watershed. Average monthly runoff is 0.10 inches of water or less for the period of August through February. March and April see the greatest runoff into the river at 0.41 and 0.50 inches respectively, as a result of melting snow and rainfall over frozen and saturated ground.

Wind

Rolling and flat terrain dominate the landforms of the three county area. Open fields with few windbreaks, farmstead groves, or towns provide little surface resistance to winds at the ground surface for most of the year. Speed and direction are mostly a function of weather fronts, altitude, and the diurnal cycle.

The three nearest sources of historic wind data include Fargo, Redwood Falls, and St. Cloud. The wind direction for the winter months is consistently from the north to northwest. The late spring, summer, and early fall months see the dominant winds coming from the south and southeast for each of the three stations.

On an annual basis, winds are predominantly from the south-southeast at a speed of 12 mph at Fargo. Winds are generally from the west at 11 mph on an annual basis at Redwood Falls. The City of St. Cloud typically has winds from the north at 8 mph on an annual basis.

3.1.2 Ambient Air Quality

The MPCA installed a continuous air monitor (CAM) and meteorological station at the farrowing/nursery site from July 28, 1999 to October 10, 2000. The equipment collected air quality data as well as wind speed and direction. This information was used for the modeling of air emissions from the facility in the EIS.

Ambient (or background) air conditions in the area of the project were characterized by means of guidance and protocols developed by EPA and MPCA. Background (non-project) levels of hydrogen sulfide and ammonia were calculated based on measured concentrations from the HPP farrowing site as well as other feedlots elsewhere in the state.

The MPCA installed a meteorological station and CAMs at the Hancock farrowing site to simultaneously record wind speed, wind direction, hydrogen sulfide concentration, and ammonia concentration. The wind direction information allowed a determination of whether the recorded hydrogen sulfide and ammonia concentrations originated from the farrowing site or from off-site sources. The concentrations occurring when winds were not blowing from the farrowing site towards the monitors provide a measure of background concentrations, i.e., concentrations due to other sources such as wetlands, other feedlots, and industrial sources (although in this case there are no industrial sources near the Hancock farrowing site). The background concentrations estimated from the monitoring data are considered applicable within a distance of about 3 miles from the site, so they apply to the Schaefer and Nohl sites as well.

The monitored hydrogen sulfide concentrations for off-site sources ranged from 0 to 111 ppb. In air dispersion modeling studies to determine compliance with an ambient air quality standard, U.S. Environmental Protection Agency modeling guidance (40 CFR 51, Appendix W) states that a background concentration taken from air quality monitoring data should be added to the model-predicted concentrations to account for pollution sources that were not specifically modeled. The estimated background concentration should be taken from ambient air quality monitoring data that is not influenced by the source or sources that will be directly modeled. In addition, the background concentration should conform to the format of the particular standard. For example, if the standard under consideration is an annual average concentration, then the annual average concentration from representative monitoring data should be taken as the background concentration.

The Minnesota H_2S ambient air quality standard has a more complicated format. The 0.05 ppm (50 ppb) standard is a one-half hour average not to be exceeded more than twice per year. Starting with representative air monitoring data, the appropriate H_2S background concentration for this standard would be the third highest (allowing two exceedances) one-half hour average recorded over one year of monitoring.

The 0.03 ppm (30 ppb) standard is a one-half hour average not to be exceeded more than twice in any five consecutive days. To find the appropriate H_2S background concentration for this standard involved reviewing every five-day period of monitoring data and selecting the third-highest concentration during the period. This "highest third-highest" concentration would then be the appropriate background value.

The third highest non-site hydrogen sulfide concentration, 32 ppb, is used in this EIS as the background concentration for the 50-ppb hydrogen sulfide standard for the purpose of assessing air impact in **Section 4.1**. The third highest concentration in any 5 consecutive days was 21 ppb, which is used as the background concentration for the 30-ppb standard. The 13-week time-averaged non-site hydrogen sulfide concentration for the first 13-weeks of monitoring was 0.7 ppb, which is used as the background concentration for the subchronic hydrogen sulfide iHRV. These background values are used in this EIS because they are actual, measured numbers from the CAM.

Since there is no monitored hydrogen sulfide data from the remainder of the HPP sites, agency guidance calls for use of statewide average background values that were calculated based on monitored data from a number of other sites in Minnesota. Thus, for the Solvie, Greiner, Olson, Charles, Paul, and Zeltwanger sites, the hydrogen sulfide background numbers used in this EIS are 17 ppb for the five-day standard and 18 ppb for the annual standard.

Background values for ammonia that are used for all sites in this EIS are limited to the measured concentrations recorded by the CAM at the farrowing site. Controlled surveillance of ammonia concentrations has not been performed at any other sites in the state, so no statewide average for background ammonia can be calculated. The monitored (at the farrowing site) ammonia concentrations for off-site sources ranged from 0 to 148 µg/m3. The maximum observed off-site ammonia concentration (148 µg/m3) was used as the background concentration for the acute ammonia iHRV. The annual average off-site ammonia concentration was 5.72 µg/m3, which was used as the background concentration for the chronic ammonia iHRV.

3.1.3 Existing Land Use and Odor Sources

The HPP project is located in an area that is zoned agricultural. Three of the ten sites include new construction at an existing operation. Five of the operations include construction on property with no pre-existing hog operation (this includes Alan Charles, who has not actually built his HPP facility to date).

There are no schools, parks, churches, cemeteries, or other public access facilities within one mile of any of the HPP feedlots, except that the Charles barn, if built, would be within one mile of the city of Hancock. The only public structures or facilities near any of the sites are public roadways.

There are numerous pre-existing odor sources in the HPP project area (see **Figure 3-1)**, some of which are feedlot operations. Gantzer Environmental utilized these odor sources in the regional odor assessment that is part of the air-modeling component of the EIS.

3.2 REGIONAL GEOLOGY/SOILS

3.2.1 Bedrock

The area of the project is described by Sims (1970) as being underlain primarily by undifferentiated gneisses and schists. The gneisses have mineral assemblages characteristic of the upper amphibolite and granulite metamorphic facies. The early geologic history of these gneisses has largely been obliterated by metamorphism and emplacement of granitic rocks about 2,650 million years ago.

Rocks of the Cretaceous age are nearly continuous beneath a thick cover of Pleistocene material throughout the western half of the state. The rocks consist of a weathering-residuum and overlying clastic strata, and lie unconformably on a surface consisting of rocks ranging in age from Precambrian to Devonian. Deep weathering of the gneisses formed a regolith, commonly about 100 feet thick, part of which was reworked to form Cretaceous deposits of sandstone and shale. These sedimentary formations were then eroded, in some areas completely eroded, during a significant period of glaciation in the Pleistocene epoch.

The bedrock hydrogeologic units existing under or near the HPP project area include formations of both the Precambrian and Cretaceous eras. The Precambrian units are not considered an aquifer, except locally in faults and fractures. The Geologic Map of Minnesota (Morey and Meints 2000) identifies faults encroaching on the HPP project area as shown on **Figure 3-2**.

Recent delineations of the extent of the Cretaceous aquifer suggest that intact remnants of the Cretaceous era formations exist in southern Stevens County, thereby possibly encroaching on the HPP project area (Morey and Meints 2000, Austin 1972). A review of the April, 2001 County Well Index, as published by the Minnesota Geological Survey and the Minnesota Department of Health revealed a well in the project area logged by the USGS, which recorded sandstone at a depth of 301 to 302 feet below ground surface (bgs), (depth of well was recorded as 302 feet bgs). This well (UWN 216970) occurs at the extreme northeast extent of the HPP project area, which is overlain by the Alexandria Moraine (See **Figure 3-3a**). The existence of this Cretaceous-associated deposit may be attributed to the Alexandria Moraine, as the latter may have protected the remaining Cretaceous bedrock from the erosive forces of later glacial events.

However, the logs from two wells (UWN 188306 and UWN 255624) located 2.5 miles southeast of UWN 216970 show hard, mafic-type rock at 200 and 225 feet bgs, respectively, with no mention of an overlying cretaceous deposit. Moreover, no wells containing waters of Cretaceous Age were identified in the aquifers beneath the HPP project area. Unfortunately, potentiometric contours were not published by the United States Geological Survey (USGS) for Chippewa, Swift, Stevens, Pope or Stearns County in the Regional Hydrologic Investigations Atlas (Kanivetsky 1978). Therefore, it is impossible to be certain whether the Cretaceous aquifer extends into the HPP project area as it is illustrated on **Figure 3-2**.

In general, the bedrock is overlain by 200-400 feet of Quaternary deposits and is not utilized as a water source in West Central Minnesota. The USGS Hydrologic Atlas Series (Morey and Meints 2000) for the region further refers to these Quaternary deposits as consisting of several aquifers, which are the uppermost, and arguably the only, resource aquifers in the area. The bedrock in this vicinity may thus not contain aquifers, is not utilized as such even if it does and is far enough from the surface (under a number of confining layers) so that the possibility of impacts on it from the HPP project is extremely remote. It is therefore not addressed further in this EIS.

3.2.2 Quaternary Deposits

Land utilized by Hancock Pro Pork facilities is underlain by glacial drift approximately 200 to 400 feet thick (Grant 1972, Kanivetsky 1978). These deposits consist primarily of glacial till and outwash sands and gravels. The glacial drift includes ground moraines and outwash sands undivided as to moraine association. Glacial till in this location generally consists of gray calcareous material, including shale and limestone clasts with silt and clay. The topography of the areas in which till is present at the surface is generally rolling and irregular, and may be dominated by cohesive (clayey) soils. Glacial outwash areas, on the other hand, are nearly flat to gently rolling, and are usually characterized by granular (sandy or gravelly) soils. The Quaternary deposits of the Hancock Pro Pork facilities are shown on **Figure 3-3**.

Granular outwash deposits are located near the Pomme de Terre and Chippewa Rivers and in a broader outwash area located in south-central portion of the HPP project area (Wright 1972). Glacial melt-water stream positions and rates of discharge were often quite variable over geologic time, causing variability in the streams erosive and depositional characteristics (Soukup *et al* 1984). This caused the resulting outwash deposits to vary in areal extent, thickness, and grain size. As shown on **Figure 3-3**, four of the ten sites are located in part or in whole in an area of granular outwash deposits. In some areas, earlier sand deposits were later covered over by till from subsequent glacial advances, thus forming buried aquifers. Glacial Lake Benson was located in Swift County in the area of the southern Hancock Pro Pork facilities (Wright 1972). Broad alluvial fans comprised of medium-grained sands were deposited by glacial streams entering Glacial Lake Benson from the north. Finer sands and silt were deposited farther south near the City of Benson.

In geological terms, then, granular outwash deposits were several times deposited over geologic time on top of much finer glacial till. As a result, the surficial aquifer (the granular material) is underlain by a low hydraulic conductivity layer of glacial till, and is thereby hydrogeologically isolated from deeper layers.

Soil surveys for Stevens, Pope, and Swift counties indicate soils in the area of many of the HPP facilities consist primarily of nearly level to gently sloping, silt loam to clay loam (relatively cohesive) soils. However, some of the manure land application areas utilized by HPP facilities occupy land composed of granular soils. **Figures 3-4a** through **3-4c** illustrate soil associations present in the area of the HPP facilities.

3.3 REGIONAL HYDROGEOLOGY AND HYDROLOGY

3.3.1 Ground Water Resources

The project area was glaciated repeatedly and now contains five glacial aquifers, four of which are buried beneath (and separated from each other by) layers of relatively impermeable glacial till. The fifth aquifer unit, the surficial aquifer, is extensively used where present and is not provided with the natural geologic protection of overlying confining layers as the buried aquifers are. The four buried aquifers, named the Morris, Benson-upper, Benson-middle, and Benson-lower, are comprised primarily of sand and gravel bounded above and below by relatively impermeable glacial till. The surficial aquifer is near the surface and does not have an overlying low permeability layer.

The glacial till is composed of an unsorted mixture of clay, silt, sand, gravel, and boulders that were primarily deposited beneath stagnated or advancing glaciers. The buried aquifers constitute the main source of ground water where the surficial aquifer is thin or absent. Low vertical hydraulic conductivity of the till layers allows these layers to act as confining units above and below the buried sand and gravel aquifers. These low conductivity layers provide natural protection against the downward migration of contamination from surface sources.

The areal extent and saturated thickness of the surficial aquifer in the area of the HPP facilities is shown in **Figure 3-5a.** The figure illustrates that the surficial aquifer is present beneath the farrowing, Olson, Nohl, and part of the Schaefer and Solvie facilities. The Spohr, Paul, Charles, Zeltwanger, and Greiner facilities are underlain by glacial till. The saturated thickness of the surficial aquifer ranges from approximately 20 to 40 feet (Delin 1986). Depth to the water table ranges from zero, where surface water bodies exist, to approximately 40 feet below grade.

Regionally, ground water flow within the surficial aquifer is primarily north to south (Delin 1986). Locally, ground water flow is toward the surface water bodies, including the Pomme De Terre and Chippewa Rivers. Vertical flow within the surficial aquifer is predominantly downward (Soukup *et al* 1984). **Figure 3-5b** illustrates the configuration of the potentiometric surface in the area of the HPP facilities. Where buried drift aquifers coalesce with the surficial aquifer, ground water generally flows upward from the confined aquifer to the surficial aquifer (Delin 1986).

Figures 3-5c through **3-5k** illustrates the areal extent and thickness, potentiometric surface, and top elevations of these surficial and buried drift aquifers. **Figure 3-5l** contains a generalized geologic cross-section illustrating the vertical distribution of the aquifers. **Table 3-1** summarizes the aquifers' characteristics and depositional history.

3.3.1.1 Area Ground Water Well Use

Ground water use near the HPP facilities was evaluated by means of well record information obtained from the April 1, 2002 version of the Minnesota Geological Survey (MGS) County Well Index (CWI) and the Minnesota Department of Natural Resources ground water appropriation-permit database. Well information was collected for locations within one-half mile of each potential manure land application area's boundaries. The CWI currently includes information on 183 wells within these areas. **Figure 3-6** shows the location of high capacity wells in the area that are generally used for irrigation and public supply. Uses of the 183 CWI wells include:

- five (5) for public water supply;
- 74 for irrigation;
- 58 for domestic water supply;
- 16 test wells, and
- 30 of unknown use.

All five public water supply wells are completed in Quaternary buried artesian aquifers. The 74 irrigation wells include 15 completed in Quaternary buried artesian aquifers, two completed in undifferentiated Quaternary deposits, 35 completed in the surficial water table aquifer and 23 undefined by aquifer. The domestic wells and wells of unknown use include wells completed within Quaternary buried artesian aquifers and within the surficial water table aquifer. Aquifers used by the 16 test wells were not indicated, but, based on the wells' depths, most appear to be completed within Quaternary buried artesian aquifers.

3.3.2 Ground Water Quality

The project site is located in a historically agricultural area of western Minnesota. The water quality of these aquifers is described by both regional water quality information and local water quality data collected by the MPCA at certain HPP sites. This section will focus on nitrate, since it is the most common ground water contaminant assessed related to feedlot impacts. In sufficient amounts in drinking water, nitrate can cause "blue baby syndrome" (methemoglobinemia) in young children.

The MPCA has conducted a significant amount of research on the fate of nitrogen compounds in the environment, and has concluded that geochemistry is an important factor in understanding the distribution of nitrate in ground water. In a "nitrate stable" (oxygen-rich or "oxidizing") environment, the chemistry of the ground water system does not support denitrification. Any nitrate entering such an environment will therefore remain as nitrate. Conversely, in "nitrate unstable" (oxygen-poor or reducing) environments, any nitrate entering the system will rapidly undergo denitrification. A given concentration of nitrate will, therefore, pose a greater risk to ground water receptors in a "nitrate stable" environment than it would in a "nitrate unstable" environment. For the purpose of assessing the fate of nitrate in ground water the MPCA defines nitrate-stable conditions as including all of the following parameters: an oxidation-reduction potential (Eh) > 250 mV, dissolved oxygen (DO) concentration of > 1 part per million (ppm), and a filtered iron concentration of < 0.1 ppm.

The general water quality in the area of the HPP project is presented in a MPCA report, the Baseline Water Quality of Minnesota's Principal Aquifers, Northwest Region. This report notes that while nitrate is an important chemical of concern in the region due to the intense agricultural activities, relatively few detections of nitrate occurred in the water samples. Of the 182 wells samples in the report, only 17 reportedly detected nitrate, and only one exceeded the Health Risk Limit (HRL) of 10 mg/l. The estimated mean concentration of nitrate was less than 0.2 mg/l, well over an order of magnitude lower than the HRL.

The report concludes that the lack of nitrate in the wells from this region is due to the geochemistry of the aquifers. The report also notes that Eh values in the region, particularly in the surficial aquifer wells, are less than the values from similar aquifers statewide. This data suggests that "nitrate unstable" condition exist in these aquifers.

Water quality data available from the CWI supports the conclusion in the MPCA report. Examination of the CWI water quality database revealed that 23 wells were sampled in Stevens, Pope and Swift Counties. Depths of these wells ranged from 35 to 356 feet bgs. Four of these wells are reported to be in the surficial aquifer with the remaining wells screened deeper within buried aquifers. None of the samples from these wells detected nitrate above 10 mg/l. The range of nitrate concentrations from the wells screened within the surficial aquifer was 0.49 to 8.8 mg/l. The range of nitrate concentrations from the remaining wells was 0.49 to 3.2 mg/l.

In addition to the regional data discussed above, the MPCA collected water quality samples at three of the HPP facilities. Samples were obtained from temporary monitoring wells installed at the farrowing site, the Olson site and the Schaefer site.

This investigation detected nitrate levels above the HRL at all sites. However, this does not by itself indicate the potential for significant impacts, nor that the sites themselves are necessarily the source of contamination.

At the farrowing site, the MPCA sampling found 25.59 mg/L of nitrate upgradient of the nursery barn, indicating a high level of groundwater nitrate originating from unknown sources before the groundwater reaches the site. Downgradient, the highest reading was 30.42 mg/L, which MPCA staff believe to be a nonsignificant increase, likely attributable to the high variability in local groundwater quality conditions. The staff's judgment on this is strongly influenced by the fact that sodium concentrations found both up- and downgradient were nearly identical, indicating no additions from the barns.

At the Olson site, the highest upgradient value was quite low at 0.45 mg/L, likely reflecting the upgradient land use, which is a large Conservation Reserve Program (CRP) field. The highest downgradient value was 12.25 mg/L, which MPCA staff view as a significant increase over background, likely caused by runoff from the Olson barns. Here, the sodium concentrations were higher downgradient than upgradient, reflecting a likely contribution from the barns.

The Schaefer site data were inconclusive, due in large part to the fact that the soils at that site are cohesive in nature. Several sampling wells were inserted around the barns, but none produced significant volumes of ground water, due to the slow movement of ground water through such soils. The three samples obtained there produced nitrate values of 22.94, 50.02, and 3.19 mg/L. No upgradient value was identified because it was impossible to characterize the ground water flow gradient under the sampling conditions existing at that location. It is thus impossible to say which, if any, of the values found is the upgradient condition. The variable numbers found may, again, reflect the variability in area groundwater quality, and have nothing to do with contributions from the barns. Additional study to adequately characterize ground water quality conditions at this site would require considerably more work and a multi-seasonal survey to, first, adequately characterize the background condition, and, second, to identify the contributions, if any, from the barns. Since the Schaefer barns are newly constructed according to MPCA requirements for new feedlot facilities, MPCA judges the potential that the barns are making significant such contributions as minimal.

Further, while this investigation did detect values for nitrate above the HRL at all three locations, these detections were all from the uppermost portion of the aquifer. When samples were obtained from deeper within the aquifer, the results indicated denitrifying conditions with depth and non-detectable concentrations of nitrate.

It should be noted that these site-specific data were collected from very shallow depths and thus are not necessarily representative of drinking water quality in the region (since regional drinking water supplies mostly come from deeper aquifers). Therefore they cannot be compared directly to the above regional data. However, the data are consistent with the findings of the MPCA report; reducing (nitrate unstable) conditions do occur with depth, which accounts for the nitrate reduction in the lower aquifers. This indicates that, even where nitrate concentrations in the ground water were found to be elevated—and regardless of source—the tendency seems to be that nitrate is rapidly attenuated by reducing conditions with increasing depth. The potential for significant impacts caused by the barns is correspondingly minimal, even if they are contributing to the nitrate load.

Further discussion of the fate of nutrients and pathogens in the ground water is provided in the Literature Review **Section 3.7.1** of this EIS.

3.3.3 Surface Water Resources

The HPP project is located within two major watersheds of the Minnesota River, the Pomme de Terre and the Chippewa Watersheds, with most of the HPP project located within the boundaries of the Chippewa River watershed. The Paul and Spohr manure land application fields lie within the Pomme de Terre watershed (Cotter *et al* 1968). All other manure land application fields utilized by Hancock Pro Pork facilities lie within the Chippewa River watershed (Cotter *et al* 1966). These two major watersheds, along with the Upper Minnesota River and Lac Qui Parle watersheds, make up the headwaters of the Minnesota River.

Page Lake and Lake Emily lie north of the HPP finishing feedlots and are located within the Chippewa River Watershed. Judicial Ditch 9 (JD 9) is a man-made waterway that outlets through additional ditches into the Chippewa River. JD 9, or private ditches connecting to JD 9, runs through several of the finishing feedlot sites as well as the farrowing facility's land application areas. See **Figures 3-7** for boundaries of the watersheds and the locations of the lakes, rivers, and JD 9.

3.3.3.1 Watershed/Ecoregions

Minnesota ecoregions were defined by means of an Environmental Protection Agency (EPA) approach developed in Oregon (Heiskary and Wilson 1989). These ecoregions were delineated by means of land use, soils, surface form, and potential natural vegetation data. There are two ecoregions in the vicinity of the HPP project area, the Northern Glaciated Plains (NGP) and the North Central Hardwood Forest (NCH). The HPP project lies entirely within the NGP, with the NCH situated along the eastern edge of the project area. The main differences between the regions are the amount of land cultivated (NGP 80% and NCH 5%) and number and depth of surface waters. The NGP has fewer lakes and they are larger and shallower than those found in the NCH (Heiskary and Wilson 1989). The types of lakes within the NCH are diverse, and range from larger, shallow lakes to smaller, deeper lakes that may thermally stratify.

The surface water quality in the NGP in 1989 was characterized by high phosphorus (130-250 ug/ml), Secchi transparency between 0.3-1.0 m and Total Nitrogen (TN)/Total Phosphorus (TP) ratios ranging from 5:1 to 15:1, indicating that nitrogen is the limiting factor. TN:TP ratios greater than 17:1 are generally considered phosphorus limited, while ratios less than 10:1 indicate nitrogen limitation (Heiskary 1997, Heiskary and Wilson 1989). High incidence of algal blooms and excessive aquatic plant growth indicate hypereutrophic lakes. Total phosphorus levels are higher during the summer.

The surface water quality in the NCH ecoregion is as diverse as the types of lakes found in the ecoregion. A wide range of trophic states can be expected because the NCH ecoregion has a much more diverse population of lakes with differing characteristics. Some lakes may have small surface area, and have greater depth (20 m), while others may have large surface area and shallower depths. The deeper lakes typically thermally stratify, allowing seasonal circulation to take place. This helps to decrease the TSS and nutrient concentrations. Fifty percent of the lakes have a Secchi disk reading of 1.4 m (approximately 4.5 feet) (Heiskary and Wilson 1989). Typical summer values for total phosphorus are between 23-50 mg/L and TSS concentrations are less than 4 mg/L.

Pomme de Terre Watershed

The Pomme de Terre Watershed covers 905 square miles, flowing from Stalker and Long Lakes in Ottertail County with no major tributaries. At a flow rate of 110 cubic feet per second, the Pomme de Terre Watershed represents approximately 60 percent of the Minnesota River Basin flow where it enters the Minnesota River system at Marsh Lake in Appleton, MN (Minnesota River Assessment Project 2000). However, the Pomme de Terre represents only 9 percent of the total acreage of the entire Minnesota River watershed, and less than one-hundredth of the total discharge of the Minnesota River when it enters the Mississippi River in St. Paul, MN (Waters 1977). The Pomme de Terre and the Upper Minnesota River watersheds have the smallest influence on the Minnesota River Basin overall (Waters 1977, MPCA 2001a). The Pomme de Terre River watershed boundary in the vicinity of the HPP project is shown on **Figure 3-7**.

The Pomme de Terre River rises in the NCH ecoregion and meanders through a series of lakes and marshes, surrounded by wooded hills and meadows, until it reaches Morris, MN. The marshes and lakes act as deposition sites for sediment before reaching the river. Downstream of Morris, MN, the character of the river changes, becoming more turbid until it reaches Marsh Lake (MPCA 2001a). The soils within the lower Pomme de Terre watershed are increasingly erodible. The Pomme de Terre River enters the Minnesota River south of Appleton, MN, creating Marsh Lake. Marsh Lake is a natural reservoir formed by the Pomme de Terre delta, which creates a natural dam as it enters the Minnesota River.

Chippewa River Watershed

The Chippewa River Watershed is one of the largest major watersheds of the Minnesota River. Its drainage area consists of 2085 square miles. The Chippewa River headwaters are located in central Minnesota, in Douglas County (Waters 1977, MPCA 2001b). The Chippewa is 130 miles long with three smaller tributaries; the Little Chippewa River, Chippewa East Branch, and Shakopee Creek. JD 9 also drains a portion of the watershed and enters the Chippewa River just below Benson, MN. The Chippewa River joins the Minnesota River at Montevideo, MN. It represents approximately 40 percent of the Minnesota River Basin at the point of entry (Waters

1977). With a flow rate of 315 cubic feet per second, the Chippewa River is almost three times larger than the Pomme de Terre.

This watershed covers both ecoregions, the NGP and the NCH. The eastern half of the watershed lies within the NCH ecoregion and is composed of primarily granular soils, with a resulting increased potential for sediment delivery to streams. The western half of the watershed lies within the NGP ecoregion. The soil types in this area range from clay to loam and sand. The western half of the watershed is extensively tiled and the erosion potential is high near the stream banks (MPCA 2001b).

JD 9 was constructed between 1917 and 1920, and consists of 10.4 miles of open ditch and a drainage area of 53 square miles. JD 9 flows drains several HPP project properties. JD 9 is part of a drainage ditch system that is tributary to the mainstem of the original collection ditch, County Ditch 3 (CD 3) (MDNR 1993). Several additional smaller manmade waterways (County Ditches 7 and 23, and Judicial Ditch 8, Branch E1) also connect to CD 3. CD 3 is directed into the Danvers Wildlife Wetlands and Management Area and eventually discharges into the Chippewa River. The drainage system worked well until after the drought years in the 1930s when additional private ditches were constructed and connected to the ditch system. The waters from JD 9 historically flowed into CD 3 and into the Danvers Wildlife Management Area. However, in 1986 a new manmade waterway, County Ditch 83 (CD 83) was constructed to bypass the Danvers Wetland, thus diverting the water from JD 9 and the other smaller ditches from CD 3. During periods of high flow, a portion of JD 9 runoff still enters Danvers Wildlife Management Area (MDNR 1993). CD 83 outlets into the Chippewa River south of Benson, Minnesota. See **Figure 3-7**.

3.3.3.1.1 Lake Water Quality

<u>Lake Emily Water Quality</u>
Lake Emily is the larger of the two lakes within the HPP project area. Lake Emily is located in the NGP ecoregion, with an approximate surface area of 2246 acres (MDNR 2000). Lake Emily is a large, shallow, hypereutrophic lake (MDNR 2000), with a maximum depth of 7 feet. There are very few areas with aquatic vegetation. The MDNR stocks the lake with walleyes for recreational use, but the lake does sustain other fish populations as well (MPCA ND).

Water quality throughout Lake Emily is consistently poor. Secchi disk data, indicating the clarity of the water, average approximately 1.5 feet. The sediments are continuously resuspended by the wind. Phosphorus concentrations in a lake typically less than 40 ppb indicate that the lake supports recreational swimming (MDA 2000). However, Lake Emily's mean total phosphorus (TP) average is 122 ppb (MDNR 2000). Chlorophyll-a is also used as an estimate of the amount of algae in water. Chlorophyll-a between 30 and 60 ppb typically indicates that nuisance algal blooms are likely to occur (Heiskary and Wilson 1989). Lake Emily's chlorophyll-a average is 57.6 ppb (MDNR 2000).

Page Lake Water Quality

Page Lake is much smaller, but deeper than Lake Emily, with a surface area of 372 acres and a maximum depth of 17 feet (MDNR 1995). Page Lake is located within the NGP ecoregion. Although deeper than Lake Emily, Page Lake is still a relatively shallow lake that is hypereutrophic and prone to algal blooms during the summer. Emergent vegetation is rare. The MDNR stocks the lake with walleyes and northern pike for recreational use and the lake also sustains other fish populations (MPCA ND).

Water quality throughout Page Lake is consistently poor. Secchi disk data indicate the clarity of the water averages approximately 2 feet. Page Lake's mean TP average is 329 ppb and its chlorophyll-a average is 30.5 ppb (MDNR 1995).

Stevens County monitored Page Lake between 1993 and 1996. There was an increase in total suspended solids (TSS) concentrations from 1993 to 1996, as shown in **Figure 3-8a**. The TP concentrations, illustrated in **Figure 3-8b**, showed a decreasing trend from 1993-1995 but a rise in 1996. The dissolved oxygen concentrations, shown in **Figure 3-8c**, were relatively constant except during August of 1995 and 1996. Page Lake zooplankton counts shown in **Figure 3-8d** indicate that algal blooms increased from 1994 to 1996.

3.3.3.1.2 Stream Water Quality

Pomme de Terre River Water Quality

The regional water quality in the Pomme de Terre watershed is poor, especially in the lower reaches before it enters the Minnesota River. High TSS concentrations are due to the high erodibility of the soil and sediment loading from reduction of wetlands within the watershed (MPCA 2001a).

Stevens County Environmental Services monitored the water quality of the lower Pomme de Terre River from 1994-1996. The most northerly monitoring location is at County State Aid Highway (CSAH) 76, with 4 additional stations placed intermittently downstream, the last placed near CSAH 8. The stations at CSAH 8 and CSAH 10 are directly upstream of the HPP Project, as shown on **Figure 3-7**. The other three stations are located several miles upstream and their data are presented in **Figures 3-8e** through **3-8h**. Water quality data for the Pomme de Terre River are also being collected and analyzed by the Pomme de Terre Watershed Project, but this data is not yet available.

The Stevens County Data shows that the dissolved oxygen, Secchi disk, nitrate, and TP concentrations in the Pomme de Terre are at the highest concentrations during the summer. At

CSAH 8, the concentrations for TP are between 0.25-0.3 mg/L. All are below the recommended concentrations of 1 mg/L for the NPG Ecoregion (Heiskary and Wilson 1989). The concentrations upstream of CSAH 8 are below 0.15 mg/L. The highest TSS concentrations occur downstream of Morris, MN, which correlates with the presence of erodible soils in the area. The high TP concentrations in the summer are probably due to surface water runoff during storm events. The nitrate concentration did not exceed 1.4 mg/L at any of the sampling sites.

Chippewa River Water Quality

The MPCA and Chippewa River Watershed Project (CRWP) studies of the Chippewa River Watershed have shown that pollutant levels are high. Pollutants of concern are the same as throughout the Minnesota River Basin: high nutrient content, suspended solids, and pathogens (MDA 2000). The high concentrations of suspended solids and nutrients can be linked to artificial drainage patterns and reduction of wetlands in the watershed (Minnesota River Assessment Project 2000).

The overall health of the Chippewa River watershed has been characterized and studied since 1999 by the CRWP. The data are organized according to the sub-basins within the Chippewa River watershed. The HPP project is located within 3 of the sub-basins of the Chippewa River watershed: the Lower Mainstem, the Middle, and the Little Chippewa sub-basins. Data from these sub-basins are shown on **Figures 3-8i** through **3-8l**. The Middle and Little Chippewa sub-basins contain the Little Chippewa tributary, Lake Emily, and its outlets. The Lower Mainstem sub-basin is drained by JD 9. Water flows in JD 9 southeast from the HPP project area into CD 3, then around the Danvers Wildlife and Wetlands Management Area (WWMA), and eventually enters the Chippewa River. Under normal flow conditions, runoff from the HPP project does not flow into the Danvers WWMA. The boundaries of the watershed and locations of streams are shown in **Figure 3-7a**.

Two feedlots within the HPP project are located in the Middle and Little Chippewa sub-basins. Farther downstream, six additional HPP facilities are located within the Lower Mainstem sub-basin. The water quality data for the Middle and Little Chippewa sub-basins indicates that average TSS loading rates are decreasing, whereas total phosphorus, ortho-phosphorus (a form of phosphorus more biologically available than total phosphorus) and nitrate loading rates are increasing. The average annual concentrations for TSS, total phosphorus, ortho-phosphorus, and nitrogen show large, annual fluctuations in concentrations, indicating that they are sensitive to flow and precipitation, as well as possibly other factors.

Fecal coliform data was collected within the Chippewa Watershed from 1998 through 2001. The data indicates fecal coliform concentrations are static with the exception of a spike occurring in late 1998 (**Figure 3-8i**). Fecal coliform concentrations above 200 CFU/100 ml are considered to indicate fecal impairment.

JD 9, Cottonwood Creek, and portions of Shakopee Creek drain the Lower Mainstem sub-basin. The water quality in the downstream sub-basin is poorer than the upstream sub-basin, with TSS concentrations three times higher than in the Middle and Little Chippewa Sub-basin, as shown in **Figure 3-8k**. **Figure 3-8l** indicates that sampling phosphorus and nitrogen levels are relatively constant at the sites up and down stream of the HPP project area.

3.4 REGIONAL WILDLIFE AND HABITAT

3.4.1 Terrestrial Ecology

Historically, western Minnesota has been classified as part of both the Tallgrass Prairie and the Prairie Pothole Regions (TPR and PPR, respectively). The TPR extends from the northwest to southeast in Minnesota. Dominant grasses such as big bluestem, switchgrass and Canada wildrye typify the TPR. Marsh grasses such as reed canarygrass characterize the PPR. However, land use in western Minnesota has been agricultural since populations began to settle there, and the original ecosystems have been greatly altered as a result.

The U.S. Fish and Wildlife Service-Morris Wetland Management District conducts studies and compiles a bird checklist that contains counts of bird populations within public lands in a 7-county region that includes Big Stone, Chippewa, Lac Qui Parle, Yellow Medicine, Pope, Stevens, and Swift Counties. The bird checklist describes various bird species and classifies them into groups according to how abundant they are. The more common birds are ducks (several different species), geese, hawks, ring-necked pheasants, as well as common small birds such as sparrows, doves, swallows, and thrushes (USFWS 1991). Deer, coyotes, foxes, and raccoons also occur in the area.

3.4.2 Aquatic Ecology

The Pomme de Terre River meanders toward the Minnesota River, connecting a series of lakes and cattail and canarygrass marshes, particularly in its headwaters. Many of the state Waterfowl Production Areas in Stevens County are along the Pomme de Terre River. The lower portion of the Pomme de Terre does not flow through marshes and lakes. The HPP project area is located in the lower portion of the watershed, which is typically characterized by relatively erodible soils and higher sedimentation rates in the river itself.

Aquatic species such as walleyes, northern pike, forage fish, and plants such as sago pondweed and claspingleaf are present within Page Lake. Aquatic plants are uncommon in Lake Emily.

3.4.3 Rare and Endangered/Threatened Species

The DNR Natural Heritage and Nongame Research Program (NHNRP) identified nine known occurrences of rare species, including bald eagles, or natural communities, including dry and mesic prairie, in the vicinity of the area searched that included the HPP feedlots and land application areas. The database used is completely updated for Stevens and Swift Counties. Survey work is in progress for Pope County. The information available for the rare species within these counties is believed to be reasonably complete. However, there may be other rare or otherwise significant species and natural communities in the project area that are not known at this time. **Table 3-2** presents the rare and endangered species as reported by DNR. See also **Appendix D**.

Other species of concern are two types of mussels, the Creek Heelsplitter and Black Sandshell Mussels.

3.5 ANIMAL HEALTH

3.5.1 Swine Health Maintenance

Hancock Pro Pork feed generally consists of 70-90% corn and soybean meal. The remaining fraction of feed consists of specialized premixes that contain different percentages of nutrients for specific hog types. The premixes contain varying percentages of vitamins A, D_3, and E, essential amino acids, salt, minerals (zinc, copper and selenium), and low dosage antibiotics. See **Table 2-2** for specifics on additive and antibiotic use at the farrowing and finishing sites. Nutritional needs of swine vary throughout stages of development. The vitamins, minerals, and pharmaceutical feed additives are intended to promote growth, feed intake, and improve feed efficiency, while controlling disease outbreaks.

Animal health maintenance has always been an important issue at feedlots. As feedlots have gotten larger, this has become even more of an issue as disease in a larger feedlot can affect more animals and have greater adverse effects on the facility's profitability. The closed confined areas increase contact between healthy and infected pigs, increasing the probability of disease outbreak. Large feedlots, such as the farrowing facility, have greater risk for disease outbreaks simply due to the large number of hogs within confined areas that are in close proximity to one another. Modern feedlot operators go to great lengths to minimize the potential for disease transfer, as well as to control disease if it occurs.

Common diseases that occur in swine, but not necessarily at any one feedlot in the HPP project, are ileitis (an intestinal disease), bacterial enteritis, bacterial pneumonia, swine dysentery, and other respiratory and skin diseases. While no feedlot in the HPP project has reported high incidence of disease, all use feed additives and pharmaceuticals at subtherapeutic levels to prevent and control outbreaks of the diseases mentioned above, as do many feedlots nationwide.

Subtherapeutic use of antibiotics is a common practice in animal agriculture industry and has economic benefits for the feedlot operator. An obvious reason for this practice is to minimize the potential for disease outbreaks. Just as important to the operator, however, is that subtherapeutic use of antibiotics often improves animal growth rates and feed efficiency, thus shortening the time needed to finish an animal for market. Indeed, the federal Food and Drug Administration has approved the use of certain antibiotics for both disease prevention and growth enhancement (Wallinga 2002).

3.6 SOCIOECONOMICS

This section of the EIS provides a cursory assessment of community demographics, land use, social and economic issues, and the anticipated impacts of the proposed project. The impacts of the project have been assessed by means of data collected from various government agencies, including the U. S. Census Bureau, counties in the vicinity of the proposed action, and the Minnesota Planning Agency. The relevant data encompasses Pope and Stevens Counties, and the west central region of Minnesota.

The recently completed Generic Environmental Impact Statement on Animal Agriculture (Minnesota EQB 2001), incorporated herein by reference, includes a number of literature reviews and technical work papers on social and economic issues (Phillips *et al* 1999, Lazarus *et al* 1999, Hayes *et al* 1999, Coleman *et al* 1999, Flora *et al* 1999, Lazarus 2001, Decker *et al* 2001, Coleman *et al* 2001, and Wright *et al* 2001). An overarching theme in the GEIS social issue sections concerns the impacts on quality of life and on what the document refers to as "social capital" in rural communities, defined as the "trust, mutual reciprocity, and sense of shared future between individuals, and the ability to work constructively for the good of the community" (Minnesota EQB 2001).

The GEIS economic discussion focuses on changes in scale in agriculture and strategies aimed at maintaining competitiveness in the global market. Economic and structural changes in animal agriculture have been linked to concerns about the vitality of rural communities. The treatment of economics in the GEIS focused mainly on four overriding forces: (1) evolution of the food-producing system into more tightly coordinated supply chains; (2) information technologies; (3) globalization: and, (4) public skepticism about science, technology, and globalization.

Community Demographics

The State Demographic Center (SDC) in the Minnesota Planning Agency provided census data and other relevant information about Stevens and Pope Counties. Data on population, households, and land areas for Stevens County is illustrated in **Table 3-3**. The population in Stevens County has undergone a moderate reduction during the past thirty years. The number of households has also declined during that timeframe. The increase in land area in Stevens County from 1980 to 1990 could be the result of more precise survey equipment and the use of Global Positioning Systems (GPS).

The population in Pope County (**Table 3-4)** has grown moderately during the past thirty years. The number of households has also increased during that timeframe. The slight increase in land area could also be attributed to more precise survey equipment and the use of GPS.

The State of Minnesota Census 2000 shows that the Stevens County population decreased by approximately 5.48 percent and the Pope County population grew by approximately 4.57 percent. While Stevens County has had a moderate decrease in households, Pope County has experienced a strong growth in households.

The communities near the HPP project sites in Pope and Stevens Counties include Walden, Hoff, Horton, Hodges, and Moore Townships, and the City of Hancock. The populations for these rural communities are presented in **Table 3-5**.

Population figures for the six townships indicate that population in those communities sustained moderate changes during the past ten years (1990 to 1999).

The number of households within a one-mile radius of the proposed project sites is shown in **Table 3-6**. According to the 2000 Census, the average number of persons in a household in Pope County was 2.42 and in Stevens County, 2.43. Therefore, it is estimated that a total of 148 people live within a mile of the various HPP sites.

3.6.1 Land Use

The GEIS (Minnesota EQB 2001) presents five recurring themes for land use: changes in animal agriculture, quality of life impacts, community interactions, future of animal agriculture, and changes in population dynamics, all of which would affect decisions on land use in Pope and Stevens Counties. The most significant land use decisions regarding feedlots are expected to be those related to density in residential and commercial development and to cumulative environmental impacts.

Pope County completed its comprehensive land use plan during the summer of 1998. This plan defines three types of farms: specialized, hobby, and traditional.

Specialized farms are farms owned by two or more families who share ownership, management, and labor. They will specialize in one enterprise, such as dairy, hogs, or turkeys. They will utilize the latest in technology and research to be profitable and competitive with other producers in the United States and overseas. Generally, the HPP project falls into this category.

The hobby farm and traditional farm have less ambitious goals. The hobby farm may generate revenues of less than $1,000 per year. The traditional family farm is owned by a single family where one spouse would seek employment in the community and the other spouse may also have a part-time job in the community to make ends meet on the farm.

Stevens County does not have an approved comprehensive land use plan. Zoning for the County is accomplished by means of existing ordinances.

3.6.2 Economics

Several economic issues were discussed in the GEIS (Lazarus *et al* 1999; Lazarus *et al* 2991) that may characterize an area with existing or proposed feedlot operations. The following summarizes the economic issues in an area with existing or proposed expansion of feedlot operations.

Table 3-7 shows the number of all farms and number of hog and hog farms in the State of Minnesota and in Pope and Stevens Counties. The USDA assesses all farms in the state every five years. Therefore, their data is presented in five-year increments starting in 1978 and ending in 1997. The USDA has not yet collected and analyzed data for the state farms for the years 1998 to 2002.

According to the USDA, between 1978 and 1997 the number of farms raising hogs within the State of Minnesota decreased from 25,703 to 7,512. This represents a decrease of 18,191 Minnesota hog farms in twenty-five years. The total number of hogs on farms in the state increased only modestly from 1978 to 1992 (4.1 million in 1978; 4.7 million in 1992). By 1997, there were 5.7 million hogs on Minnesota farms, one million more than five years before in 1992, and on 5,613 fewer farms.

Similar trends in the number of hogs and hog farms have been recorded for Pope and Stevens Counties. Between 1978 and 1997 the number of farms raising hogs in Pope County decreased from 276 to 44. The decline was moderate from 1978 to 1992, but accelerated from 1992 to 1997. While the total number of hogs in Pope County decreased somewhat from 1978 to 1997 (36,545 in 1978; 27,438 in 1997), the hogs were found on 232 fewer farms than in 1978 in Pope County.

Between 1978 and 1997 the number of farms raising hogs in Stevens County decreased as well, from 249 to 83. While the total number of hogs in Stevens County increased by about 42% from 1978 to 1997 (60,410 in 1978; 85,979 in 1997), the number of farms with hogs has declined by 166 farms.

The total number of hogs in Pope and Stevens Counties increased slightly from 1978 (96,955) to 1997 (113,417). The hogs were raised on 398 fewer farms than in 1978. This represents an average size farm of approximately 890 hogs in the two county area, compared to the 5.7 million hogs and 7,512 hog farms in the state, representing an average size farm of approximately 780 hogs.

The GEIS found that the swine industry in Minnesota underwent significant consolidation from 1982 to 1997, with decreasing numbers of Minnesota farms and increasing numbers of hogs and hogs per farm. Between 1982 and 1997, the number of farms with hogs declined by 64% (from 20,813 to 7,512). In relation to all farms, the percentage of hog farms decreased by 54% between 1982 and 1997 (from 22% of all farms to 10%). The number and percentage of farms with hogs decreased in every county of the State, with the highest decreases in the northern two-thirds of the state. From 1982 to 1997, the number of hogs in the state increased by 28% (from 4,473,181 to 5,722,460). Over the same period, hogs per farm increased by 254% (from 215 to 780). However, the geographic distribution of hog operation also changed during this time. The number of hogs per thousand acres fell in the northern half of the State between 1982 and 1997, as well as in several of the far southeast counties. Increases were concentrated in the southwest and south central counties. Pipestone County had the highest increase in hog numbers per thousand acres, at 162%, followed by Martin at 150%, and Blue Earth at 124%.

3.7 RESEARCH AND LITERATURE REVIEW – HUMAN HEALTH

3.7.1 Ground Water Impacts

The analysis of ground water impacts from this project focuses on nutrient, chemical, and pathogen migration from manure storage and manure land application. This section reviews the migration potential of these compounds.

If manure is applied in excess of agronomic rates, the nutrients can build up in the soil, leach from the soil, and negatively impact ground water. Numerous factors such as soil type, nutrient content of manure, time and rate of application, and crop rotation affect the concentration of nutrients within the soil.

The speciation of nitrogen in the environment is largely microbially mediated via oxidation/reduction (redox) reactions. In aqueous systems, the predominant species (NO_3^- and NO_2^- or NH_4^+, NH_3 and organic forms) are dictated by the redox conditions at the sampling location.

Ambient sources of nitrogen from most aquifer materials are insignificant. Consequently, any nitrogen present is typically human induced from the ground surface. Nitrogen must leach through the soil and unsaturated zones to reach ground water, generally in one of two scenarios, point-source introduction of nitrogen on a large scale, or nonpoint-source leaching of nitrogen through the unsaturated zone to ground water. Point source migration could occur from leaks in the containment pits, from individual domestic septic systems, or from massive spills, while potential non-point sources include the land application of manure and other fertilizers.

Nitrate is highly soluble in water and therefore quite mobile. Nitrate readily leaches through the soil and unsaturated zone to ground water. The two major mechanisms for the mitigation of nitrate-impacted water are dilution through dispersion and chemical reduction (denitrification).

Nitrogen is an essential plant nutrient, but if applied in excess of the crop's needs it is subject to leaching and may negatively impact water quality. Nitrogen exists in the soil system in many forms and changes very easily from one form to another. These include inorganic forms such as ammonium ion (NH_4^+), ammonia gas, and nitrate (NO_3^-) and organic forms (such as amino acids and urea) in organic matter and crop residues. NH_4^+ and NO_3^- are readily available for plant uptake, while organic nitrogen is not. The rate and timing at which these forms of nitrogen change is heavily influenced by physical and chemical properties of a given soil and prevailing climatic conditions.

Sixty to eighty percent of the nitrogen in swine manure is in the form of NH_4^+ (Ruhl 1999; Ham *et al* 1999). The remaining 20 to 40% of the nitrogen is in the other forms. Therefore, the majority of the nitrogen in swine manure is readily available for plant uptake. If the plant does not utilize the nitrogen in the soil, several processes will facilitate the loss of the nitrogen from the soil system.

Plants utilize nitrogen in the forms of NH^+ (ammonium ion) and NO_3^- (nitrate ion). NH_4^+ has a positive charge and therefore is attracted and held by soil particles and soil organic matter, which are negatively charged. Consequently, NH_4^+ is relatively immobile in the soil and usually does not leach to ground water. However, if the NH_4^+ in the soil is not taken up and utilized by the plants, it is subjected to the process of nitrification. Nitrification is a biological process that converts NH_4^+ to NO_3^-. NO_3^- has a negative charge (so soil does not bind it) and is highly water-soluble. Therefore, if the plants do not utilize the NO_3^-, it is susceptible to leaching. The rate of leaching is most significant in granular soils due to their lower water holding capacities and resulting greater permeability.

Research suggests that nitrate has the greatest opportunity to leach when manure is applied in the fall after the growing season. During this time period, plants are not utilizing the nitrogen in the soil and the NH_4^+ in the manure is rapidly oxidized to NO_3^-. This NO_3^- is then subject to leaching throughout the fall, winter, and most prominently during the spring recharge period (Munyankusi *et al* 1998; Randall *et al* 2002.). Delaying manure application, especially on granular soils, until spring eliminates adding nitrogen in the soil during the non-growing season, which will minimize the amount of NO_3^- available for leaching during the spring thaw and recharge. Spring application is the most frequently cited best management practice (BMP) for reducing nitrate migration to ground water in cropland.

Ammonia and organic forms of nitrogen (the typical forms present in animal wastes) are typically attenuated in the unsaturated zone and are not likely to reach ground water in appreciable quantities. One exception to this is the case of a large point source, as might occur beneath a feedlot or a leaking manure storage basin. All but two of the HPP facilities are comprised of barns with concrete-lined storage systems. The concrete-lined system is considered the least permeable, having an average permeability on the order of 10^{-8} cm/s or less. Recent studies by the MPCA conclude that impacts of nitrogen do not pose a significant concern for ground water at lateral distances beyond 100 feet from this type of structure. Further analysis of the data by the MPCA reveals that the concrete-lined system is at least two to three times as effective as earthen-lined technologies. This research conducted by the MPCA analyzed facilities located on granular soils, and is therefore applicable to the HPP project sites.

Pathogens of concern are those that are shed into the environment in high numbers, are highly infectious at low doses, can survive and remain infectious in the environment for long periods, and/or that are highly resistant to wastewater treatment processes. *Cryptosporidium parvum*, *Giardia lamblia*, *Escherichia coli* O157:H7 (E. coli O157:H7), *Campylobacter jejuni*, *Salmonella*, *bacillus anthracis* (Anthrax), and other bacteria and viruses are listed in **Table 3-8** as the main pathogens of concern, as well as their incidence of disease, and typical transport pathways.

Pathogen movement from feedlots into ground water could potentially occur during manure transfer (spills or leaks from equipment), through cracks in storage structures, or they may leach out from inadequately built (e.g., unlined) earthen manure storage pits (Mulla *et al* 2001). Pathogen movement into ground water could also occur after land application of manure, via preferential pathways (i.e., voids in the soil) sinkholes, or improperly sealed wells that provide a direct connection from the land surface to ground water.

There have been 14 documented incidents of *Cryptosporidium* disease outbreaks in the U.S. and Canada since 1984. Four of these events were linked to nonpoint source agricultural pollution; the others were primarily caused by septic tank and human sewage contamination (Mulla *et al* 2001). The presence of pathogens within the ground water near the HPP project has not been documented. Potential impacts from pathogen-impaired ground water are discussed in **Section 4.2**.

Manure storage facilities that leak, or land applied manure, could possibly leach pathogens and nutrients into soil and ground water. The survival of any pathogen during storage depends on several factors: size of source and loading rate (how many hogs are infected, frequency of waste additions, and dilution), temperature (cool temperatures increase pathogen survivability), length of storage, treatment, and the type of pathogen (Rosen 2000). Nutrients may reach ground water through preferential pathways in granular soils. As will be discussed in **Section 3.7.4**, nitrogen may act to extend the viability of certain pathogens, in addition to causing methemoglobinemia ("blue baby syndrome"). This disease results from overexposure to nitrates, resulting in the displacement of oxygen in the bloodstream. Infants are most susceptible to the disease, hence its colloquial name.

3.7.2 Surface Water

Livestock waste can degrade surface water quality by contributing nutrients, sediment, pathogens, and various chemicals through surface water runoff and manure spills. Sources of contamination that would potentially affect surface water are runoff from fields, overflow and leaks from manure storage structures, and spills during manure transfer. An average of 20 spills per year occur in Minnesota, most originating from hog farms (Mulla *et al* 2001)

The risk of pollution from land application is typically greater at smaller feedlots than at larger feedlots due to the typical manure management practices at smaller feedlots. Smaller feedlots often apply manure every 2-3 days (daily haul) year round in solid form without incorporation. Sometimes manure must be stockpiled temporarily if conditions are not favorable for land application. This increases the potential for direct precipitation contact with manure, increasing the amount of phosphorus, nitrogen, and pathogens in runoff. Frozen ground application is also more likely, which also increases the amount of nutrients and pathogens in runoff.

Nutrients are often carried in runoff from manured fields to surface waters; the potential for elevated nutrients in runoff increases with the rate of manure applied, precipitation, soil condition, and slope. Nutrient losses are least when manure is applied in late spring and greatest when manure is applied in fall; they may be excessive if manure is applied to frozen soil or snow. Nutrient losses also increase when the time between land application and rainfall is brief.

<u>Phosphorus</u>
Phosphorus is necessary for plant growth but is considered a pollutant when levels exceed the needs of healthy plant populations. The current phosphorus levels in surface waters in west central Minnesota are high. The primary source is agricultural runoff, specifically within the NGP and NCH Ecoregions.

Phosphorus is the primary nutrient lost in surface runoff, although nitrogen may be lost from fields in this way as well. Most of the phosphorus applied to soil in manure is bound in the soil, and therefore reaches surface water when eroded soil is carried there by runoff. In this way, livestock waste can contribute significantly to phosphorus loads in surface waters. Anywhere from 7-65% of total phosphorus load initially applied to soils may end up there (Mulla *et al* 2001). As with nitrogen, losses of phosphorus (and nitrogen) in runoff are affected by rate, method and timing of manure application, tillage, rainfall intensity and timing, and slope steepness (Sharpley *et al* 1998). Other important factors for phosphorus losses include erosion rate, soil phosphorus levels, soil phosphorus sorption saturation levels, and proximity to waterbodies (Wall and Johnson 1996).

Nitrogen

Nitrate losses to subsurface tile drainage increase with the rate of manure or fertilizer applied. Liquid manure applications cause more risk for nitrate leaching to tile drains than surface applications of solid manure, especially when liquid manure is injected. Nitrogen is the primary nutrient that can leach and impact ground water, but it represents a lesser risk of nutrient loss to surface water than phosphorous (Mulla *et al* 1999). Livestock waste can contribute nitrogen loads in surface water of 15%-37% of the total nitrogen load initially applied (Mulla *et al* 2001).

Pathogens

Surface water impairment from pathogens may be caused by domestic wastewater system failure or improper manure management at feedlots. Manure spills and land application on frozen ground, steep slopes, stream banks and lake shores, just before heavy rains, or too close to tile inlets all can result in pathogen impairment of surface water. This is a problem in many rural areas of Minnesota, causing many rivers and lakes to be generally unsuitable for swimming (Addis *et al* 1999). See **Table 3-8**.

Manure spills and improper land application may also cause fish kills. An average of 20 spills per year occurr in Minnesota (Mulla *et al* 1999). The 1997 Report on Animal Waste by the U.S. Senate reports that 40 animal waste spills killed 670,000 fish in 1996. An MPCA press release in January 1998 reported a 100,000-gallon manure spill in Renville County, Minnesota that resulted in a fish kill of almost 700,000 (Mulla *et al* 2001).

Table 3-8 summarizes the principal pathogens of concern and their incidence in the environment. Most of the fecal bacteria in surface waters (over 80% throughout Minnesota) may come from manured fields (Mulla *et al* 2001).

Fecal coliforms are a subgroup of total coliform bacteria. Fecal coliforms are bacteria that live only in the intestines of warm-blooded animals. Fecal coliforms are used as indicators of the presence of other pathogens in surface water and ground water. Indicator bacteria may not be pathogenic in and of themselves, but high numbers may indicate fecal contamination (Rosen 2000).

Large numbers of viruses and bacteria are excreted in infected animal feces and can enter water bodies through manure land application or through direct contact. Bacteria and viruses are small enough to move through the soil (Rosen 2000). However, transport of the pathogens within the soil profile is limited due to the adsorption of the pathogens from percolating waters onto the soil material itself (Wall and Johnson 1996). Also, many pathogens are attenuated by environmental factors such as sunlight, oxygen, or temperature. The die-off rate is an important process affecting availability of the pathogens. The die-off rate for various pathogens varies depending on the type of pathogen and the seasonal environment. See **Table 3-8**.

In addition to poor manure management, compost piles inadequately operated or placed may also impact surface waters, particularly when insufficient cover material is used, but also when compost piles are placed in flow paths. Poorly managed compost material may leach pathogens or nutrients from the pile and possibly contaminate ground water or surface waters. The BAH regulatory program contains guidance to minimize this potential.

3.7.3 Odorous and Nonodorous Gases

The best-known odorous gases emitted from feedlots are hydrogen sulfide and ammonia. Methane and nitrous oxide (greenhouse gases), also emitted from feedlot operations, are pollutants, but not odorous. A large number of volatile odorous organic compounds (VOOCs) are also emitted. The gases are produced from urine and feces as well as microbial degradation of manure, in liquid or solid storage areas and in unincorporated land applied fields.

Hydrogen Sulfide

According to the GEIS Technical Work Paper on Air Quality (Earth Tech 2001a), hydrogen sulfide is produced from storage, handling, and decomposition of animal wastes, as well as natural sources such as swamps, sea spray, and sulfur springs. Other contributors are wastewater treatment facilities, fossil fuel combustion, and industrial processes.

The air concentrations of hydrogen sulfide will vary depending on the source and the proximity to the source from which the measurement is taken. Hydrogen sulfide levels from natural sources vary between 0.11 and 0.33 ppb, levels in urban areas typically range between 0.07 and 4 ppb, and levels measured in industrial areas range from 140 to 210 ppb. Hydrogen sulfide measurements taken near feedlots around the State of Minnesota range from 0 to 497 ppb, with an average reading of 11.5 ppb, and a median value of 5.6 ppb. High levels of hydrogen sulfide may be emitted during agitation or emptying of manure storage basins and pits. Levels during agitation have been reported as high as 1,000 ppm (Earth Tech 2001).

Concerns with hydrogen sulfide include its ability to produce strong odors (similar to rotten eggs) at low concentrations, its role in producing acid rain, and most importantly its ability to adversely affect humans at relatively low concentrations (Kellogg *et al* 1972; Sullivan 2003). Hydrogen sulfide is a respiratory toxicant, and can cause death at sufficiently high concentrations. When hydrogen sulfide is exposed to oxygen, such as on release to the atmosphere, it is converted via a series of chemical reactions to sulfuric acid. It can also contribute significantly to odorous emissions from feedlots.

Ammonia

Amino acids in animal feed, if not taken up and incorporated into tissue, are broken down into urea and uric acid and are excreted in animal wastes. Ammonia is produced from the decomposition of these compounds, and is also contained in some feedlot cleaning product compounds. Animal agriculture is considered a major contributor of global atmospheric ammonia emissions (Earth Tech 2001a). Other major contributors are wastewater treatment facilities, fossil fuel combustion, and industrial processes. Ammonia is a severe respiratory irritant, and can cause death at sufficiently high concentrations.

Atmospheric concentrations of ammonia can be quite high near intense feedlot activity (Mellon *et al* 2001). There, ammonia concentrations may range from 1.3 to 1,734 mg/m^3, while in relatively unpolluted rural areas ammonia concentrations range from 0.2 to 17 mg/m^3 (Earth Tech 2001). Ammonia is very reactive in the atmosphere and may form ammonium particulates (which can be ammonium salts or ammonium free radicals) that may be removed from the atmosphere via dry or wet deposition (Robarge *et al* 2000; Dragosits *et al* 2002). Dry deposition occurs more or less continuously, without precipitation. Wet deposition occurs during precipitation events. Dry deposition predominates in regions characterized by high levels of ammonia emissions from relatively low-level emission sources and is indicative of short-range transport of typically less than 5 kilometers. On the other hand, wet deposition is more significant in regions where emission levels are lower, and is indicative of long-range transport ranging from ten to thousands of kilometers from the emission source (ECETOC 1994, Fangmeir 1994, both cited in Earth Tech 2001)). Several studies in the GEIS Air TWP indicate that surface water quality can be impacted by atmospheric deposition of ammonium compounds (Earth Tech 2001). This is discussed in **Section 4.3.**

Volatile Odorous Organic Compounds

At least 168 different chemicals have been found in manure, and many of these volatilize to form odorous gases (O'Neil and Phillips 1992; Veenhuizen 1996, *in* USEPA 1996). It is these that are largely responsible for the annoying odor that emanates from feedlots. The concentration of volatile organics in the air is a good indicator of odor intensity (Guo *et al* 2000), and Zahn (2000, 2001) took advantage of this fact to correlate the human olfactory response to feedlot odors with specific airborne concentrations of odorous feedlot gases. Zahn also developed accompanying field and laboratory methods for assessing odor intensity in the vicinity of feedlots, as well as graphic methods that use the resulting data to show how much of an odor problem a particular feedlot may be. These methods have been employed in the air analysis for this EIS.

3.7.4 Other Public Health Concerns

A significant portion of the following discussion is based on literature summaries and technical work papers attached to the GEIS.

Resistant Pathogens

Antibiotics were first developed in the middle of the last century, and proved to be a major leap forward in the prevention of bacterial disease in humans. However, by 1950 it had been discovered that the addition of small amounts of antibiotics (“subtherapeutic” or “nontherapeutic” use) to animal feed enhanced growth rates and increased feed utilization efficiency in meat animals (JSC 1960 *in* Halverson 2001), although even today it is not completely clear how this works (Wallinga 2002). At about this time, use of antibiotics for disease prophylaxis and growth enhancement became a common practice in the US (Halverson 2001; Crooker 1999). In the half century since then, such use of antibiotics has become routine in animal agriculture, sometimes specifically to *treat* clinical disease, but more often on a routine basis to *prevent* disease (even though no clinical disease is evident) and improve growth rates. This routine use has been unquestioned until recently (Crooker *et al* 1999).

During the same time period, it has become increasingly clear that some pathogens have become, some increasingly, resistant to some antibiotics. Use of antibiotics is the key driver of this phenomenon, and, as overuse and unnecessary use of antibiotics in humans have been well documented, it was not initially recognized that subtherapeutic use in animals was a contributing factor (Wallinga 2002; WHO 2001). However, a “strong scientific consensus” now exists that this is so (Falkow and Kennedy 2001, cited in Wallinga 2002; WHO 1997a&b, cited in Halverson 2001), and this is supported by other evidence in the scientific literature. In Taiwan, for example, a strain of *Salmonella* that is resistant to fluoroquinolone therapy was found in hospitalized patients and traced back by molecular typing to herds of swine raised for food (Cheng-Hsun Chiu *et al* 2002; see also Halverson 2001). Fluoroquinolones are the drug of choice for severe *Salmonella* infections, especially in those cases where the infection is resistant to other antibiotics.

In Illinois, movement of genes resistant to tetracycline was traced from a feedlot using that antibiotic for growth promotion as far as 1/6 of a mile from the feedlot (Aminov *et al*, cited in Barlow 2001). The same author concluded that survival and horizontal movement of resistance genes was occurring in the environment, and for “long distances.” The federal Food and Drug Administration recently proposed withdrawing approval for use of fluoroquinolones in poultry based in part on its finding that, although these drugs had been available and routinely prescribed for treatment of *Campyobacter* disease in people since 1986, *Campyobacter* resistance to fluoroquinolones did not increase until 1996-1997, shortly after FDA approved their use at feedlots (Halverson 2001; Crooker, 1999). The FDA withdrawal process is cumbersome and time consuming, however; it required six and twenty years, respectively, for FDA to withdraw approval for diethylstilbesterol (DES) and nitrofurans in animal feed (Wallinga 2002).

Estimates vary as to the amounts of antibiotics used in humans and animals. Wallinga (2002) reports that the Institute of Medicine estimates that 20 million pounds of antibiotics are given to animals yearly (and 80% of this use is nontherapeutic), while the Union of Concerned Scientists estimate is 29.5 million pounds (93% nontherapeutic), as compared with the UCS estimate of only 3 million pounds given to humans annually. Others such as Levy (1998; cited in Halverson

2001) estimates that 40-45% of antibiotics produced in the US are used in animals, of which only 20% are used to treat actual clinical disease, according to Halverson (2001). Wallinga further notes, however, that the livestock and animal pharmaceutical industries maintain that only 13.5% of antibiotic use in animals is for growth promotion. There is no formal mechanism for tracking use, and the line between use for growth promotion and use for disease treatment and prevention is not sharply defined, so definitive information is hard to come by. The various estimates do seem to agree, however, that the use in agriculture is extensive (Wallinga 2002).

What seems undeniable is that resistance to antibiotics is growing and this is having adverse consequences for humans (Manning 2002). The GEIS has noted the rise in recent years in the number of hospital infections that involve antibiotic resistant organisms as well as food-borne bacterial disease outbreaks (Crooker *et al* 1999; Addis *et al* 1999). The European Union has now banned the use as growth promoters of medically important antibiotics, following partial or total bans by several European countries (Crooker *et al* 1999; Halvorson 2001), and has proposed phasing out most other use of antibiotics as growth promoters by 2006 (Wallinga 2002). A number of concerned groups have called for similar action in this country; legislation has been introduced in Congress for this purpose (CSPI 1999, cited in Halvorson 2001; Wallinga 2002). Formal comments submitted to the Centers for Disease Control (CDC) by Environmental Defense, The American Public Health Association, Physicians for Social Responsibility, Union of Concerned Scientists, Center for Science in the Public Interest, Institute for Agriculture and Trade Policy, and others, recommended elimination of the use of medically important antibiotics as growth promoters, disclosure of data on antibiotic use, and an end to new approvals for subtherapeutic antibiotic use at feedlots.

All of the HPP facilities routinely use one or more antibiotic pharmaceuticals (**Table 2-2**).

Chemicals

The nation's water supply contains traces of dozens of antibiotics, steroids, and other drugs. A percentage of these chemicals can be attributed to human activities, but a number of studies indicate that animal agricultural practices contribute a percentage as well (Kolpin *et al* 2002; Mellon *et al* 2001; Raloff 2002; Uehling 2001; Addis *et al* 1999; Nichols *et al* 1997).

Many metal-containing compounds are added to animal feed, often in the form of antimicrobials. Most of these metals are essential nutrients that can be toxic at high concentrations. In addition, some metals are known to bioaccumulate in plants. However, no documentation was found indicating adverse health effects occurring from secondary exposure to heavy metals in the environment resulting from animal production practices.

Endocrine disruptors (such as estrogen) are chemicals (both synthetic and natural) that substitute for hormones utilized in animals and humans. Typically, naturally produced hormones drift through the blood to cells that have the correct receptor molecules on the surface. Once locked onto a receptor, a hormone may instruct a cell to divide or multiply, or increase or decrease production. Endocrine disruptors increase or decrease the effects of the natural hormone system by sending the wrong signals or by blocking naturally produced hormones.

Endocrine disruptors are common in the environment in plants that naturally produce phytoestrogens, in animal feed additives used to increase the rate of animal weight gain, in pharmaceuticals, in pesticides, and in various industrial processes and products. Endocrine disruptors are a concern because they are effective in extremely small doses (in the parts per trillion range) and can lead to a variety of health problems including but not limited to cancer, decreased fertility, abnormalities in newborns, and defects in reproductive organs (Kamrin 1999). Zondek and Sulman (1943, cited in Shore *et al*1995) found that no common soil or fecal bacteria can metabolize estrogen. There are no chemicals used in HPP feedlot operations that are known to act as endocrine disruptors.

Some experts downplay the potential for adverse effects in humans, noting that the amounts found so far are in trace amounts, often in the parts per trillion range (Schaffer and Meersman 2002; Uehling 2001). They have been shown to adversely affect sexual morphology and function in fish, however (Raloff 2002), as well as other biota (USEPA 1997; Nichols *et al* 1997). Environmental estrogens have been implicated in the drastic sperm count reductions in Western men (Sharpe and Skakkebaek 1993, cited in Shore *et al* (1995) and in Nichols *et al* 1997).

The GEIS (Mulla *et al* 1999) notes that reports of such phenomena are increasing, but the cause and effect situation is poorly understood (*see also* Nichols *et al* 1997). The chemicals implicated may come from a variety of sources--not just feedlots--and may act synergistically. While it is known that land application of feedlot wastes can contribute estrogens to runoff (*see* for example Nichols *et al* 1997; Bushee *et al* 1998), and that elevated levels of these chemicals in water can adversely affect fish, birds, and other wildlife (Nichols *et al* 1997), “there is no evidence that livestock management [as an individual source] causes endocrine disruption in any fish or wildlife species” (Mulla *et al* 1999). Presumably, this conclusion would extend to humans as well, although this author did not specifically say so.

The literature surveyed for this EIS indicates that the bulk of endocrine disruptors originating at feedlots come from poultry, beef and dairy operations where steroids are used as growth and production promoters or are shed naturally from the animals themselves. As noted above, here are no chemicals used in HPP feedlot operations that are known to act as endocrine disruptors.

Water Transmission of Disease

Human health effects from exposure to nitrates of agricultural origin are well documented in the literature (for example, see Mulla *et al* 2001). The principle effect, methemoglobinemia ("blue baby syndrome") results from consumption of nitrates, generally in drinking water, resulting in the displacement of oxygen in the bloodstream. Infants are most susceptible to the disease, hence the colloquial name. Since its initial identification in 1941, numerous cases of exposure have been documented, some as recently as the 1990s. Most of the cases resulted from ingestion of drinking water contaminated with nitrates.

Diseases transmitted via water are the most common. A list of pathogens is summarized in **Table 3-8**. Significant proportions of *Giardia* and *Cryptosporidia* infections are waterborne. These protozoa form cysts or oocysts that are resistant to disinfection (as via chlorination), and filtration systems are required to remove them from drinking water (Rosen 2000). Four *cryptosporidium* disease outbreaks in the U.S. have been linked to agricultural runoff. Other bacteria linked to waterborne disease include *Campylobacteria*, *Salmonella*, *E. Coli* O157:H7, *Leptospira*, *Yersinia*, and *Mycobacteria* (Mulla *et al* 2001).

Nearly all the viruses that cause gastroenteritis in humans have related strains that can cause diarrhea in livestock. Rotaviruses are the most common cause of severe diarrhea in humans worldwide and they are also a major cause of mortality in calves and piglets. Large numbers of viruses are excreted in an infected animal's feces, and these viruses can enter water bodies through land application of animal wastes or by direct contamination from pastures and feedlots. However, these strains appear to be highly host specific. Although these animal viruses have been found in humans, they have not been documented as having an important role in human disease, either endemically or in outbreaks (LeBaron *et al* 1990).

<u>Soil-borne Transmission of Pathogens</u>

Some bacteria exhibit a low risk of being transmitted through water, including those that cause tetanus (*Clostridium tetani*), brucellosis (*Brucella abortus* (melitensis)), anthrax (*Bacillus anthracis),* and erysipelosis (*Erysipleas rhusiopathie*) (LeBaron *et al* 1990; Mulla *et al* 2001). There is a report of transmission of *E. coli* O157:H7 through direct contact with soil, causing an outbreak of gastroenteritis in people attending a music festival held in fields previously used to graze cattle (Addis *et al* 1999). However, soil mediated disease that originates in feedlots may hinge more on the ability of pathogens to migrate through the soil to drinking water supplies than on direct human contact.

If liquid manure is applied by incorporation or injection into the soil, two major factors that control disease causation are survival time and ability to migrate through the environment. Pathogen survival depends on environmental factors and the type of pathogen. Visible light, ultraviolet radiation, and desiccation all can negatively affect pathogen survival in soil. The more protection from desiccation and ultraviolet light, the longer the pathogen will remain viable.

Pathogen movement tends to be inhibited in soil. While many pathogens are small enough to move with water through soil voids, clay particles and organic material effectively trap viruses, bacteria and protozoa, as the pathogens are adsorbed to negatively charged surfaces. Larger pathogens are filtered by narrow soil pore sizes, although macropores and preferential pathways in soils can accelerate pathogen movement towards the ground water, and this may be exacerbated in granular soils. Soils with high nitrogen tend to extend the survivability of pathogens, particularly *E. coli* O157:H7. The additional nitrogen appears to allow cells to go through a period of progressive cell dormancy that prolongs their viability (Rosen 2000).

Most of the fields on which HPP manure is spread are composed of cohesive soils, which tends to bind pathogens and otherwise inhibit their movement in the environment. This will also be true on granular soils, although to a somewhat lesser degree; the organic material in the manure will tend to bind pathogens. Manure application on the surface (as at the Olson and Zeltwanger facilities) exposes any pathogens to environmental forces such as desiccation, heat, and sunlight, all of which tend to deactivate pathogens.

<u>Air-borne Transmission of Dust, Pathogens and Other Biologically Active Materials</u>

Dust is a common airborne irritant in animal confinement barns. The major components of dust are typically traced to feed, with additions from animal dander and hair, animal feces and urine, pathogens, and endotoxins (biologically active cell wall material from gram negative bacteria). Examples of diseases that could potentially be transmitted from an animal feedlot to humans through the air include anthrax, Q fever, brucellosis, influenza A, and histoplasmosis (Mulla *et al* 2001). Compounds such as ammonia, methane, and hydrogen sulfide may also attach to the dust particles and become airborne. The airborne matter may irritate or infect building workers, and also may be vented and released into the environment.

Dust concentrations in confinement buildings are affected by factors such as use of litter, animal husbandry practices, climate, and barn type. An EU-funded study that observed different types of barns for three different animals in four European countries found that dust concentrations are higher during the day and vary seasonally for hogs, being higher in the winter than in the summer (Takai *et al* 1997). However, viable respirable particles (endotoxins and pathogens) inside mechanically ventilated barns were almost twice the concentrations found inside naturally ventilated barns (Robarge *et al* 2000). A different study conducted in Kansas indicates that two similar barns, one mechanically ventilated and the other naturally ventilated, showed relatively little difference in dust concentrations between the two buildings. Mechanical ventilation versus natural ventilation did not impact dust concentrations in the Kansas study. However, the EU study suggests that the airflow exhaust locations, on sidewalls or endwalls versus roof exhaust, alter the airflow within barns, thus affecting dust concentration levels.

Emissions from confinement barns are affected by certain factors, including season, climate, ventilation system, type of barn, and type of animal housed within the barn. The EU study indicates that inhalable dust emission rates from barns were higher in winter because higher ventilation rates were used in the summer (Seedorf 1997). Travel distances of the emissions were not discussed. Local topography, weather, and ventilation system design also affect potential contaminant transmission. Dust emissions from hog barns are typically higher than dairy and cattle barns (Takai *et al* 1997).

In a pilot study conducted by Purdue University, bioaerosol (pathogens, endotoxins, and other biologically active substances) concentrations were measured in and up to 400 meters from a farrowing to finish swine facility. The purpose of the study was to determine the viability of bioaerosols at increasing distances from the barn. The results of the study indicated that at over 300 meters the total bacteria concentrations were low. However, it should be noted that the conditions during sampling were not conducive to airborne pathogen survival (Homes *et al* 1996). With the exception of soil borne bacteria such as anthrax, bacteria are typically not viable unless suspended in mist form from a liquid reservoir (Earth Tech 2001a).

While air emissions of the pathogens from animal confinement facilities increase the pathogen population in the environment, there are insufficient data to determine if this results in an increased risk to human health. Some studies indicate that there is no direct evidence that individuals living near large feedlots are at increased risk for developing diseases associated with contaminants transmitted via the air from these facilities. Other studies show workers and neighbors are most at risk, in terms of which segments of the population are most susceptible to health problems related to animal agriculture for airborne contaminants (Halverson 1999). Little research has been conducted on the emission rates of microorganisms from concentrated feedlots, and there is wide variation in the reported ranges of microorganism concentrations in air and emission rates from concentrated feedlots. Even less is known about the impact of these organisms on people living nearby (Earth Tech 2001b).

<u>Vector-borne Transmission of Pathogens and Potentially Toxic Compounds</u>

Insects, especially flies, are a potential vehicle for the transmission of human disease from manure, animal carcasses, and other animal wastes. Flies typically found in or near feedlots are house flies (*Musta domestica*), stable flies (*Stomoxys calcitrans*), fruit flies (family *Brosophidae*), and blow flies (family *Calliphoridae*). These flies typically carry enteric disease-causing bacteria such as *Salmonella spp*. and *Campylobacter jejuni*. The GEIS discusses two studies indicating that enteric disease incidence decreases when fly presence in food preparation areas and food consumption areas (e.g. cafeterias, mess halls) is decreased. Disease incidence increases as proximity decreases among feces, flies and food (Addis *et al* 1999).

Bacteria causing food-borne illnesses could potentially be transmitted via flies from animal production facilities to human food and cause disease. This has not actually been documented, however. There have been several studies attempting to implicate flies as disease transmitting vectors (Earth Tech 2001a). However, flies have yet to be unambiguously documented as important contributors to incidence of diarrheal disease in communities around such facilities (Homes *et al* 1996; Addis *et al* 1999). Since pathogens are rapidly destroyed by desiccation, ultra violet light, and other environmental factors, their viability may tend to decrease in the course of the first flight after acquisition (Addis *et al* 1999).

3.8 GREENHOUSE GASES

The discussion in this section is largely from Ciborowski (2003, MPCA, personal communication).

The term "greenhouse gases" collectively describes a group of gases that consist of carbon dioxide, methane, nitrous oxide, and other trace atmospheric gases. Greenhouse gases are produced from a variety of sources, the largest being industrial and commercial processes, transportation and agriculture. Greenhouse gases are thought to be the principal contributor to global warming. Greenhouse gases absorb energy in the infrared part of the electromagnetic spectrum. Once present in the atmosphere, they absorb a part of the long-wave radiation (heat) that the earth's surface and lower troposphere radiate to space, essentially trapping it in the lower troposphere and causing global surface temperatures to rise. Most scientists who are actively engaged in research on the question of global warming believe that increasing atmospheric concentrations of greenhouse gases are causing an increase in global temperature. Some ecologists and wildlife biologists believe that global climate change could have substantial negative impacts on plant and animal populations worldwide. The principal debate among atmospheric scientists is not whether it will warm if greenhouse gas concentrations are substantially increased, but how much it will warm and how fast.

Methane (CH_4) and nitrous oxide (N_2O), two key greenhouse gases, are produced at, and emitted to the atmosphere from, swine feedlots (Oenema *et al* 1993; Nevison *et al* 1996; Li *et al* 2001; Lessard *et al* 1996; Chadwick *et al* 2000; Pierce 1999; Chang *et al* 1998; Monteny *et al* 2001; Flessa *et al* 2002). Carbon dioxide, another key greenhouse gas, is also produced at feedlots, but in relatively minor quantities. The primary source of carbon dioxide emissions to the atmosphere is fuel combustion (Flessa *et al* 2002).

Methane is produced during the decay of organic matter in swine manure storage facilities. The production of methane from manure requires the presence of anaerobic or reducing conditions such as are found in underbarn manure pits or outdoor tanks, lagoons and basins. Swine manure stored in below barn pits or basins is highly diluted with water, leading to the creation of anaerobic conditions within which methane production is enhanced. When manure is managed as a solid, methane production from it is minimal.

By contrast, nitrous oxide production in manure is minimal under anaerobic conditions; anaerobic conditions favor the further reduction of any produced nitrous oxide to nitrogen gas, which is not a greenhouse gas. Because most swine manure in Minnesota is managed as a dilute slurry or liquid (e.g., total solids 2% or less), relatively little nitrous oxide is produced at swine feedlots, whereas substantial amounts of methane are produced on Minnesota feedlots.

Other sources of greenhouse gas emissions from swine feedlots include: swine flatulence, feedlot runoff, and land application of swine manure. Nitrous oxide is produced in soils by bacteria that convert ammonia to nitrate or that denitrify nitrate to N_2O. The application of swine manure to agricultural soils supply these bacteria with a nitrogen source needed for the production of nitrous oxide. The same bacterial processes produce nitrous oxide in surface waters and ground waters using run-off from feedlot surfaces and from soils as a nitrogen source. Finally, small amounts of methane are produced in the digestive tract of swine, and are emitted to the atmosphere as swine flatulate.

Most of the greenhouse gas emitted from swine feedlots in Minnesota is methane. An estimated total of 60,000 tons of methane are emitted from Minnesota swine feedlots each year. Most of this is derived from underbarn storage of manure; only about 15% is the result of swine flatulence. The emission of 60,000 tons of methane is equivalent to an emission of carbon dioxide of about 1.25 million tons. By contrast, the direct emission of nitrous oxide from swine feedlots is small, about 100 tons annually or, in terms of CO_2-equivalent emissions, about 30,000 CO_2-equivalent tons, which makes it small in relation to feedlot emissions of methane. To this one might add an additional emission of about 500 tons of N_2O (150,000 CO_2-equivaent tons) from the application of swine manure to agricultural fields in Minnesota and from runoff of manure nitrogen from field or feedlot surfaces.

An estimated 307,000 tons of methane (6.5 million CO_2-equivalent tons) are released to the atmosphere from all sources of emission in Minnesota. Emissions from livestock and emissions from manure stored on feedlots are the second and third largest methane emission sources in Minnesota, respectively, after solid waste landfills.

In all likelihood, no individual feedlot, including the HPP feedlots, contributes significantly to the greenhouse phenomenon. This is a cumulative type of impact, resulting from individual non-significant contributions from many sources, some human and some natural. The global warming problem is a global problem requiring a global solution. No single nation, state, or feedlot can solve the problem itself. Emission reductions at Minnesota feedlots would have no measurable effect on atmospheric methane levels. Long-term international and national efforts are underway to address this problem.

3.9 SITE SPECIFIC ENVIRONMENTAL SETTING

Water. Descriptions of soil associations, surficial aquifer conditions, buried drift aquifer conditions, surface water proximity, and tile inlet locations at each of the Hancock Pro Pork facilities are presented below. **Figures 3-4a-c** illustrate the various soil associations present at each of the land application field areas available to each of the Hancock Pro Pork facilities. **Figure 3-5b** illustrates interpreted ground water flow directions within the surficial aquifer, where present, beneath each of the Hancock Pro Pork facilities. **Figures 3-5d, 3-5g and 3-5j** illustrate interpreted ground water flow directions within buried drift aquifers beneath each of the Hancock Pro Pork facilities. **Figures 3-9 through 3-18** illustrate locations of surface water and tile inlets and wells at each of the Hancock Pro Pork facilities. **Table 3-9** presents a summary of the wells that are present within 1/2-mile of each of the project sites. **Table 3-10** presents a summary of environmental setting including tile inlets (TIs), aquifers, surface waters, or ecological or historic places on or near each site.

None of the regional wells in Swift, Stevens, or Pope counties contained nitrate levels above the Health Risk Limit of 10 ppm. This factor and the absence of any nitrate-stable conditions in the ground water chemistry data for the area suggest that nitrate-unstable conditions predominate within the project area.

In addition, although an investigation during September and October of 2000 that was conducted by the MPCA on three of the facilities in this EIS found nitrate impacts to the ground water above the HRL, only the Olson site could be conclusively shown to be contributing significant nitrate to the ground water. Further, as discussed above, natural attenuation limits the extent of potential impacts, due to an increase in reducing conditions in the ground water with increasing depth. All water samples collected from the farrowing facility and the Olson feedlot, with the exception of three, were collected at the water table. The three water samples collected at depth displayed the lowest nitrate (below method detection limit) and the most reducing conditions. These results suggest that stratification of the aquifer exists in the form of more reducing conditions with depth, indicating reduced potential for nitrate impacts with increasing depth. See **Section 3.3.2** for a more in-depth discussion.

Air. Information on the area's climate and ambient air quality is given in **Section 3.1.** There are no schools, parks, churches, cemeteries, or other public access facilities within one mile of any of the HPP feedlots, except that the Charles barn, if built, would be within one mile of the city of Hancock. The only public structures or facilities near any of the sites are the public roadways near each site. The air impact analysis assesses the potential for impacts at facility fence lines and the nearest non-project neighbor.

3.9.1 Farrowing Facility

The environmental setting for the farrowing site is summarized in **Table 3-10**.

JD 9 is the only surface water located within 1 mile of the farrowing facility. This man-made waterway runs through several of the farrowing facility land application sites. Some of the fortythree tile inlets (TIs) that drain the 1560 acres available for the facility's manure application, as identified in the facility's Manure Management Plan, drain into private ditches that connect to JD 9. The TIs may act as a direct connection from manure-applied fields to surface water.

Perimeter tile drains surround the five concrete manure pits. The perimeter tile drains are designed to intercept ground water if it rises near the base of the concrete pits. If ground water levels rise to the base of the concrete pits, the ground water will drain out of the perimeter tile and into the catch basins between the barns. The farrowing facility has testing protocols in place to test the water to determine if flow from the perimeter tile is impacted by a leak from a concrete pit should the perimeter tile begin to flow. The perimeter tiles have been reported to be dry since operation of the farrowing facility has begun. Storm water run off from the barn roofs and the facility's roads are directed toward a field tile to the northeast of the gestation barns.

The catch basins are grassed areas with slopes that direct water to the TI at its base. The farrowing facility has six catch basins and associated TIs. The locations of these TIs are shown on **Fig. 2-4**.

The TIs connect to a retention pond east of the facilities that drains to a field tile line northeast of the gestation barns. The latter discharges to a series of tile lines that eventually connect to JD 9.

Well logs located near the farrowing facility and its land application sites indicate that depth to ground water is approximately 10 feet and flows to the southeast. Well logs are located in **Appendix E**. The vertical gradient from the surficial aquifer is downward. Fifty-five (55) known wells are within a half-mile radius of the facility and the associated landspreading sites as shown on **Figure 3-9**. The surficial aquifer is present beneath the feedlot and almost all land application sites. The feedlot and all spreading fields contain granular soils.

3.9.2 Charles

The environmental setting of the Charles site is summarized in **Table 3-10**.

Page Lake is approximately one mile to the northeast of the Charles site. The locations of the TIs in the site's land application fields are shown on **Figure 3-10**.

If this site is built, a perimeter tile drain will surround the concrete pit beneath the barn. The perimeter tile will likely drain via overland flow to a vegetated area near the proposed barn site.

The grading around the concrete pit would direct storm water away from the pit. Storm water runoff from the barn roof is directed towards the adjacent fields and windbreak.

Ground water is at approximately 75 feet bgs near the feedlot. The surficial aquifer does not exist beneath the feedlot or any of the land application sites. The nearest aquifer is separated by cohesive soils. Eleven (11) known wells are within a half-mile radius as shown on **Figure 3-10**. Refer to **Appendix E** for individual well logs. No granular soils have been identified on the land application areas or the proposed feedlot.

3.9.3 Greiner

The environmental setting at the Greiner site is summarized in **Table 3-10**.

Surface waters in the area include Lake Emily (1/4 mile north of some land application fields) and a wetland within 1/2-mile of the eastern land application field. These waters are not located on Greiner land application sites. The fourteen TIs within the land application areas are reported to drain to road ditches (which are considered waters of the state, and thus subject to state water quality standards) or to wetlands nearby .

Perimeter tile drains surround the concrete pit beneath the hog barn. The Greiner site does not have protocols in place to test water when it flows from the tile. The perimeter tile drains via overland flow to a vegetated area near the barn.

The grading around the concrete pit directs the storm water away from the pit. Storm water run off from the barn roof is directed towards the adjacent fields. Driveway run off is directed towards the road ditch.

Well logs indicate ground water is approximately 50 feet from the surface near the Greiner feedlot. The surficial aquifer does not exist beneath the feedlot or any of the land application sites. Two (2) known wells are within a half-mile radius as shown on **Figure 3-11**. Refer to **Appendix E** for individual well logs. No granular soils were identified within the land application sites.

3.9.4 Nohl

The environmental setting of the Nohl site is summarized in **Table 3-10**.

There are no surface water bodies (other than road ditches and a partially open drainage ditch) within 1 mile of the land application fields or feedlot sites. The land application sites contain thirty-two TIs that connect to additional tile lines or private ditches that in turn connect to JD 9 over two miles away.

Perimeter tile drains surround the concrete pits beneath the hog barns. The Nohl site does not have testing protocols in place for use when water flows from this tile. The perimeter tile also drains runoff from a vegetated area between the north and south barn that is drained by a TI. The TI is connected to a tile line that leads to the ditch to the north, which flows to JD 9.

The grading around the concrete pits directs storm water away from the pits towards the west. Storm water runoff from the barn roofs is directed towards the windbreak to the west. A catch basin between the barns and drainpipe assist in diverting water between the barns to the west.

Well logs indicate that ground water is within 10 feet of the surface near the Nohl site and its land application sites, and flows to the southeast. Twenty (20) CWI wells are within a half-mile radius as shown on **Figure 3-12**. Refer to **Appendix E** for individual well logs. The surficial aquifer is present beneath the feedlot and all of the land application sites. The feedlot and all of the land application sites contain granular soils.

3.9.5 Olson

The environmental setting of the Olson site is summarized in **Table 3-10.**

The land application sites contain two TIs that drains to an intermittent stream that leads to JD 9. JD 9 flows through the nearby land application fields.

The hogs on the Olson feedlot are allowed to enter and exit the barn onto open fenced lots. Clean water diversions exist around the open lots. The lots themselves drain directly to the nearest field. The north and east lots drain directly east and the south lot drains directly couth, respectively. Grassed buffers exist between the lots and the field.

There are no concrete pits on the Olson site and no perimeter tiles.

Solid manure is hauled directly to the fields and incorporated within 12-96 hours during spring and fall application. During winter conditions it sometimes necessary to temporarily stockpile manure until field conditions are favorable for spreading. Manure applied during the winter is not incorporated until spring.

Ground water is approximately 10 feet from surface near the Olson site and its land application sites, and flows to the southeast. Twenty-one (21) known wells lie within a half-mile radius as shown on **Figure 3-13**. Five farm sites are also shown on this figure, but no wells for them show up on the CWI on in the DNR Permit database. The surficial aquifer is present beneath the feedlot and all of the land application sites. The feedlot and all of the land application sites contain granular soils.

3.9.6 Paul

The environmental setting of the Paul site is summarized in **Table 3-10**.

A wetland lies approximately 800 feet from the barn. The land application sites contain 30 TIs.

Perimeter tile surrounds the concrete pit beneath the hog barn. The Paul site does not have testing protocols in place for use when water flows from the tile during wet periods. The perimeter tile drains via overland flow to a grassy area near the barn. During the November 2001 MPCA inspection, the perimeter tile drained into the wetland. Paul was informed that this was not acceptable and subsequently changed the drainage.

The grading around the concrete pits directs storm water away from the pit. Storm water runoff from the barn roofs is directed towards the open vegetated areas between the barn and the road and east to additional open fields.

Ground water lies between 55-60 feet bgs near the feedlot and flows toward the Pomme de Terre River (southwest). Refer to **Appendix E** for individual well logs. The surficial aquifer is not present beneath the feedlot or any of the land application sites. The nearest aquifer is overlain by cohesive soils. Twelve known wells are within a half-mile radius as shown on **Figure 3-14**. No granular soils have been identified on the land application areas or at the feedlot.

3.9.7 Schaefer

The environmental setting of the Schaefer site is summarized in **Table 3-10**.

There are no surface waters (other than road ditches) identified on or within a half-mile radius of the feedlot site or land application fields. The feedlot and land application sites contain thirty-one TIs that drain to road ditches, join other tile lines, or outlet to fields.

Perimeter tile drains surround the concrete pits beneath the hog barns. The Schaefer site does not have testing protocols in place for use when water flows from the tile during wet periods. The perimeter tile sump drains to a tile line that flows north to a road ditch that outlets over one and half-miles away in a field not owned by Schaefer.

The grading around the concrete pits directs storm water away from the pits. A TI is located in a catch basin between the new barns and is connected to a tile line near the facility. Another TI lies in a grassy area between the new barns and the older barn. Storm water run off from the barn roofs is directed toward the catch basin or the adjacent fields in all directions.

Ground water is relatively close to the surface near the Schaefer site and its land application sites and flows to the south and southeast. Fourteen (14) known wells are within a half-mile radius as shown on **Figure 3-15**. Refer to **Appendix E** for individual well logs. Ten farm sites are located in the same area, but no wells show up for them on the CWI. Well logs indicate that depth to water is approximately 10 feet. The surficial aquifer is present beneath all of the land application and feedlot sites. Approximately thirty percent of the land application sites contain granular soils. None were found to exist at the feedlot site.

3.9.8 Solvie

The environmental setting of the Solvie site is summarized in **Table 3-10**.

Surface waters in the area include the Chippewa River (less than 1/4-mile east of the eastern land application fields) and a wetland within 1/2-mile of the eastern land application field. The Chippewa River floodplain and the wetland are not located on Solvie land application sites. One TI is located within the area available for land application of manure. The TI outlets to the road ditch immediately adjacent to the property. The ditch eventually drains to a nearby unnamed wetland.

Perimeter tile drains surround the concrete pit. A sump pump discharges to a wooded area near the barns. The grading around the concrete pit directs storm water away from the pit. Storm water run off from the barn roofs is directed towards the adjacent fields and wooded area.

The Solvie feedlot is the only feedlot within the HPP project with sensitive habitat within a half-mile radius from its land application sites. Protected mussel habitats identified by the DNR NHNRP near the banks of the Chippewa River are sensitive to increases in suspended solids.

The pre-existing barn that houses hogs from another source does not have a perimeter tile and uses a clay-lined basin for manure storage. The older barn has no pit storage or perimeter tile.

Well logs indicate ground water is approximately 7 feet from the surface near the Solvie feedlot. Twenty-five (25) known wells are within a half-mile radius as shown on **Figure 3-16**. There are also several irrigation wells in the area, and fourteen farm sites for which no CWI entries could be found. Refer to **Appendix E** for individual well logs. The surficial aquifer exists beneath portions of land available for land application of manure associated with the Solvie facility. Approximately 25% of the facility and associated land application acreage are within areas of granular soils, with approximately 75% in areas of cohesive soils.

3.9.9 Spohr

The environmental setting of the Spohr site is summarized in **Table 3-10**.

There are no surface waters other than road ditches identified on or within a half-mile radius of the feedlot site or land application fields. The land application fields contain twenty-nine TIs (in Section 36) that drain to road ditches to the west, and eventually outlet near the Pomme de Terre River.

Perimeter tile surrounds the concrete pit beneath the hog barn. The Spohr site does not have testing protocols in place for use when water flows from the tile during wet periods. The perimeter tile drains via overland flow to a road ditch that flows west.

The grading around the concrete pit directs the storm water away from the pit. Storm water run off from the barn and other facility building roofs is directed towards the adjacent fields. Driveway areas are gravel and drainage from these is directed towards nearby fields and the road ditch.

Ground water is approximately at 50-60 feet bgs near the feedlot and flows towards the Pomme de Terre River (southwest). The surficial aquifer does not exist beneath the feedlot or any of the land application sites. The nearest aquifer is separated from the surface by cohesive soils. Three Five (5) known wells are within a half-mile radius as shown on **Figure 3-17**. No granular soils have been identified on the land application areas or feedlot.

3.9.10 Zeltwanger

The environmental setting of the Zeltwanger site is summarized in **Table 3-10**.

There are no surface waters other than road ditches identified on or within a half-mile radius of the feedlot site or land application fields. The closest surface water is Page Lake, approximately 1.5 miles to the northwest. The land application sites contain twenty-nine TIs that drain to road ditches or private ditches. In section 1, the four western-most TIs eventually flow to an intermittent stream that flows 1.5 miles south to a National Wildlife Management Area that eventually flows into JD 9. Zeltwanger's remaining TIs in section 1 eventually lead to unnamed wetlands and/or other private ditches prior to flowing into the Chippewa River. The 14 TIs in sections 3 and 10 eventually flow into JD 9.

The site does not have concrete pits or perimeter tile drains.

Hogs on the Zeltwanger feedlot are kept in the barns and open lot areas. The areas near the barns and open lots are graded to minimize surface water run on. Driveways are gravel and drainage from these surfaces is directed towards the northwest to the adjacent fields. A concrete pad is used to stockpile manure when field conditions prevent direct haul for spreading. Runoff from this pad is directed north through vegetated areas to nearby fields.

Ground water lies approximately at 50-60 feet bgs near the feedlot and flows south and southwest. The surficial aquifer is not present beneath the feedlot or any of the land application sites. The nearest aquifer is separated from the surface by cohesive soils. Thirty-nine (39) known wells are within a half-mile radius as shown on **Figure 3-18**. No granular soils have been identified on the land application areas or feedlot.

4.0 ENVIRONMENTAL IMPACT OF PROJECT

The project operational details provided in **Section 2.0** and the Environmental Setting data in **Section 3.0** provide the information used to assess the environmental impact of each facility of the project. This assessment is supplemented by the air quality modeling completed by Gantzer Environmental, the findings of which are also summarized in this Section.

The environmental effects are assessed in the following areas of inquiry: air quality; surface water quality; ground water quality; ecological effects, public health, and socioeconomic effects. The section summarizes the positive effects or attributes of the project and the negative effects of the project that may require mitigation.

4.1 AIR QUALITY

Air quality impacts associated with the Hancock Pro-Pork Project were assessed by a two-step process. First, the emission rates of hydrogen sulfide (H_2S), ammonia (NH_3), and 14 volatile odorous organic compounds (VOOCs) were measured at each site. Second, air quality modeling by means of the *CALPUFF* computer model (see **Section 4.1.1**) estimated the property line and offsite concentrations of the emitted gases for each of the Hancock Pro-Pork sites. The major inputs for the air quality modeling effort were the measured onsite emission data, the size and location of each site's livestock barns and manure storage facilities, and the 15 months of onsite weather data collected by the Minnesota Pollution Control Agency at the Hancock Pro-Pork farrowing site from July 30, 1999 to September 30, 2000. The hourly gas concentrations generated by the air quality model were compared to the target concentrations listed in **Table 4-1** to determine the potential for impact. Adverse environmental impacts were considered to be possible when the estimated hourly property-line and off-site concentrations were above the listed target concentrations.

Livestock housing and manure storage facilities emit hydrogen sulfide, ammonia, and volatile odorous organic compounds (VOOCs) that can create odor episodes downwind of livestock operations (Earth Tech 2001). At least 168 individual VOOCs have been identified from liquid swine manure directly and from anaerobic headspace analysis of liquid manure (O'Neil and Phillips 1992). Field studies indicate that about 20 of these VOOCs are routinely found in the atmospheric gas plumes created by hog facilities. The atmospheric VOOCs are predominantly made up of volatile organic acids, phenolic compounds, and substituted heterocyclic compounds (Zahn 1997; Zahn *et al* 1997; Zahn *et al* 2001a).

In developing the methods used in this EIS analysis, Zahn (2001b) conducted field studies to determine simultaneously the atmospheric concentration of VOOCs and odor intensity in the field at 29 different hog production facilities. Odor intensity was measured by the method of direct scaling with reference to two odor standards. Away from the tested plume, the odor panelists evaluated a 220 ppm (v/v) solution of *n*-butanol that was considered to have a neutral odor intensity (odor intensity = 3 out of a 10 scale) and a synthetic swine manure solution (Z2) that was considered to have an unpleasant odor intensity (odor intensity = 6.5 out of a 10 scale). The synthetic swine manure solution mimics the VOOC emissions from hog manure pits located beneath slatted hog barns. After exposure to the two reference odor intensities, the panelists were positioned 1.5-meters from the evaluated hog manure system and asked to compare the odor intensity with the two reference odor standards. Numerical evaluations of odor intensity ranged from neutral (3) to unbearable (10). During the odor intensity evaluation, air was drawn through multimedia sampling tubes. The VOOCs were desorbed from the tube media in the laboratory and analyzed by gas chromatography (Zahn *et al* 1997). (This is a description of the studies Zahn conducted to develop the methods that were used in this EIS analysis; it is not a description of the EIS analysis.)

Figure 4-1 illustrates the observed relationship between total VOOC concentration and odor intensity. Odor intensity and the logarithm (base 10) of the total VOOC concentration ($\mu g/m^3$) in the air emitted from hog facilities were strongly correlated (r^2=0.88). These results, and a comparison of the individual gas chromatograms, indicate that total VOOC concentration, rather than chemical diversity, defines odor intensity. This observation is important because odorant synergisms and antagonisms have been suggested as the most significant obstacle in applying chemical methods to odor measurement (Zahn *et al* 2001b). The field studies described above demonstrate that total VOOC concentration can be used to predict odor intensity associated with hog production sites.

While the target hydrogen sulfide and ammonia concentrations reflect either Minnesota ambient air quality standards or the inhalation Health Risk Values (iHRVs), the target concentrations for the aggregate concentration of the individual VOOCs were used to assess downwind odor intensities. As illustrated in **Figure 4-1**, a total VOOC (tVOOC) concentration of 10 $\mu g/m^3$ approximately corresponds to a detectable swine odor with a "neutral" (not annoying) intensity. A tVOOC concentration of 70 $\mu g/m^3$ approximately corresponds to an "unpleasant" (annoying) odor intensity. Detectability is interpreted from the graph.

The hydrogen sulfide, ammonia, and tVOOC concentrations generated by the air quality modeling were compared to the concentrations listed in **Table 4-1** to assess the potential for environmental impacts. However, this comparison does not fully account for the one-half hour averaging time incorporated into the Minnesota hydrogen sulfide standard. The U.S. EPA air dispersion modeling guidelines (USEPA 1999a) do not provide for averaging times less than one hour. In contrast, the Minnesota ambient air quality standards for hydrogen sulfide are based on average concentrations over a 30-minute time period. Given this mismatch, and to be consistent with past MPCA practice (and the only practical alternative), one-hour average model concentrations are compared to the Minnesota one-half hour H_2S standard.

With regard to odor, the direct scaling method used to develop **Figure 4-1** reflects an instantaneous measurement, which is also mismatched with the one-hour average model time period. This mismatch may have some consequences. For example, an odor intensity that an odor panelist may find to be merely detectable in an instantaneous field measurement could be annoying if present for an hour or longer.

The air quality modeling results are presented as maximum hourly concentrations, maximum 13-week time-averaged concentrations, or maximum annual average concentrations. While a maximum hourly hydrogen sulfide concentration at a site's property line of 35 ppb suggests the potential for a site to exceed the ambient standard, the maximum concentration by itself does not in itself suggest a potential violation of the 30 ppb standard. To determine the potential for a violation, a time series analysis is need in which the frequency of modeled concentrations exceeding 30 or 50 ppb is examined. If the model-generated hourly concentrations at any point along a site's property line exceed 30 ppb more than twice in any 5-day period, then the site is considered to have the potential to violate the 30 ppb standard. If the model-generated hourly concentrations at any property-line point exceed 50 ppb more than twice in any 365-day period, then the site is considered to have a potential violation of the 50 ppb standard.

4.1.1 Modeling Approach

The property-line and off-site atmospheric concentrations of hydrogen sulfide, ammonia, and tVOOC were estimated by use of the *CALPUFF* (version 5.5, level 010730) air quality model (USEPA 1995a Scire *et al* 2000). The *CALPUFF* model can model gas plumes under calm and near-calm wind conditions, which have been shown to be the conditions under which odors are most intense.

On-site weather data were used in estimating the property-line and off-site gas concentrations. The MPCA operated an air quality monitoring station and a meteorological station at the Hancock Pro-Pork farrowing site during parts of 1999 and 2000. The wind direction and wind speed data collected by the on-site weather station from July 30, 1999 to September 30, 2000 were collected every half hour. The hourly averaged wind speeds and wind directions were used in the *CALPUFF* modeling. The on-site weather station recorded wind speeds down to 1 mph (0.447 m/sec). Slower wind speeds were recorded as 0 mph. Air temperatures, atmospheric stability class, and rural mixing heights were determined from the surface weather data for the Minneapolis weather station and from upper air data for the Chanhassen weather station. The surface and upper air weather data sets were obtained from the National Climatic Data Center. The on-site wind data, the Minneapolis surface weather data, and the Chanhassen upper air data were combined into an ISC (Industrial Source Complex) meteorological file. The atmospheric stability classes determined by *PCRAMMET* (USEPA 1999b) were corrected to reflect the on-site wind speeds. To allow use of the 1-mph wind speeds observed by the on-site station, the minimum wind speed allowed for non-calm conditions by *CALPUFF* was changed from the default of 0.5 m/sec to 0.4 m/sec.

Maximum one-hour average concentrations were calculated for each receptor. A receptor is a point at which *CALPUFF* estimates a gas concentration. Rural dispersion coefficients were used to characterize atmospheric mixing. The modeling was conservative (i.e. worst case), in that it assumed no deposition and assumed no decay of any modeled gas due to chemical reactions. The modeled receptor height was 0 meters, i.e. ground level. A flat terrain was assumed. All modeled receptors were defined as discrete receptors. Receptors were spaced along site property lines at 25-meter intervals. Local area modeling had a receptor spacing of 75 meters and covered a 3-mile by 3-mile grid with the modeled site located in the center square mile. Regional modeling had a receptor spacing of 500-meters and covered a 23-mile by 23-mile grid.

All gas emission sources were characterized as line sources, volume sources, or area sources. Livestock barns that are greater than 2 times longer than their width were modeled as line sources. Otherwise, the livestock barns were modeled as volume sources. Outdoor manure storage basins and treatment lagoons were modeled as area sources.

Long, naturally-ventilated livestock barns were modeled as line sources by means of the "approximate approach" described in U.S. EPA air quality modeling documentation (USEPA 1995b). Each barn was represented as a line of square volume subsources separated by a distance that was at least one-half the width of the modeled barn. The resulting square volume subsources were characterized in terms of their location, size, gas emission rate, release height, initial lateral dimension of the volume source, and the initial vertical dimension of the volume source. The sides of each square volume subsource were equal in length to the width of the finishing barn. The distance between the centers of the neighboring square volume subsources was calculated by the following equation:

$$D = W + \frac{L - nW}{n - 1} \tag{4.1}$$

in which D is the distance between volume subsource centers (ft), W is the width of the finishing barn (ft), L is the length of the finishing barn (ft), and n is the number of square volume subsources used to characterize the finishing barn. The second right-hand-side term in equation (4.1) is the distance between the sides of neighboring square volume subsources. The emission rate for each square volume subsource equaled the total emission rate for the finishing barn divided by the number of square volume subsources used to represent the barn. The source height of the emitted gas equaled one-half the height of the barn. The initial lateral dimension was determined by the following equation:

$$\sigma_{yo} = 0.3048\frac{D}{2.15} \tag{4.2}$$

in which σ_{yo} is the initial lateral dimension of the volume subsource (m), D is the center-to-center distance between volume subsources (ft), and 0.3048 converts the units of feet into meters. The initial vertical dimension was obtained from the following equation:

$$\sigma_{zo} = 0.3048\frac{H}{2.15} \tag{4.3}$$

in which σ_{zo} is the initial vertical dimension of the volume subsource (m) and H is the height of the finishing barn (ft).

Short, naturally-ventilated barns were modeled as volume sources characterized by a single square volume subsource. The side length of the square volume subsource was calculated from the following equation:

$$S = \sqrt{LW} \tag{4.4}$$

in which S is the side length (ft). The emission rate for single square volume subsource equaled the total emission rate for the entire barn. The source height of the emitted gas was equal to one-half the height of the barn. The initial lateral dimension was determined by the following equation (USEPA 1995b):

$$\sigma_{yo} = 0.3048\frac{S}{4.3} \tag{4.5}$$

in which σ_{yo} is the initial lateral dimension of the single volume subsource (m), S is the subsource side length (ft), and 0.3048 converts the units of feet into meters. The initial vertical dimension was obtained from equation (4.3).

Long, mechanically ventilated barns were also modeled as line sources using the "approximate approach" (equations 4.1 through 4.3), except the square subsources were characterized as potentially buoyant area sources instead of non-buoyant volume sources. For the Hancock farrowing site, the best fit between the observed and *CALPUFF*-generated hydrogen sulfide concentrations was obtained with an effective rise radius for each square area subsource of 1.6 meters and a rise velocity of 0.0001 m/sec based on the procedures described in U.S. EPA (1992).

Hydrogen sulfide, ammonia, and tVOOC emission rates were assigned to each modeled livestock barn and manure basin. Typically, at least one set of emission measurements was collected for each unique type of livestock barn on a Hancock Pro-Pork site. The only exceptions involved several older straw-pack barns and two barns with shallow pits that were empty of pigs when the barns were sampled (April-May 2001), but housed pigs during the November 2001 site visits. The tVOOC emission rates were determined by adding the emission rates for the 14 constituent volatile odorous organic compounds listed in **Table 4-2**.

The gas emission rates from the sampled hog barns were determined by multiplying the calculated airflow rate by the measured gas concentration:

$$ER = GC\left(\frac{86400\,\text{sec}}{\text{day}}\right)\left(\frac{\text{gram}}{1\bullet 10^{6}\,\mu\text{g}}\right) \tag{4.6}$$

in which *ER* is the emission rate for the sampled barn or room (g/day), *G* is the airflow rate (m^3/sec), and *C* is the measured air-phase concentration ($\mu g/m^3$). Airflow or ventilation rates were estimated by means of the carbon dioxide balance method. For the sampled curtain-sided and naturally-ventilated barns within which the air-phase could be considered completely mixed, the airflow rate was estimated by the following equation (Phillips *et al* 1998):

$$G = \frac{P}{10^{-6}\left(C_{CO2} - 369\right)} \tag{4.7}$$

in which *P* is the carbon dioxide production rate for the housed pigs (m^3/sec), and C_{CO2} is the measured carbon dioxide concentration within the barn (ppm, v/v). The atmospheric carbon dioxide concentration is 369 (ppm, v/v) (Keeling and Whorf 2001). Measured C_{CO2} concentrations less than 550 ppm were set equal to 550 ppm to prevent substantial overestimates of airflow rates (Phillips *et al* 1998). The carbon dioxide production rate was calculated assuming that 1 liter of carbon dioxide is produced per 24.6 kJ of total heat released by the housed animals. Total heat production values for various sizes and types of swine were interpolated from tabulated values (Albright 1990). The carbon dioxide balance approach was also used to estimate airflow rates in mechanically-ventilated rooms (Wood *et al* 2001), except plug-flow conditions were assumed.

Gas samples were typically sampled from the center of the hog barn or room. Carbon dioxide and ammonia concentrations were determined by means of colorimetric tubes (Sensidyne, Inc., Clearwater, FL). Hydrogen sulfide concentrations were measured with a Jerome Hydrogen Sulfide Analyzer (Arizona Instrument, Phoenix, AZ). Individual VOOC concentrations were determined by the method described in Zahn *et al* (1997). About 10 liters of air were drawn through multibed thermal desorption tubes. The tubes were sealed and shipped to the laboratory on dry ice. Analysis consisted of thermal desorption followed by gas chromatography. The methods used for VOOC sampling and analysis were similar to those used to measure the atmospheric concentrations of hazardous industrial volatile organic compounds (U.S. EPA, 1984; Lin, 2001).

Manure samples were collected from the deep pits at the new HPP barns on all sites. The temperature and pH were measured in the field by means of electronic probes. The total dissolved sulfide concentration was measured on a syringe-filtered sample by means of the methylene blue method (Hach Method 8131, which is equivalent to U.S. EPA Method 376.2). Frozen samples were sent to a laboratory for determination of volatile fatty acid, 4-AAP phenols, and ammonia concentrations. A second set of samples was sent to another laboratory for measurement of the individual VOOC concentrations. The solid phase microextraction (SPME) method described in Zahn *et al* (1997) was used to determine the individual VOOC concentrations by gas chromatography.

Ammonia emission rates for the hog barns were also estimated by means of the Battye *et al* (1994, Tables 2-1 and 2-9) "stable + manure" ammonia emission factors for pigs. The ammonia emission factors are 3.18 kg NH_3/head/yr for finishing pigs and 8.09 kg NH_3/head/yr for mature sows. The Battye *et al* ammonia emission factor for housed finishing pigs (3.18 kg NH_3/head/yr) is consistent with a recently determined value of 3.7 kg NH_3/head/yr for a tunnel-ventilated pull-plug finishing barn in North Carolina. Battye *et al* (1994) do not provide an ammonia emission factor for nursery pigs. However, an emission factor of 2.42 kg NH_3/head/yr for breeding sows of 20-50 kg is provided. This lower value was used as the ammonia emission factor for nursery pigs. The Battye emission factors represent ammonia emissions on an annual basis. To account for temperature variations on ammonia emissions from the pitted barns, the respective "stable + manure" ammonia emission factors were multiplied by the monthly scalars listed in **Table 4-3**.

The ammonia emission rates that were determined by the ammonia colorimetric tubes and estimated air exchange rates were always significantly less than the ammonia emission rates obtained from the Battye ammonia emission factors. Instantaneous ammonia emission measurements cannot capture the daily-average ammonia emission rates due to the diurnal changes in hog activity levels and elimination patterns. Hence, the ammonia emission rates for hog barns were based on the Battye ammonia emission factors so that the daily-average ammonia emission rates were incorporated into the air quality modeling.

The emission rate of hydrogen sulfide, ammonia, and VOOCs from the Solvie manure storage basin was calculated based on the dissolved concentration of the volatile chemical species and the overall mass transfer coefficient (WEF 1995).

$$ER = KAC\left(\frac{86400\,\text{sec}}{\text{day}}\right) \tag{4.8}$$

in which *ER* is the emission rate (g/day), *K* is the overall mass transfer coefficient (m/sec), *A* is the basin surface area (m^2), and *C* is the water-phase concentration of the volatile chemical species (g/m^3). For example, while *C* includes the dissolved hydrogen sulfide (H_2S) concentration, it does not include the bisulfide anion (HS^-) concentration. The U.S. EPA recommended algorithms that were used in estimating *K* considered the Henry's Law coefficient for the emitted gas, wind speed, and water temperature (USEPA 1994).

Hourly emission rates for hydrogen sulfide, ammonia, and tVOOC were generated (a *CALPUFF* BAEMARB.DAT file) based on the measured chemistry of the basin, the on-site hourly wind speed, and the hourly water temperature. Hourly temperatures for the modeled manure basin were estimated by the heat balance approach described in Thomann and Mueller (1987). The required hourly solar radiation inputs were estimated by use of the algorithms found in the U.S. EPA's *PCRAMMET* program (USEPA 1999b).

Manure samples were collected from the Solvie manure basin, which is the only operational manure basin at a HPP facility. The temperature and pH were measured in the field by means of electronic probes. The total dissolved sulfide concentration was measured on a syringe-filtered sample by means of the methylene blue method (Hach Method 8131, which is equivalent to U.S. EPA Method 376.2). Frozen samples were sent to a laboratory for determination of volatile fatty acid, 4-AAP phenols, and ammonia concentrations. A second set of samples was sent to another laboratory for measurement of the individual VOOC concentrations. The solid phase microextraction (SPME) method described in Zahn *et al* (1997) was used to determine the individual VOOC concentrations by gas chromatography.

4.1.2 Site Specific Air Effects

The air quality impacts associated with each Hancock Pro-Pork site were assessed by comparing *CALPUFF*-generated property-line and off-site hydrogen sulfide, ammonia, and tVOOC concentrations to the threshold concentrations listed in **Table 4-1**. The *CALPUFF*-generated concentrations were based on the measured emission rates for hydrogen sulfide and tVOOC, published ammonia emission factors, and on-site wind velocities and directions. This approach examined the effect that only the Hancock Pro-Pork sites had on local air quality. The cumulative effect created by non-HPP unmodeled sources in combination with the modeled Hancock Pro-Pork sources was estimated by adding the background concentrations listed in **Table 4-4** to the *CALPUFF*-generated concentrations.

Two sets of hourly hydrogen sulfide background concentrations were used. The first set consists of a 21-ppb background for the 30-ppb, 5-day hydrogen sulfide standard and a 32-ppb background for the 50-ppb, 1-year hydrogen sulfide standard. These values are the background concentrations observed at the Hancock Pro-Pork farrowing site and are considered appropriate for a distance of approximately 3 miles from the farrowing site (MPCA 2002). The Nohl, Olson, and Schaefer sites are located approximately 3 miles from the farrowing site, and these background values therefore apply to those sites as well. The second set of hourly hydrogen sulfide background concentrations consists of a 17-ppb background for the 30-ppb, 5-day hydrogen sulfide standard and an 18-ppb background for the 50-ppb, 1-year hydrogen sulfide standard. These values are the average background concentrations observed for several rural monitoring sites including the Hancock Pro-Pork farrowing site (MPCA 2002). This second set of hourly background concentrations was applied to the Charles, Greiner, Paul, Solvie, Spohr and Zeltwanger sites. This protocol is consistent with MPCA guidance for modeling feedlot emissions (MPCA 2002).

4.1.2.1 Farrowing Site

The Hancock Pro-Pork farrowing site consists of 5 hog barns located on about 19 acres of land. As illustrated in **Figure 4-2**, the property line setback distances for the farrowing site range from 151 to 295 feet. The site's nearest neighbor is 1400 feet west of the site's southwest corner. The dimensions and capacities of the 5 hog barns are provided in **Table 4-5**. Manure and gas samples were collected from the 3 gestation barns. Gas samples were collected from one room in the nursery barn and one room in the farrowing barn.

The gas emission rates calculated from the gas samples and from the Battye ammonia emission factors are provided in **Table 4-6**. No ammonia emissions were assigned to the piglets in the farrowing barn, because their individual weight (less than a maximum of 10-15 pounds) is well below the weights for the Battye emission factors. The listed barn emission rates indicate that the nursery is a large source of hydrogen sulfide, ammonia, and tVOOC emissions relative to the other barns.

The estimated maximum 1-hour property-line concentrations for the farrowing site are provided in **Table 4-7**. The *CALPUFF* modeling results suggest that the farrowing site has the potential to exceed and violate the 30 ppb Minnesota ambient air quality standards for hydrogen sulfide. The estimated maximum hydrogen sulfide concentrations exceed 30 ppb at the north (41.89 ppb) and south (30.01 ppb) property lines. When a background concentration of 21 ppb is added to the *CALPUFF*-generated concentrations, the 30 ppb hydrogen sulfide standard is predicted to be exceeded at all four property lines. Time-series analysis indicates that the *CALPUFF* concentrations without background along the property lines did not exceed 30 ppb more than twice within 5-day periods at any given receptor. However, with the 21-ppb background concentration, at least 3 of the modeled 46 property-line receptors showed potential violations of the 30-ppb standard. The 30-ppb standard was violated 23 times for a receptor along the north property line (directly north of the nursery barn) and 21 times for a receptor along the south property line (directly south of the nursery barn). Thus, the *CALPUFF* results suggest potential violations of the 30-ppb hydrogen sulfide standard when the 21-ppb background concentration is added to the *CALPUFF*-generated concentrations.

The modeling also suggests the potential to exceed and violate the 50-ppb hydrogen sulfide standard. When a background concentration of 32 ppb is added to the *CALPUFF*-generated concentrations, the 50 ppb standard is exceeded at the north and south property lines (**Table 4-7**). Time-series analysis indicates no modeled violations of the 50 ppb standard without the 32-ppb background hydrogen sulfide concentration. However, with the 32-ppb background concentration, at least four of the modeled 46 property-line receptors showed potential violations of the 50-ppb standard. The 50 ppb standard was violated 28 times for a receptor along the north property line and 10 times for a receptor along the south property line.

The maximum 13-week property-line and nearest-neighbor hydrogen sulfide concentrations for the farrowing site are presented in **Table 4-8**. With and without a background concentration of 0.7 ppb, the nearest neighbor and all property-line concentrations are below the sub-chronic hydrogen sulfide iHRV of 7.1 ppb. Thus, the *CALPUFF* results suggest no on-site or off-site potential exceedances of the subchronic iHRV for hydrogen sulfide.

A comparison of the 25 highest hourly concentrations monitored by the MPCA CAM and the 25 highest hourly concentrations estimated by *CALPUFF* is provided in **Figure 4-3**. The *CALPUFF*-generated concentrations are for the location of the air quality monitor based on the 2001 emission measurements, reflecting the July 30, 1999 through September 30, 2000 on-site weather data. The monitored hourly hydrogen sulfide concentrations are for July 30, 1999 through September 30, 2000. The monitor data was screened for wind directions coming from the farrowing site. **Figure 4-3** indicates that the *CALPUFF* results underestimated the CAM results by 0 to 2.5 ppb. Importantly, this indicates strong agreement between the CAM-measured concentrations and the concentrations predicted by the model at the CAM location.

The CAM data from July 1999 through September 2000 indicated no exceedances of the 30 ppb hydrogen sulfide standard, except during manure pit agitation and pumpout. However, caution should be used when citing this monitoring data as an example of compliance with the hydrogen sulfide standard. The air quality monitoring station was not located along the south property line at the location of the modeled highest hydrogen sulfide concentrations. The April 2001 emission measurements suggest that the nursery barn is the farrowing site's largest hydrogen sulfide, ammonia, and tVOOC source. As illustrated in **Figure 4-4**, the *CALPUFF* results suggest that the highest hydrogen sulfide concentrations along the site's south property line will be located directly south of the nursery. The modeling also suggests that the monitoring station is exposed to only about one-third of the maximum hydrogen sulfide concentrations estimated for the south property line.

The relationship between the maximum hourly hydrogen sulfide property-line concentration and the assumed uniform total dissolved sulfide concentration in the 5 manure pits located beneath the farrowing site's hog barns was estimated by the *PitEmissions* software. All manure pits were assumed to have a manure temperature of 10.5°C, a manure pH of 7.22, and the same total dissolved sulfide concentration. As illustrated in **Figure 4-5**, the uniform total dissolved sulfide concentration must be below 4.3 mg S/L for the maximum hourly property line hydrogen sulfide concentration to be below 9 ppb (30 ppb with a 21-ppb background) based on the *CALPUFF* modeling results. This indicates that if the manure hydrogen sulfide concentration can be kept below 4.3 mg S/L, compliance at the fence line can be maintained.

The *CALPUFF*-generated maximum hourly property-line and nearest-neighbor ammonia concentrations for the farrowing site are provided in **Table 4-9**. The highest estimated property line concentration, with a background concentration of 148 $\mu g/m^3$, is 2662 $\mu g/m^3$, which is below the acute ammonia iHRV of 3200 $\mu g/m^3$.

The *CALPUFF*-generated annual-average property-line and nearest-neighbor ammonia concentrations are provided in **Table 4-10**. With a background concentration of 5.72 $\mu g/m^3$, the maximum annual property line concentration is 50.06 $\mu g/m^3$ and the annual nearest neighbor concentration is 8.29 $\mu g/m^3$, which are below the chronic ammonia iHRV of 80 $\mu g/m^3$.

The *CALPUFF*-generated maximum hourly tVOOC concentrations for the farrowing site's property lines and nearest neighbor are provided in **Table 4-11**. The maximum property line tVOOC concentration is 79.2 $\mu g/m^3$, which is greater than the 70$\mu g/m^3$ threshold for annoying odors and suggests the potential for the farrowing site to create annoying off-site odors. However, as illustrated in **Figure 4-6**, by the time an odorous plume reaches the site's nearest neighbor its estimated intensity is reduced to a detectable, but non-annoying odor (*i.e.*, the tVOOC is near 10 $\mu g/m^3$). The *CALPUFF*-generated maximum nearest neighbor tVOOC concentration is 5 times less than the tVOOC concentration associated with "unpleasant" odor intensities.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC are provided in **Figures 4-7**, **4-8**, and **4-9**, respectively. The modeling results indicate that the farrowing site can be responsible for hydrogen sulfide concentrations of 10 ppb (31 ppb with background) up to 0.5 miles from the site. Detectable non-annoying odors (tVOOC concentrations greater than 10 $\mu g/m^3$) can persist for up to 0.8 miles from the site.

4.1.2.2 Charles Site

If built, the Charles site would consist of a single hog-finishing barn located on about 300 acres of land. As illustrated in **Figure 4-10**, the property line setback distances for the site range from 368 to 3800 feet. The site's nearest neighbor is located about 1400 feet west of the proposed hog barn. The dimensions and capacity of the single finishing barn are provided in **Table 4-12**.

Because the barn is not built, the potential emissions for the site were assumed equal to the average measured hydrogen sulfide, ammonia, and tVOOC emission rates for the curtain-sided, deep-pitted finishing barns at the other HPP sites. The average measured emission rates and the ammonia emission rate obtained from the Battye emission factors are provided in **Table 4-13**.

The *CALPUFF* results suggest that the pending Charles hog-finishing site will comply with the Minnesota ambient air quality standard for hydrogen sulfide. The estimated maximum hourly property line and nearest neighbor concentrations for the proposed site are provided in **Table 4-14** and are below 30 ppb. When a background concentration of 17 ppb (v/v) is added to the *CALPUFF*-generated concentration, the maximum estimated property-line hydrogen sulfide concentration is 22.76 ppb, which is below the standard of 30 ppb. As illustrated in **Table 4-15**, the *CALPUFF*-generated maximum 13-week property-line and nearest-neighbor concentrations are below the sub-chronic iHRV of 7.1 ppb.

The *PitEmissions* software estimated the relationship between the maximum hourly hydrogen sulfide property-line concentration and the total dissolved sulfide concentration in the proposed barn's manure pit. The manure pit was assumed to have a manure temperature of 10.5°C and a manure pH of 7.22. As illustrated in **Figure 4-11**, the total dissolved sulfide concentration must be below 22.3 mg S/L for the maximum hourly property-line hydrogen sulfide concentration to be below 13 ppb (30 ppb with a 17-ppb background) based on the *CALPUFF* results.

The maximum hourly time-averaged property-line ammonia concentrations that were estimated by the *CALPUFF* model are provided in **Table 4-16**. The highest estimated property-line concentration with a background concentration of 148 $\mu g/m^3$ is 1024 $\mu g/m^3$, which is below the acute ammonia iHRV of 3200 $\mu g/m^3$. Thus, modeled ammonia emissions from the proposed Charles hog-finishing site are not predicted to cause an exceedance of the acute ammonia iHRV. As illustrated in **Table 4-17**, the *CALPUFF*-generated annual-average property-line and nearest-neighbor ammonia concentrations are below the chronic ammonia iHRV of 80 $\mu g/m^3$.

The *CALPUFF*-generated maximum hourly tVOOC concentrations for the Charles site's property lines are provided in **Table 4.18**. The maximum property-line tVOOC concentration is 20.7 $\mu g/m^3$, which is less than the 70$\mu g/m^3$ threshold for annoying odors and suggests that the Charles will not create annoying off-site odors. As illustrated in **Figure 4-12**, the maximum property-line tVOOC concentration is 3.4 times less than the annoying odor threshold and the maximum nearest-neighbor tVOOC concentration is 12.5 times less than the annoying odor threshold of 70 μg/m^3.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC are provided in **Figures 4-13**, **4-14**, and **4-15**, respectively. The graphs indicate that detectable non-annoying concentrations of hydrogen sulfide (concentrations greater than 3.7 ppb) and tVOOC (concentrations greater than 10 μg/m^3) may exist off-site under certain weather conditions.

4.1.2.3 Greiner Site

The Greiner site consists of a single 208-foot by 41-foot hog-finishing barn. No hog barns were on the site prior to the formation of HPP. As illustrated in **Figure 4-16**, the property line setback distances for the site range from 121 to 4640 feet. The site's nearest neighbor is located about 1-mile west-southwest of the finishing barn. The dimensions and capacity of the single finishing barn are provided in **Table 4-19**. The measured emission rates and the ammonia emission rate obtained from the Battye emission factors are provided in **Table 4-20**.

The *CALPUFF* modeling results suggest that the Greiner hog-finishing site will not exceed the 30-ppb Minnesota ambient air quality standard for hydrogen sulfide. The estimated maximum hourly property-line concentrations for the Greiner site are provided in **Table 4-21**. When a background concentration of 17 ppb (v/v) is added to the *CALPUFF*-generated concentration, the maximum estimated property-line hydrogen sulfide concentration is 27.95 ppb (v/v), which is below the standard of 30 ppb, v/v. Also, the *CALPUFF*-generated maximum 13-week property-line concentration is below the sub-chronic iHRV of 7.1 ppb.

CALPUFF and the *PitEmissions* software were used to estimate the relationship between the maximum hourly hydrogen sulfide property-line concentration and the uniform total dissolved sulfide concentration in the manure pit. The manure pit was assumed to have a manure temperature of 10.5°C and a manure pH of 7.22. As illustrated in **Figure 4-17**, the total dissolved sulfide concentration must be below 11.8 mg S/L in both manure pits for the maximum hourly property-line hydrogen sulfide concentration to be below 13 ppb (30 ppb with a 17-ppb background).

The maximum 1-hour time-averaged property-line ammonia concentrations that were estimated by the *CALPUFF* model are provided in **Table 4-23**. The highest estimated property-line concentration with a background concentration of 148 μg/m^3 is 1803 μg/m^3, which is below the acute ammonia iHRV of 3200 μg/m^3. Thus, the modeling results suggest that the Greiner site does not exceed the acute ammonia iHRV. As illustrated in **Table 4-24**, the *CALPUFF*-

generated annual-average property-line and nearest-neighbor ammonia concentrations are below the chronic ammonia iHRV of 80 μg/m^3.

The *CALPUFF*-generated maximum hourly tVOOC concentrations for the Greiner site's property lines are provided in **Table 4-25**. The maximum tVOOC concentration for the east property line is 54 μg/m^3, which is below the annoying odor threshold of 70 μg/m^3. As illustrated in **Figure 4-18**, the maximum nearest-neighbor tVOOC concentration of 1.22 μg/m^3 is 57 times less than the annoying odor threshold.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC are provided in **Figures 4-19, 4-20**, and **4-21**, respectively. The graphs indicate that detectable non-annoying concentrations of hydrogen sulfide (concentrations greater than 3.7 ppb) may exist off-site. Detectable non-annoying odors (tVOOC concentration greater than 10 μg/m3) may persist for up to 1500 feet from the site. Since the nearest neighbor is a mile away, the modeling thus suggests that the Greiner site would not cause significant odor impacts at receptors.

4.1.2.4 Nohl Site

The Nohl site consists of two hog-finishing barns located on a 6-acre parcel of land. No hog barns were on the site prior to the formation of HPP. As illustrated in **Figure 4-22**, the property line setback distances for the site range from 22 to 401 feet. The dimensions and capacities of the two finishing barns are provided in **Table 4-26**. The hydrogen sulfide, ammonia, and tVOOC emission rates were measured for the north finishing barn. The emission rates for the south finishing barn were assumed to be 95 percent of the north finishing barn, which is the ratio of the barn surface areas. The emission rates for the two barns are provided in **Table 4-27**.

The *CALPUFF*-generated property-line hydrogen sulfide concentrations for the Nohl site are provided in **Table 4-28**. When a background concentration of 21 ppb (v/v) is added to the *CALPUFF*-generated concentrations, the maximum property-line hydrogen sulfide concentrations exceed the 30-ppb standard along the south and west property lines. Time-series analysis indicated that the *CALPUFF*-generated concentrations with the 21 ppb background did not exceed 30 ppb more than twice within any 5-day period at any of the modeled property-line receptors. Thus, the modeled hydrogen sulfide emissions from the Nohl site have the potential to exceed, but not violate, the 30 ppb standard. As illustrated in **Table 4-29**, the *CALPUFF*-generated maximum 13-week property-line and nearest-neighbor concentrations are below the sub-chronic hydrogen sulfide iHRV of 7.1 ppb.

CALPUFF and the *PitEmissions* software were used to estimate the relationship between the maximum hourly hydrogen sulfide property-line concentration and the uniform total dissolved sulfide concentration in the site's two manure pits. The manure pits were assumed to have a manure temperature of 10.5°C and a manure pH of 7.22. As illustrated in **Figure 4-23**, the total dissolved sulfide concentration must be below 6.0 mg S/L for the maximum hourly property-line hydrogen sulfide concentration to be below 9 ppb (30 ppb with a 21-ppb background).

The maximum hourly time-averaged property-line ammonia concentrations that were estimated by the *CALPUFF* model are provided in **Table 4-30**. The highest estimated property-line concentration with a background concentration of 148 $\mu g/m^3$ is 2352 $\mu g/m^3$, which is below the acute ammonia iHRV of 3200 $\mu g/m^3$. Thus, the modeling results suggest that the Nohl site does not exceed the acute ammonia iHRV. As illustrated in **Table 4-31**, the *CALPUFF*-generated annual-average property-line and nearest-neighbor ammonia concentrations are below the chronic ammonia iHRV of 80 $\mu g/m^3$.

The *CALPUFF*-generated maximum hourly tVOOC concentrations for the Nohl site's property lines and nearest neighbor are provided in **Table 4-32**. The maximum tVOOC concentration for the south property line is 49 $\mu g/m^3$, which is below the annoying odor threshold of 70 $\mu g/m^3$. As illustrated in **Figure 4-24**, the maximum nearest-neighbor tVOOC concentration of 3.39 $\mu g/m^3$ is 20 times less than the annoying odor threshold.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC are provided in **Figures 4-25**, **4-26**, and **4-27**, respectively. The off-site graphs illustrate that the *CALPUFF*-generated hydrogen sulfide concentrations greater than 6 ppb (without background) are limited to areas that are within a few hundred feet of the Nohl hog site. Total volatile odorous organic compound (tVOOC) concentrations are reduced to detectable, non-annoying levels (10 $\mu g/m^3$) within 1500 feet of the Nohl hog site.

4.1.2.5 Olson Site

The Olson site consists of three hog-finishing barns on about 154 acres of land. The same three barns were present before the formation of HPP. As illustrated in **Figure 4-28**, the property line setback distances for the site range from 162 to 2184 feet. The dimensions and capacities of the three straw-pack finishing barns are provided in **Table 4-33**. The hydrogen sulfide, ammonia, and tVOOC emission rates were measured for the south barn. The emission rates for the north and middle barns were calculated based on their floor surface areas relative to the south barn. The emission rates for the three barns are provided in **Table 4-34**.

The *CALPUFF* modeling results suggest that the Olson hog-finishing site complies with the Minnesota ambient air quality standard for hydrogen sulfide. The estimated maximum hourly property-line and nearest-neighbor concentrations for the Olson site are provided in **Table 4-35**. When a background concentration of 21 ppb (v/v) is added to the *CALPUFF*-generated concentrations, the maximum estimated property-line hydrogen sulfide concentration is

24.15 ppb (v/v), which is below the ambient standard of 30 ppb. As illustrated in **Table 4-36**, the *CALPUFF*-generated maximum 13-week property-line and nearest-neighbor concentrations are below the sub-chronic hydrogen sulfide iHRV of 7.1 ppb.

The estimated maximum hourly time-averaged property-line ammonia concentrations are provided in **Table 4-37**. The highest estimated property-line concentration with a background concentration of 148 $\mu g/m^3$ is 776 $\mu g/m^3$, which is below the acute ammonia iHRV of 3200 $\mu g/m^3$. Thus, the modeling results suggest that the Olson site does not exceed the acute ammonia iHRV. As illustrated in **Table 4-38**, the *CALPUFF*-generated annual-average property-line and nearest-neighbor ammonia concentrations are below the chronic ammonia iHRV of 80 $\mu g/m^3$.

The *CALPUFF*-generated maximum hourly tVOOC concentrations for the Olson site's property lines are provided in **Table 4-39**. The maximum property-line concentration is 20.41 $\mu g/m^3$ at the north property line. Thus, the modeling suggests detectable (non-annoying) swine odors can exist at the site's north property line. As illustrated in **Figure 4-29**, the estimated maximum nearest-neighbor tVOOC concentration of 2.67 $\mu g/m^3$ is 26 times less than the annoyance odor threshold of 70 $\mu g/m^3$.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC are provided in **Figures 4-30**, **4-31**, and **4-32**, respectively. The off-site graph for tVOOC suggests the potential for detectable (non-annoying) swine odors to exist up to 250-ft north of the Olson site.

4.1.2.6 Paul Site

The Paul site consists of a single 208-foot by 41-foot curtain-sided finishing barn located on about 154 acres of land. No hog barns were on the site prior to the formation of HPP. As illustrated in **Figure 4-33**, setback distances from the site's property lines range from 188 to 2333 feet. The nearest residence is rental property on the Paul property and is located about 1400 feet northeast of the hog-finishing barn. The dimensions and capacity of the site's single finishing barn are provided in **Table 4-40**. The measured emission rates and the ammonia emission rate obtained from the Battye emission factors are provided in **Table 4-41**.

The *CALPUFF*-generated property-line and nearest-neighbor hydrogen sulfide concentrations for the Paul site are provided in **Table 4-42**. When a background concentration of 17 ppb (v/v) is added to the *CALPUFF*-generated concentrations, the maximum estimated property-line hydrogen sulfide concentration is 28.15 ppb, which is below the 30 ppb standard. As provided in **Table 4-38**, the *CALPUFF*-generated maximum 13-week property-line and nearest-neighbor concentrations are below the sub-chronic iHRV of 7.1 ppb.

CALPUFF and the *PitEmissions* software were used to estimate the relationship between the maximum hourly hydrogen sulfide property-line concentration and the total dissolved sulfide concentration in the barn's manure pit. The manure pit is assumed to have a manure temperature of 10.5°C and a manure pH of 7.22. As illustrated in **Figure 4-34**, the total dissolved sulfide concentration must be below 16.02 mg S/L for the maximum hourly property-line hydrogen sulfide concentration to be below 13 ppb (30 ppb with a 17-ppb background).

The estimated maximum hourly property-line and nearest-neighbor ammonia concentrations are provided in **Table 4-44**. The highest estimated property-line concentration with a background concentration of 148 µg/m^3 is 1072 µg/m^3, which is below the acute ammonia iHRV of 3200 µg/m^3. Thus, the modeling results suggest that the Paul site does not exceed the acute ammonia iHRV. As provided in **Table 4-45**, the *CALPUFF*-generated annual property-line and nearest-neighbor ammonia concentrations are below the chronic ammonia iHRV of 80 µg/m^3.

The *CALPUFF*-generated maximum hourly tVOOC concentrations for the Paul site's property lines are provided in **Table 4-46**. The maximum property-line concentration is 28.55 µg/m^3, which is above the 10 µg/m^3 detection threshold and below the 70 µg/m^3 annoyance threshold. As illustrated **Figure 4-35**, the maximum nearest-neighbor tVOOC concentration of 7.29 µg/m^3 is about 9 times less than the annoyance threshold concentration.

The estimated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC are provided in **Figures 4-36**, **4-37**, and **4-38**, respectively. The graphs indicate that detectable non-annoying concentrations of hydrogen sulfide (concentrations greater than 3.7 ppb) and tVOOC (concentrations greater than 10 µg/m^3) may exist off-site under certain weather conditions. **Figure 4-38** suggests the existence of detectable non-annoying tVOOC plumes that extend 1000-feet beyond the site's south property line.

4.1.2.7 Schaefer Site

The Schaefer site currently consists of three small hog barns and two 208-foot by 41-foot hog-finishing barns on about 120 acres of land. The construction of the latter two barns is associated with the formation of HPP. The construction of a third 208 foot by 41 foot finishing barn was proposed, but is currently not being considered. The proposed third finishing barn would be located about 80 feet south of the existing south finishing barn. In addition to modeling the property-line and nearest-neighbor gas concentrations for the exiting two barns, the local air quality impacts potential associated with construction of the proposed third finishing barn was examined. As illustrated in **Figure 4-39**, the property-line setback distances for the existing barns range from 20 to 1794 feet. The site's nearest neighbor is located about 900 feet northwest of the three small hog barns. The dimensions and capacities of the site's currently existing hog barns and the one proposed barn are provided in **Table 4-47**. When the emission measurements were conducted in May 2001, the three small barns were not being used and, hence, the emission rates for the three small barns were not measured. The hydrogen sulfide, ammonia (measured), and tVOOC emission rates for the three small barns were calculated based on the average emission flux rates observed for the Olson and Zeltwanger straw-pack barns. The hydrogen sulfide, ammonia (measured), and tVOOC emission rates for the proposed third finishing barn were assumed to be the average of the values for the existing north and south finishing barns. The measured and calculated emission rates for the five existing Schaefer barns and the proposed third finishing barn are provided in **Table 4-48**.

The *CALPUFF*-generated hourly property-line hydrogen sulfide concentrations for the Schaefer site before and after construction of the two 208-foot by 41-foot finishing barns are provided in **Table 4-49**. Prior to the construction of the two 208-foot by 41-foot barns, the highest *CALPUFF*-generated concentration with a background of 21 ppb is 23.92 ppb, which is below the ambient standard of 30 ppb. After construction of the two barns, maximum *CALPUFF*-generated property-line concentration of 17.01 ppb is predicted at the west property line. When a background concentration of 21 ppb (v/v) is added to the *CALPUFF*-generated concentrations, the maximum estimated hydrogen sulfide concentrations for the west and north property lines exceed 30 ppb. A time-series analysis indicates that the predicted hydrogen sulfide concentrations along west property line may violate the 30-ppb, 5-day standard (more than 2 exceedances of 30 ppb within any 5-day period). No violations were predicted for the north property line. As illustrated in **Table 4-50**, the *CALPUFF*-generated maximum 13-week property-line and nearest-neighbor concentrations for the existing barns are below the sub-chronic iHRV of 7.1 ppb.

If the proposed finishing barn is built, then the *CALPUFF* results suggest potential violations of the 30-ppb hydrogen sulfide standard along both the west and north property lines. The *CALPUFF*-generated maximum hourly property-line and nearest-neighbor hydrogen sulfide concentrations associated with the construction of the north, south, and proposed third finishing barns are provided in **Table 4-51**. With a background concentration of 21 ppb, the maximum hourly hydrogen sulfide concentrations for the west and north property lines are 40.03 and 35.21 ppb, respectively. A time-series analysis indicate that hydrogen sulfide concentrations greater than 30 ppb (with background) would occur more than twice within several five-day periods for the west and north property lines. While the west property line has the predicted potential to exceed 50 ppb with a background concentration of 32 pp, time-series analyses showed no predicted violations of the 50-ppb, 1-year standard. As illustrated in **Table 4-52**, the *CALPUFF*-generated maximum 13-week property-line and nearest-neighbor concentrations with the construction of the north, south, and proposed third finishing barns are below the sub-chronic iHRV of 7.1 ppb.

CALPUFF and the *PitEmissions* software were used to estimate the relationship between the maximum hourly hydrogen sulfide property-line concentration and the uniform total dissolved sulfide concentration in the manure pits located beneath the north and south finishing barns. In this analysis, the hydrogen sulfide emissions from the three small barns were assumed to have a insignificant effect on west property-line hydrogen sulfide concentrations. The two manure pits were assumed to have a manure temperature of 10.5°C and a manure pH of 7.22. As illustrated in **Figure 4-40**, the total dissolved sulfide concentration in the two existing manure pits must be below 6.4 mg S/L for the maximum hourly west property-line hydrogen sulfide concentration to be below 9 ppb (30 ppb with a 21-ppb background). If the proposed finishing barn were built, then the required uniform total dissolved sulfide concentration for the resulting three manure pits would drop to 5.1 mg S/L.

The maximum 1-hour time-averaged property-line ammonia concentrations that were estimated by the *CALPUFF* model for before and after construction of the existing two 208-ft by 41-ft barns are provided in **Table 4-53**. Before construction, the highest estimated property-line concentration with a background concentration of 148 $\mu g/m^3$ is 872 $\mu g/m^3$, which is below the acute ammonia iHRV of 3200 $\mu g/m^3$. After construction, the highest estimated property-line concentration with a background concentration of 148 $\mu g/m^3$ is 2212 $\mu g/m^3$, which is also below the acute iHRV for ammonia. Thus, the modeling results suggest that the Schaefer site continues to have property-line ammonia concentrations below the acute ammonia iHRV. If the proposed finishing barn were built, then the estimated maximum property-line ammonia concentration with background is 2322 $\mu g/m^3$ (**Table 4-54**). As illustrated in **Table 4-55**, the *CALPUFF*-generated annual-average ammonia concentrations along all property lines and at the nearest neighbor are below the chronic ammonia iHRV of 80 $\mu g/m^3$. This remains the case if the proposed finishing barn were to be built (**Table 4-56**).

The *CALPUFF*-generated property-line and nearest-neighbor tVOOC concentrations before and after construction of the existing two 208-ft hog barns are provided in **Table 4-57**. Without the two barns, the maximum estimated tVOOC concentration is 13.41 $\mu g/m^3$. With the two barns, the maximum estimated tVOOC concentration is 83.55 $\mu g/m^3$ along the west property line, which represents an annoying swine odor. As illustrated **Figure 4-41**, the maximum nearest-neighbor tVOOC concentration of 36.06 $\mu g/m^3$ is about one-half the annoyance threshold concentration of 70 $\mu g/m^3$. If the proposed finishing barn were to be built, the estimated maximum tVOOC concentrations for the west property line and the site's nearest neighbor are 85.95 and 48.88 $\mu g/m^3$, respectively (**Table 4-58**). Thus, the modeling suggests that the Schaefer site (with two or three barns) can create annoying off-site odors along the west property line, but that annoying odors do not reach the nearest neighbor.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC representing the local air quality before the construction of the 208-foot barns are provided in **Figures 4-42**, **4-43**, and **4-44**, respectively. The off-site graph for tVOOC suggests the potential for detectable (non-annoying) swine odors to persist for about 200 feet beyond the site's west property line.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC representing the local air quality after the construction of the existing two 208-foot barns are provided in **Figures 4-45**, **4-46**, and **4-47**, respectively. The off-site graph for tVOOC suggests the potential for detectable (non-annoying) swine odors to persist for up to 2000 feet beyond site's west property line.

The estimated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC assuming the subsequent construction of the proposed finishing barn are provided in **Figures 4-48**, **4-40**, and **4-50**. With the three 208-foot finishing barns, the modeling suggests the potential for tVOOC concentrations greater than 70 $\mu g/m^3$ (annoying swine odors) to exist up to 250 feet beyond the site's west property line

4.1.2.8 Solvie Site

As shown in **Figure 4-51**, the Solvie site currently consists of three hog barns and one manure basin located on about 300 acres of land. The old barn is a 138-foot by 36-foot straw-pack barn. The south finishing barn is a 160-foot by 41-foot curtain-sided barn with a shallow manure pit that drains into the 140-foot by 110-foot manure basin. The north finishing barn is a 208-foot by 41-foot curtain-sided barn with a deep manure storage pit. The construction of the north finishing barn is associated with the formation of HPP. The present property line setback distances range from 609 to 3451 feet. The nearest off-site neighbor is located about 1700 feet west of the site. The dimensions and capacities of the three barns are provided in **Table 4-59**. The emission rates of both the north and south finishing barns were measured. The emission rates for the old barn were calculated based on the average emission fluxes observed for the Olson and Zeltwanger straw-pack barns. The measured and calculated emission rates for the three Solvie barns are provided in **Table 4-60**.

The estimated hydrogen sulfide, ammonia, and tVOOC emission rates for the manure basin varied hourly with changes in wind speed and air temperature. The basin emission rates were based on the measured chemical parameters of basin samples collected on May 4, 2001. The estimated noon-hour basin water temperatures from July 30, 1999 through September 30, 2000 are provided in **Figure 4-52**. When the estimated water temperature dropped to 0°C and below, the basin was assumed to have an ice cover and gas emission rates went to zero. The calculated noon-hour hydrogen sulfide, ammonia, and tVOOC emission flux rates for the Solvie manure basin are provided in **Figures 4-53**, **4-54**, and **4-55**, respectively.

The *CALPUFF*-generated property-line hydrogen sulfide concentrations for the Solvie site before and after construction of the north finishing barn are provided in **Table 4-61**. Prior to the construction of the north finishing barn, the highest *CALPUFF*-generated concentration with a background of 17 ppb is 39.14 ppb, which is above the ambient standard of 30 ppb. After construction of the north finishing barn, the highest *CALPUFF*-generated concentration with a background of 17 ppb is 39.33, which is also above the ambient standard of 30 ppb. A time-series analysis indicates that the occurrences of hydrogen sulfide concentrations greater than 30 ppb (with background) at points along the south property line do not occur within any 5-day period. While the modeling results indicate maximum property-line hydrogen sulfide concentrations greater than 30 ppb, the modeling results do not indicate violations of the 30 ppb standard. As illustrated in **Table 4-62**, the *CALPUFF*-generated maximum 13-week property-line and nearest-neighbor concentrations are below the sub-chronic iHRV of 7.1 ppb.

The maximum hourly time-averaged property-line ammonia concentrations that were estimated by the *CALPUFF* model for before and after construction of the north finishing barn are provided in **Table 4-63**. Before construction, the highest estimated property-line concentration with a background concentration of 148 $\mu g/m^3$ is 1037 $\mu g/m^3$, which is below the acute ammonia iHRV of 3200 $\mu g/m^3$. After construction, the highest estimated property-line concentration with a background concentration of 148 $\mu g/m^3$ is 1409 $\mu g/m^3$, which is also below the acute iHRV for ammonia. Thus, the modeling results suggest that the Solvie site continues to have property-line ammonia concentrations below the acute ammonia iHRV. As illustrated in **Table 4-64**, the *CALPUFF*-generated annual-average ammonia concentrations along all property lines and at the nearest neighbor are below the chronic ammonia iHRV of 80 $\mu g/m^3$.

The *CALPUFF*-generated property-line and nearest-neighbor tVOOC concentrations before and after construction of the north finishing barn are provided in **Table 4-65**. Without the north finishing barn, the maximum property-line tVOOC concentration is 41.22 $\mu g/m^3$. With the north finishing barn, the maximum property-line tVOOC concentration is 48.78 $\mu g/m^3$, which is considered to represent a detectable swine odor that is below the annoyance threshold of 70 $\mu g/m^3$. As illustrated in **Figure 4-56**, the maximum nearest-neighbor tVOOC concentration of 13.32 $\mu g/m^3$ is 5 times less than the annoying odor threshold concentration.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC representing the local air quality before construction of the north finishing barn are provided in **Figures 4-57**, **4-58**, and **4-59**, respectively. The off-site graph for tVOOC suggests the potential for detectable (non-annoying) swine odors to persist for up to 1600 feet beyond site's south property line.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC representing the local air quality after construction of the north finishing barn are provided in **Figures 4-60**, **4-61**, and **4-62**, respectively. The off-site graph for tVOOC suggests the potential for detectable (non-annoying) swine odors to persist for up to 2000 feet beyond site's south property line.

4.1.2.9 Spohr Site

As shown in **Figure 4-63**, the Spohr site currently consists of three hog barns. The north barn is a 70-foot by 60-foot straw-pack barn. The east barn is a mechanically ventilated finishing barn with a shallow manure pit. The south barn is a 208-foot by 41-foot curtain-sided barn with a deep manure pit. This deep pit also receives manure from the east barn. Only the south barn is associated with the formation of HPP. Prior to the construction of the south barn, manure from the east barn drained into an 85-foot by 85-foot manure basin, which was located near the east end of the present south barn. The current property-line setbacks range from 155 feet to over 3672 feet. The site's nearest neighbor is located about 1800 feet southwest of the south barn. The dimensions and capacities of the three existing hog barns are provided in **Table 4-66**.

When the emission rates for the south barn were measured in April 2001, no pigs were present in the north and east barns and emission rates were not measured for these two barns. The emission rates for the north barn were calculated based on the average emission fluxes observed for the Olson and Zeltwanger straw-pack barns. The emission rates for the east barn were calculated based on the emission flux rates observed for the south finishing barn at the Solvie site. The measured and calculated emission rates for the three Spohr barns are provided in **Table 4-67**. In calculating the hourly emission flux values for the non-existent manure basin, the chemical characteristics of the Solvie basin were assumed to be applicable. The resulting hourly temperature and emission flux rates are similar to those illustrated in **Figures 4-52** through **4-55** for the Solvie basin.

The *CALPUFF*-generated property-line hydrogen sulfide concentrations for the Spohr site before and after the replacement of the manure basin with the south barn are provided in **Table 4-68**. Prior to the replacement of the manure basin with the south barn, the highest *CALPUFF*-generated concentration with a background of 17 ppb is 37.34 ppb, which is above the ambient standard of 30 ppb. After replacement of the manure basin with the south barn, the highest *CALPUFF*-generated concentration with a background of 17 ppb is 23.19 ppb, which is below the ambient standard of 30 ppb. As illustrated in **Table 4-69**, the *CALPUFF*-generated maximum 13-week property-line concentration is below the sub-chronic hydrogen sulfide iHRV of 7.1 ppb. The HPP associated expansion of the Spohr site by 300 AU resulted in decreased property-line and nearest-neighbor hydrogen sulfide concentrations, because a deep-pitted barn replaced a manure basin.

CALPUFF and the *PitEmissions* software were used to estimate the relationship between the maximum hourly hydrogen sulfide property-line concentration and the uniform total dissolved sulfide concentration in the manure pits located beneath the east and south barns. In this analysis, the hydrogen sulfide emissions from the north barn were assumed to have an insignificant effect on west property-line hydrogen sulfide concentrations. The two manure pits were assumed to have a manure temperature of 10.5°C and a manure pH of 7.22. As illustrated in **Figure 4-64**, the total dissolved sulfide concentration in both manure pits must be below 9.2 mg S/L for the maximum hourly west property-line hydrogen sulfide concentration to be below 13 ppb (30 ppb with a 17-ppb background).

The maximum hourly time-averaged property-line and nearest-neighbor ammonia concentrations that were estimated by the *CALPUFF* model for before and after replacement of the manure basin with the south barn are provided in **Table 4-70**. Before replacement, the highest estimated property-line concentration with a background concentration of 148 $\mu g/m^3$ is 1144 $\mu g/m^3$, which is below the acute ammonia iHRV of 3200 $\mu g/m^3$. After replacement, the highest estimated property-line concentration with a background concentration of 148 $\mu g/m^3$ is 1555 $\mu g/m^3$, which is also below the acute iHRV for ammonia. Thus, the modeling results suggest that the Spohr site continues to have property-line ammonia concentrations below the acute ammonia iHRV. As provided in **Table 4-71**, the *CALPUFF*-generated annual-average ammonia concentrations along all property lines and at the nearest neighbor are below the chronic ammonia iHRV of 80 $\mu g/m^3$.

The *CALPUFF*-generated property-line and nearest-neighbor tVOOC concentrations before and after the replacement of the manure basin with the south barn are provided in **Table 4-72**. With the manure basin, the maximum property-line tVOOC concentration is 60.96 $\mu g/m^3$. With the deep-pitted south barn, the maximum property-line tVOOC concentration is 35.88 $\mu g/m^3$, which represents a detectable swine odor that is below the annoyance threshold of 70 $\mu g/m^3$. The replacement of the manure basin with the south barn resulted in lower tVOOC concentrations. As illustrated in **Figure 4-65**, the maximum nearest-neighbor tVOOC concentration after the construction of the south barn of 7.54 $\mu g/m^3$ is 9 times less than the odor annoyance threshold concentration.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC representing the local air quality before replacement of the manure basin with the south barn are provided in **Figures 4-66**, **4-67**, and **4-68**, respectively. The off-site graph for tVOOC suggests the potential for detectable (non-annoying) swine odors to persist for up to 1300 feet beyond the site’s west property line.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC representing the local air quality after replacement of the manure basin with the south barn are provided in **Figures 4-69**, **4-70**, and **4-71**, respectively. The off-site graph for tVOOC suggests the potential for detectable (non-annoying) swine odors to persist for up to 1300 feet beyond Spohr's west property line.

4.1.2.10 Zeltwanger Site

The Zeltwanger site consists of three straw-pack hog-finishing barns on about 300 acres of land. As illustrated in **Figure 4-72**, the property line setback distances for the site range from 184 to 3369 feet. The site's nearest neighbor is located about 1300 feet west-southwest of the hog barns. The dimensions and capacities of the three straw-pack finishing barns are provided in **Table 4-73**. The hydrogen sulfide, ammonia, and tVOOC emission rates were measured for the west barn. The emission rates for the east and south barns were calculated based on their floor surface areas relative to the west barn. The various emission rates for the three barns are provided in **Table 4-74**.

The *CALPUFF* modeling results suggest that the Zeltwanger hog-finishing site complies with the Minnesota ambient air quality standard for hydrogen sulfide. The estimated maximum hourly property-line and nearest-neighbor concentrations for the Zeltwanger site are provided in **Table 4-75**. When a background concentration of 17 ppb (v/v) is added to the *CALPUFF*-generated concentration, the maximum estimated property-line hydrogen sulfide concentration is 20.41 ppb (v/v), which is below the ambient standard of 30 ppb. As illustrated in **Table 4-76**, the *CALPUFF*-generated maximum 13-week property-line and nearest-neighbor concentrations are below the sub-chronic hydrogen sulfide iHRV of 7.1 ppb.

The maximum hourly time-averaged property-line and nearest-neighbor ammonia concentrations that were estimated by the *CALPUFF* model are provided in **Table 4-77**. The highest estimated property-line concentration with a background concentration of 148 $\mu g/m^3$ is 988 $\mu g/m^3$, which is below the acute ammonia iHRV of 3200 $\mu g/m^3$. Thus, the modeling results suggest that the Zeltwanger site does not exceed the acute ammonia iHRV. As illustrated in **Table 4-78**, the modeled annual property-line and nearest-neighbor ammonia concentrations are below the chronic ammonia iHRV of 80 $\mu g/m^3$.

The *CALPUFF*-generated maximum hourly tVOOC concentrations for the Zeltwanger site's property lines and nearest neighbor are provided in **Table 4-79**. The maximum property-line concentration is 6.8 $\mu g/m^3$ at the south property line, which is less than the 10 $\mu g/m^3$ threshold for detectable (non-annoying) swine odors. As illustrated in **Figure 4-73**, the maximum nearest-neighbor tVOOC concentration of 1.72 $\mu g/m^3$ is 40 times less than the annoying odor threshold concentration of 70 $\mu g/m^3$.

The *CALPUFF*-generated off-site concentrations of hydrogen sulfide, ammonia, and tVOOC for the Zeltwanger site are provided in **Figures 4-74**, **4-75**, and **4-76**, respectively. The graphs suggest that no significant off-site plumes relative to the threshold concentrations listed in **Table 4-1** exist for the Zeltwanger site.

4.1.2.11 Summary of Site Specific Air Effects

The *CALPUFF* air quality model estimated the property-line and off-site concentrations of hydrogen sulfide, ammonia, and tVOOC for the 10 Hancock Pro-Pork sites. The *CALPUFF*-generated concentrations were compared to the concentration thresholds for potential environmental effects listed in **Table 4-1**. Except for the farrowing site, all sites complied with the 50-ppb ambient air quality standard for hydrogen sulfide. All sites had 13-week time-averaged property-line hydrogen sulfide concentrations that did not exceed the sub-chronic hydrogen sulfide iHRV of 10 $\mu g/m^3$. All sites had hourly property-line ammonia concentrations that did not exceed the acute ammonia iHRV of 3200 $\mu g/m^3$. All sites had annual property-line ammonia concentrations that did not exceed the chronic ammonia iHRV of 80 $\mu g/m^3$.

The modeled ability of the sites to not exceed the various hourly threshold concentrations for hydrogen sulfide and tVOOC varies from site to site. As indicated in **Table 4-80**, the farrowing, Nohl, Schaefer (existing), Schaefer (third barn), and Solvie sites have the modeled potential to exceed 30 ppb hydrogen sulfide standard at their property lines. However, time series analysis indicated that only the farrowing, Schaefer (existing), and Schaefer (proposed) sites have the potential to violate the 30 ppb hydrogen sulfide standard. The modeling results also suggest the potential for the farrowing, Schaefer (existing), and Schaefer (proposed) sites to generate off-site episodes of annoying odors based on the hourly tVOOC concentrations at the property lines.

4.1.3 Regional Air Quality Effects

Regional air quality modeling was performed to assess the potential for emissions from the HPP sites to combine with emissions from neighboring sources to cause significant cumulative impacts on regional air quality. In a previous study of cumulative effects for the region, modeled hourly concentrations of hydrogen sulfide exceeded 30 ppb for distances up to 7.8 kilometers downwind of feedlots (MPCA 1998). The modeled long plumes of elevated hydrogen sulfide and ammonia concentrations suggested the strong potential for adverse cumulative effects. However, such long plumes are considered to be an artifact of the steady-state Gaussian plume model used in the study.

The modeled regional sources were the 10 HPP sites, 13 non-HPP sites that consisted of hog barns, and 15 non-HPP sites having outdoor storage basins holding either swine or dairy manure. Emissions from the modeled non-HPP hog barns were assumed to have emission flux rates equal to the average of the 7 sampled HPP deep-pitted barns. The modeled swine manure basins were assumed to have the same chemical characteristics as the sampled Solvie manure basin. The modeled dairy basins were assumed to have a pH of 7.8, a dissolved volatile organic acid concentration of 1860 mg/L, a total dissolved phenol concentration of 5.1 mg/L, a total dissolved sulfide concentration of 0.7 mg S/L, and a dissolved ammonia-nitrogen concentration of 815 mg N/L. All swine and dairy manure basins were assumed to be crust-free. The locations and dimensions of the non-HPP sources were obtained from the previous regional study MPCA 1998). The locations of the 38 modeled feedlot sources are plotted in **Figure 4-77**.

A set of 5,625 receptors was used to characterize the regional gas concentrations. The receptors were arranged in a 75 by 75 receptor grid with a spacing of 500 meters. The southwest corner of the receptor grid had an x-coordinate of 10 km east and a y-coordinate of 9 km north. The coordinates of the grid's northeast corner were 47 km east and 46 km north.

The pre-Hancock regional hydrogen sulfide, ammonia, and tVOOC concentrations are provided in **Figures 4-78**, **4-79**, and **4-80**, respectively. The *CALPUFF* results indicate that the highest concentrations tend to be centered on the individual feedlot sources. There are no plumes of elevated gas concentrations that extend for kilometers downwind of sources. In general, the *CALPUFF* results suggest that air quality effects associated with feedlot emissions are localized within a half-mile of a feedlot. However, the one noticeable exception is the cluster of 3 non-HPP feedlots located about 6 miles east-southeast of Morris. The close proximity of the 3 feedlots results in a common area of elevated gas concentrations. Except for this 3-feedlot cluster, the pre-HPP regional modeling results suggest that cumulative effects play a small role in defining air quality impacts. To the extent that the feedlots in question inject their manure, as many do, the adverse effects are even further reduced.

The post-HPP regional hydrogen sulfide, ammonia, and tVOOC concentrations are provided in **Figures 4-81**, **4-82**, and **4-83**. In general, the construction or expansion at the HPP sites results in the formation of additional isolated areas of elevated gas concentrations. The HPP sites are located sufficiently far from one another and from the modeled non-HPP sites so that no cumulative effects are observed. The one exception appears to be the Nohl site (4 miles southeast of the Town of Hancock), which shares a 3-ppb hydrogen sulfide isopleth and a 10-$\mu g/m^3$ tVOOC isopleth with a neighboring feedlot located to Nohl's south-southeast. The two sites do not share the plotted 500-$\mu g/m^3$ ammonia isopleth.

In summary, the regional *CALPUFF* results suggest that the HPP sites are located sufficiently far from one another and from the modeled non-HPP sites so that cumulative impacts appear to be insignificant with regard to standards violations.

4.2 GROUND WATER

4.2.1 Site Specific Effects

4.2.1.1 Farrowing Facility

As discussed in **Section 3.8.1**, the surficial aquifer exists beneath nearly all land available for land application of manure associated with the farrowing facility and ground water is approximately 10 feet bgs. Approximately 80 percent of the soils identified in the land application sites and feedlot are granular. Soil slopes are nearly level to gently sloping. Manure application rates on land application fields follow the recommended agronomic rates calculated based on manure and soil nutrient content and expected crop yields. However, the combination of granular soils and the close proximity of the ground water to the surface elevates the potential for contamination of local ground water. Restricting manure application on granular soils to the spring would reduce the risk of ground water contamination. In addition, ground water in the area appears to be "nitrate unstable," thus providing some natural protection to mitigate nitrate impacts.

Fifty-five wells were identified within one-half mile of the land application areas associated with the farrowing facility. Uses of the wells include twenty-eight for irrigation purposes and twenty-seven for domestic water supply. Ten of the wells are completed in the surficial aquifer and 17 wells are completed in buried glacial drift aquifers. The majority of the wells without an aquifer designation are shallow and likely utilize the surficial aquifer.

The MPCA completed a preliminary ground water investigation at the farrowing site in 2000, which included installation of 9 temporary wells and the collection of ground water samples. The ground water samples were primarily collected from the water table, which would represent the location of anticipated maximum impact. The data showed nitrate levels above the HRL in some shallow samples. As expected, the water table had relatively high dissolved oxygen and was a non-reducing ("nitrate stable") environment. Therefore, nitrate would persist there. However, when a sample was obtained from deeper within the surficial aquifer, nitrate was not detected, dissolved oxygen was low and the environment was more reducing. This suggests denitrification is occurring with depth within the surficial aquifer. See **Section 3.3.2** for a more in-depth discussion.

Manure storage at the farrowing facility is provided by five concrete pits, with a combined capacity of 4.2 million gallons. The pits built at the farrowing facility are poured concrete, one of the better options for minimizing leakage to ground water (Mulla *et al* 2001). Risks to ground water posed by leaks from the concrete storage pits appear minimal based on the MPCA ground water quality investigation in 2000.

If a manure spill or an overflow of manure from the pits were to occur, it may impact the surficial ground water quality. The facility has not reported a manure spill or pit overflow during its operational history.

4.2.1.2 Charles

As discussed in **Section 3.8.2**, the surficial aquifer does not appear to exist beneath any land available for land application of manure associated with the Charles facility. The Stevens County soil atlas indicates all soils present in the potential manure land application areas consist of silt or clay loams. Soil slopes are nearly level to gently sloping. The risk of impacting ground water is minimal from manure land application on the Charles fields.

Eleven wells were identified within one-half mile of potential manure land application areas associated with the Charles facility. The wells include eight for domestic water supply, one of unknown use, and two City of Hancock municipal supply wells. Ten of the eleven wells are noted as being finished in a buried aquifer (one finished at unknown aquifer and depth). The municipal wells are located within the city of Hancock and not within or near any spreading fields. Since the surficial aquifer is not present in the area, the unknown well is likely a buried aquifer well. Risks of impact to all the identified domestic water supply wells appear minimal as cohesive soils are present, and all identified domestic water supply wells utilize buried aquifers.

Manure storage at the Charles facility would be provided by one 435,000-gallon underbarn concrete storage pit. Risks to ground water posed by leaks from the concrete storage pit appear minimal based on the cohesive nature of the soil in the area and the nature of poured concrete pits.

If a manure spill or an overflow of manure from the pits were to occur, it would be unlikely to impact ground water quality due to the cohesive soils and depth to ground water in the area.

4.2.1.3 Greiner

The surficial aquifer does not appear to exist beneath any land available for land application of manure associated with the Greiner facility. The Pope County soil atlas indicates all soils present in the manure land application areas consist of silt or clay loams. Soil slopes are described as level to undulating and rolling. The risk of impacting ground water is minimal from manure land application to the Greiner fields.

Two (2) wells were identified within one-half mile of manure land application areas associated with the Greiner Facility. Both wells are for domestic water supply and completed in buried aquifers. Although regional ground water flow is primarily to the south, local ground water flow may be affected by the proximity of Lake Emily, north of the Greiner Facility. Risks of impact to the two identified domestic water supply wells appear minimal as they utilize buried aquifers.

Manure storage at the Greiner Facility is provided by one 435,000-gallon concrete storage pit. Risks to ground water posed by leaks from the concrete storage pit appear minimal based on the cohesive nature of soil in the area and the nature of poured concrete pits.

If a manure spill or an overflow of manure from the pits were to occur, it would be unlikely to impact ground water quality due to the cohesive soils and depth to ground water in the area. The facility has not reported a manure spill or pit overflow during its operation history.

4.2.1.4 Nohl

The surficial aquifer exists beneath all land available for land application of manure associated with the Nohl facility. This aquifer lies approximately 10 feet bgs and generally flows southeast with a saturated thickness of approximately 20 to 40 feet. The Stevens County soil atlas indicates that the soils present in the potential manure land application areas are generally granular sandy loams. Surface slopes are nearly level to gently sloping. The combination of granular soils and the close proximity of the ground water to the surface elevates the potential for contamination of surficial ground water.

Fourteen (14) wells were identified within one-half mile of potential manure-land application areas associated with the Nohl Facility. The wells include three (3) domestic water supply wells and eleven (11) irrigation wells. Ten of the irrigation wells utilize the surficial aquifer. All three of the domestic wells utilize the buried aquifers. Risks of impact to the irrigation wells that utilize the surficial aquifer may be elevated due to the presence of a shallow water table and granular soils. Risks of impact to the domestic water supply wells appear minimal as they utilize a buried glacial drift aquifer.

Manure storage at the Nohl facility is provided by two concrete storage pits with a combined capacity of 853,000 gallons. Risks to ground water posed by leaks from the concrete storage pits appear minimal.

4.2.1.5 Olson

The surficial aquifer appears to exist beneath all land available for land application of manure associated with the Olson facility. This aquifer lies approximately 10 feet bgs and generally flows south or southeast with a saturated thickness of approximately 20 feet. The Stevens County soil atlas indicates that soils present in the manure land application areas consist of both cohesive and granular soils. Cohesive silt and clay loams occupy manure land application areas in T123N R41W Section 27 and the eastern portion of the Olson facility in T123N R41W

Section 26. Granular soils occupy the central portion of the Olson facility. Slopes are nearly level to gently sloping. The combination of granular soils and the close proximity of the ground water to the surface elevates the potential for contamination of surficial ground water. However, risks to ground water appear minimal due to the relatively low volume of solid manure that is produced at this facility. Manure applied on Olson’s land by the farrowing facility must be applied in the spring if the fields used for this purpose are composed of granular soils, or, alternatively, the farrowing facility’s MMP must be updated to show how fall application would not harm groundwater.

Eighteen (18) wells were identified within one-half mile of manure land application areas associated with the Olson Facility. One (1) is a domestic water supply well, ten (10) are irrigation wells and seven (7) are test wells. The single domestic well is a shallow well that utilizes the surficial aquifer. Risks of impact to the wells, including the domestic supply well, that utilize the surficial aquifer may be elevated due to the presence of a shallow water table and granular soils.

Ten temporary monitoring wells were installed and sampled at the Olson site by the MPCA. Two of the samples detected nitrate above 10 mg/l. Both samples were collected from the water table and located directly down gradient from the facility’s open lot. A sample collected from a deeper portion of the surficial aquifer did not detect nitrate. This suggests denitrification is occurring with depth within the surficial aquifer.

4.2.1.6 Paul

The surficial aquifer does not appear to exist beneath any land available for land application of manure associated with the Paul facility. The Stevens County soil atlas indicates all soils present in the manure land application areas consist of silt or clay loams except for a small area in the northeast quarter of T123N R42W, Section 15. Soils in this area consist of gravelly sandy loam. Slopes are nearly level to gently sloping. Records indicate that the facility does not over apply manure to available fields. The risk of impacting ground water is, therefore, minimal from manure land application to the Paul fields.

Twelve (12) wells were identified within one-half mile of manure land application areas associated with the Paul facility. Uses of the wells include six (6) for domestic water supply and four (6) for irrigation. Since all of the identified domestic water supply wells are completed in buried aquifers, the surficial aquifer does not appear to exist beneath any of the manure land application areas associated with the Paul facility, and cohesive soils are present in nearly all areas, risks to users of ground water appear minimal.

Manure storage at the Paul facility is provided by one 435,000-gallon concrete storage pit. Risks to ground water posed by leaks from the pit appear minimal due to the cohesive soils present at the site and storage in an engineered concrete pit.

4.2.1.7 Schaefer

The surficial aquifer exists beneath certain manure land application areas available to the Schaefer facility in T123N R41W Section 22. The aquifer lies approximately 20 feet bgs and generally flows southeast with a saturated thickness of zero to 20 feet. The Stevens County soil atlas indicates nearly all soils present in the manure land application areas consist of silt or clay loams. Slopes are nearly level to gently sloping. Available records indicate that the facility does not over apply manure to available fields. Therefore, the risk of impacting ground water is minimal from manure land application to the Schaefer fields.

Sixteen wells were identified within one-half mile of manure land application areas associated with the Schaefer Facility. Uses of the wells include five for domestic water supply, six for irrigation, three designated as test wells, and two of unknown use. All of the domestic water supply wells are completed within buried aquifers. Risks of impact to the identified domestic water supply wells therefore appear minimal.

Two temporary monitoring wells were installed and sampled at the Schaefer site by the MPCA. Some samples indicated nitrate levels above the HRL. However, the data are inconclusive regarding the potential for impact. Collection of samples was difficult owing to the cohesive nature of the area's soil and the resulting very slow water level recovery rate in the borehole. See **Section 3.3.2** for a more in-depth discussion.

Manure storage at the Schaefer facility is provided by one proposed and two existing deep concrete storage pits with a combined storage capacity of 1.3 million gallons. In the older straw pack barn, a relatively small amount of manure is directly scraped and hauled for land application. Risks to ground water posed by leaks from the concrete storage pit and potential spills appear minimal based on the cohesive nature of the soil at the site and the MPCA study referenced above. Risks to ground water posed by the area in which manure is scraped and hauled appear minimal due to the low volume of manure treated in this manner.

4.2.1.8 Solvie

The surficial aquifer exists beneath some portions of fields available for land application of manure from the Solvie facility. In areas in which the surficial aquifer is present, the water table lies approximately 30 feet bgs and generally flows southeast toward the Chippewa River. The saturated thickness of the surficial aquifer is zero to 40 feet. The Pope County soil atlas indicates soils present in the manure land application areas consist of both cohesive and granular soils.

Soils in the central portion of the facility in T124N R40W Sections 4 and 5 consist of silt and clay loams. Soils at the western and eastern margins of the Solvie facility are primarily sandy soils. Soil surfaces are level to sloping. Available records indicate that the facility does not over apply manure to available fields. The risk of impacting ground water is therefore considered to be minimal from manure land application to the Solvie fields.

Twenty five (25) wells were identified within one-half mile of manure land application areas associated with the Solvie Facility. The wells include eleven (11) domestic water supply wells, thirteen (13) irrigation wells, and one (1) of unknown use. All of the domestic wells are completed in buried aquifers. Risks of impact to all identified domestic water supply wells therefore appear minimal. Risks of impact to irrigation wells that utilize the surficial aquifer may be elevated due to the presence of the water table at approximately 30 feet bgs and granular soils.

Risks to ground water posed by leaks from the earthen basin may be slightly elevated as the permeability of earthen basins is generally greater than concrete pits. Conclusions drawn by Mulla *et al* (1999) in the Literature Summary for Water Quality for the GEIS indicate the following:

> "Under certain circumstances, seepage from manure holding basins and lagoons can have a very serious impact on ground water quality, especially from nitrate-N and ammonium-N. These impacts are greatest with unlined earthen manure storage systems, and lined pits constructed in granular soils. Seepage losses generally occur when the sidewalls become cracked or develop macropores. Lined basins and lagoons which are properly constructed, engineered, and managed are generally not a serious threat to ground water quality, unless constructed in granular soils or karst terrain."

Manure storage at the Solvie facility is provided by one concrete pit and a clay-lined basin with a combined storage capacity of 1.45 million gallons. Both manure storage structures are constructed in cohesive soils. The designs of the clay-lined basin and concrete pit were listed as compliant structures in the Certificate of Compliance issued to Solvie. Potential impact to ground water is minimal due to the cohesive soils present on the feedlot.

4.2.1.9 Spohr

The surficial aquifer does not appear to exist beneath any land available for land application of manure from the Spohr facility. The Stevens County soil atlas indicates that all soils present in the manure land application areas consist of silt or clay loams. Slopes are nearly level to gently sloping. Land application practices at the site do not indicate over-application of manure. The risk of impacting ground water is minimal from manure land application to the Spohr fields.

Three wells were identified within one-half mile of manure land application areas associated with the Spohr facility. Uses of the wells include two for domestic water supply and one irrigation well. The identified domestic water supply wells are completed in a buried aquifer. As the surficial aquifer does not appear to exist beneath any of the manure land application area associated with the Spohr Facility, cohesive soils are present, and the single identified domestic water supply well utilizes a buried aquifer, risks to users of ground water appear minimal.

Manure storage at the Spohr facility was previously provided by one 266,175-gallon earthen basin. During construction of the new HPP barn, the clay material of which the earthen basin was constructed was excavated and land applied to an adjacent field. The barn constructed within the excavated pit includes a 435,000-gallon concrete pit, which currently provides the bulk of the manure storage at the Spohr facility. A small amount of manure (a little over 42,000 gallons) is stored in the shallow underbarn pit of the pre-project pit barn and another small amount of manure is directly scraped and hauled for land application. Risks to ground water posed by leaks from the concrete storage pits appear minimal based on the cohesive nature of native soils and the nature of poured concrete pits. Risks to ground water posed by the area in which manure is scraped and hauled also appear minimal due to the low volume of manure handled in this manner.

4.2.1.10 Zeltwanger

The surficial aquifer does not appear to exist beneath any land available for land application of manure associated with the Zeltwanger facility. The Stevens County soil atlas indicates all soils present in the potential manure land application areas consist of silt or clay loams. Soil slopes are nearly level to gently sloping. Estimated land application practices at the site do not indicate over-application of manure. The risk of impacting ground water is, therefore, considered to be minimal from manure land application to the Zeltwanger fields.

Thirty-six wells were identified within one-half mile of potential manure land application areas associated with the Zeltwanger Facility. The wells include fifteen domestic water supply wells, seven irrigation wells, three designated as test wells, six of unknown use, and five public supply wells. The public supply wells are deep wells completed in buried aquifers. None of the other wells are listed as being finished in surficial water table aquifers. Risks of impact to the identified wells appear minimal as the wells are completed in buried aquifers, the surficial aquifer does not appear to exist beneath any land available for land application, and soils are cohesive.

There is little to no manure storage at the facility. If winter conditions require, Zeltwanger has an old feed bunker to temporarily stockpile manure. Risks to ground water appear to be minimal due to the low volume of manure that is managed at this facility.

4.2.2 Cumulative Effects

The cumulative effects from the HPP project appear to be minimal. Risks to wells completed within buried aquifers appear to be minimal due to the presence of the relatively low permeability glacial till separating the aquifers from the surface.

There is a potential impact to the wells located near the Olson feedlot due to the shallow potentiometric water surface in the area and the presence of granular soils. However, the wells are used for irrigation and not for human consumption. The Hancock municipal wells are not located in or near spreading fields, and thus impacts on them from the project are unlikely.

Ammonia and organic forms of nitrogen (the typical forms present in animal wastes) are typically immobilized in the unsaturated zone and are not likely to reach ground water in appreciable quantities. From a nitrate management perspective, the general trend of the regional ground water, based on site-specific geochemistry, suggests a reducing environment in which nitrate is rapidly converted to reduced forms. This coupled with the findings of MPCA studies of ground water quality adjacent to animal feedlots suggests that nitrate will not be persistent in the area of the project. This is also consistent with the absence of elevated nitrate concentrations reported in ground water samples from elsewhere in the region. Utilization of best management practices in applying manure, in concert with the nitrate reducing ground water environment, should result in minimal nitrate impacts to the ground water.

Ground water can also be affected by pathogens in which soils are permeable or prone to macropore or preferential pathway development. The potential for contamination of ground water by pathogens is typically less than that for contamination of surface water, due to the soil's filtering ability and the antagonistic competition of other organisms and environmental forces in the soil. As long as preferential pathways, or 'short-circuits' (eg, unsealed or improperly sealed wells) are kept to a minimum, pathogen migration to ground water from the feedlots and associated land application sites should be minimal.

4.3 SURFACE WATER QUALITY

The following sections discuss the current or potential effects that feedlot operations may have on the surface water quality in the immediate vicinity of each site.

Several studies discussed by Earth Tech (2001) in the GEIS Technical Working Paper for Air Quality and Odor Impacts indicate that atmospheric transport and deposition of nitrogen may represent an additional source of nutrients to the environment. As discussed in **Section 3.7.3**, reactions of ammonia emissions within the atmosphere allow formation of ammonium particulates that are deposited on the earth as a result of emissions from nearby concentrated feedlots. Two studies (conducted at a dairy feedlot in 1975 and another in Canada published in

2000) indicated that locations between 500 meters and 1 km down gradient from the emission source exhibited elevated ammonia deposition rates above background levels. These depositions could damage freshwater systems in the immediate vicinity of the feedlot and cause eutrophication of water bodies. Earth Tech (2001) indicates that studies of this phenomenon are limited and additional information is needed on specific impacts to the environment.

The DNR-Glenwood office expressed concern in regard to the effects from manure land application and subsequent addition of phosphorus and other nutrients and sediment to surface waters, especially in areas where the land application is immediately adjacent to surface waters (Lake Emily and the Chippewa River in particular). The water quality in surface waters in the project area is currently hypereutrophic.

4.3.1 Site Specific Effects

4.3.1.1 Farrowing Facility

There are 6 drain tile inlets (TI) on the farrowing facility site. Two TIs are located on the west side of the farrowing barn, two on the outer perimeter of the gestation barns, and two between the three gestation barns. For locations of site tile inlets refer to **Figure 3-9.**

Perimeter tile drains surrounding the concrete storage pits were installed to keep ground water below the pit floor to minimize ground water pressure on the pit walls. Sumps were also installed to collect the water from the perimeter tile drains. These sumps have been dry since construction of the facility. Protocols to sample and monitor the sumps are in place and will be implemented if the sumps begin to flow.

Impacts from contaminated storm water are expected to be minimal at the farrowing facility. Storm water contact with manure pits and animals is minimized because animals and manure are totally confined in the barns. Grading at the site directs storm water away from the concrete manure pits towards the catch basins or other vegetated areas. The facility has a designed storm water system that reduced erosion and increases the filtration of sediments and nutrients before water leaves the site. Storm water runoff from the west side of the nursery barn is directed towards a vegetated area to the west that flows northward and around the north side of the facility. Storm water flow on the east side of the farrowing barns, between the B-G barns, and water from the perimeter sumps, flows into catch basins between the B-G barns. The catch basins discharge east under the road through relatively small pipes designed to restrict flow from the catch basins, improving the filtering properties of the system in that area. All surface water at the facility eventually flows to a vegetated shallow depression area (sediment retention area). When water in the sediment retention area reached a depth of approximately six inches, water flows into a tile inlet on the north end of this area. After a storm event, water remaining in the retention basin eventually soaks into the soil. Vegetation along the drainage route and within the sediment retention area acts a filter by removing sediments and nutrients from the water, thereby minimizing the risk of contamination. The water that reaches the field tile line drains to a ditch approximately 1/2 mile away. The ditch drains into Judicial JD 9, which in turn leads to CD 83 and ultimately to the Chippewa River.

An unnamed stream connecting to JD 9 cuts across the northern portion of Moore Township Section 34. A wetland is located approximately 800 feet south of the land application area in Section 9 of Tara Township in Swift County. This wetland is not on the land leased by HPP. The distance from the application site makes impacts from manure application unlikely. Impacts from manure application should be minimal as long as manure is applied at agronomic rates and required setbacks are followed.

A Manure Management Plan (MMP) for the farrowing facility was submitted to the MPCA with the 1997 construction application documents, complete with fields documented that are to be used for manure land application. The MMP for the farrowing facility was updated in June 2002 and is included in **Appendix B.** This plan indicates land application of liquid manure is performed by knife injection or chisel plow. The facility does not apply on granular soils in the fall. No land application is performed during the winter season.

The storage capacity for the site exceeds the predicted annual manure generation and the average total annual volume of manure applied during operation at the farrowing facility. This will minimize the potential for overflow and a manure spill.

Animal mortalities are either picked up by a renderer or incinerated in the on-site incinerator. The farrowing facility stores its mortalities for rendering in a freezer trailer near the farrowing facility.

4.3.1.2 Charles

There are five TIs on land near the proposed site of the Charles feedlot and an additional 24 TIs are located throughout the land application areas. See **Figure 3-10** for approximate locations. The TIs drain into private ditches that eventually flow into JD 9. A surface water body lies within 1/2-mile of the Charles land application areas. Prescribed setbacks would be observed for fields near this wetland.

Impacts from contaminated storm water are expected to be minimal at the Charles facility. Hogs and manure would be inside the barn at all times, minimizing contact with storm water. The storm water from the site is conducted via overland flow to adjacent fields, and remaining on Charles property.

One concrete manure storage pit has been proposed for construction. This pit would be large enough to store the anticipated annual manure production at the facility. Charles intends to use Liqui-Blue® pit additive and possibly Barrier® pit additive to breakdown solids and control odor emitted from the pit. If this facility is built and Gibson Waste Removal is employed to apply manure, the pit additive, Liqui-Blue® would be added to the concrete pits at a rate of 5 gallons per year.

The active ingredient in Liqui-Blue® is copper sulfate. Copper sulfate is used in algaecides to control algal blooms within lakes and ponds. It is extremely toxic to fish in sufficient concentration, and long-term use of this compound may actually increase the incidence of algal blooms. When copper sulfate is added to hard water, it reacts to form an insoluble salt, copper carbonate. Copper carbonate buildup on the bottom of the lake or pond will inhibit the growth of rooted bottom vegetation over a period of time. Nutrients that the bottom vegetation would have consumed are available for algae to use and contribute to excessive algal growth (Aquatic Systems Inc. 2002). The amount of copper sulfate annually applied to 100 acres at the above rate of Liqui-blue addition would come to about 5g/acre. This small amount of copper sulfate applied to cropland is not likely to impact local surface waters.

The manufacturer claims that Barrier® is environmentally friendly, but provides no data to support this. The Material Safety Data Sheet (MSDS) for the product does not indicate that environmental or animal testing has been performed (Agrilance LLC 2000). MSDSs for component chemicals 1-4 dioxane and ethylene oxide indicate that they could be carcinogenic to humans at acute exposure at high concentration and for long-term exposure at low concentration. The component chemical 1,4-dioxane evaporates from dry soil when exposed to air. Once in the air it is reported to break down into other chemicals (USEPA 1995). It appears that 1,4-dioxane has low toxicity to aquatic life and is not likely to cause environmental harm at levels normally found in the U.S environment according to USEPA (1995).

Land application would reportedly occur via injection or broadcasting with immediate incorporation. No land application has historically occurred on any fields that are associated with the Charles finishing site. The land application fields do not contain granular soils. Discussions with Charles have indicated that he is aware of the manure land application setback requirements near tile inlets and drainage ditches and that he would follow them. He also would test the soil and manure to determine the appropriate manure application rates for the fields.

Dead animals would be composted on a covered concrete pad on other property owned by the family (personal communication with Charles, April 2002). Charles would use manure and straw as the bulking material for the compost operation. Once compost is finished it would be applied and incorporated into nearby cropland. Composting procedures described by Charles generally follow the Minnesota Board of Animal Health (BAH) guidelines and regulations.

Impacts to surface waters for this site should be minimized as long as planned practices are implemented.

4.3.1.3 Greiner

The Greiner feedlot has fourteen TIs located on the land application fields, and none on the site proper. The TIs drain to the adjacent road ditches and eventually to the wetlands immediately adjacent to the land application areas. The barn is built on a hill and runoff is directed away from the barn. See **Figure 3-11** for locations of TIs near the facility.

Impacts from contaminated storm water are minimal at the Greiner facility. Hogs and manure remain inside the barn at all times, minimizing contact with storm water. Storm water from the site is conducted via overland flow to adjacent fields north of the barn and remains on Greiner property.

Perimeter tile drains surround the concrete pits. A sump collects the water from the perimeter tile lines and discharges it to a nearby road ditch adjacent to the facility. The road ditch eventually drains to an open field on a neighbor's property (Greiner, personal communication, June 2002). Two surface waters (Lake Emily and a federal wildlife protection area) lie within 1/2-mile of the site. The Greiners report following prescribed land application setbacks from surface waters and tile inlets.

The storage capacity exceeds the annual manure production at the facility. The land application areas appear to be sufficient to apply all the manure generated yearly.

The Greiners use a licensed manure application service, Gibson Waste Removal. Gibson Waste Removal adds the pit additive Liqui-blue™ to the concrete pits it pumps at a rate of 5 gallons per year. Potential impacts from this additive were discussed in **Section 4.3.1.2** and are not likely to impact surface waters. Manure is land applied via injection. Gibson Waste Removal uses the data from manure and soil tests to determine the land application rates. Land application areas are shown on **Figure 2-11**. Granular soils were not identified within the land application areas. Winter land application does not occur at this facility.

Greiner currently reports that he has a renderer pick up the animal mortalities at the site.

4.3.1.4 Nohl

There is one surface TI located on the east side of the passageway that connects the two barns. Floe from this TI flows west through a wooded area and eventually reaches a private ditch. A sump collects the water from the barns' perimeter tiles and drains it into the tile line, which is connected to the nearby ditch. Thirty-three tile inlets are located throughout the land application sites. These tile inlets drain to private ditches and then into JD 9. Tile inlet locations are shown in **Figure 3-12**.

Impacts from contaminated storm water are expected to be minimal at the Nohl facility. Hogs and manure remain inside the barns at all times, minimizing contact with storm water. Storm water from the site is conducted via overland flow west of the barn and remains on Nohl property or flows to the catch basin and to the private ditch.

There are no natural surface waters within the vicinity of the feedlot site or land application areas. A private ditch immediately adjacent to the feedlot connects to JD 9. JD 9 flows through the land application areas. As long as manure is applied at agronomic rates and required setbacks are followed, minimal impacts are expected.

The storage capacity for the site exceeds the average total annual volume of manure generated. The land application areas appear to be sufficient to apply all the manure generated yearly.

Nohl uses a licensed manure application service, Gibson Waste Removal. Gibson Waste Removal adds the pit additive, Liqui-blue™ to the concrete pits at a rate of 5 gallons per year. Potential impacts from this additive were discussed in **Section 4.3.1.2** and are not likely to impact surface waters at this facility.

Hog carcasses are composted at this site at a location approximately 100 feet south of the barn. This location is approximately 600 feet from the private ditch. Inspections by the BAH have indicated that the compost pile meets the BAH requirements except the pad is inadequate due to the presence of sandy soils. BAH is currently working with Nohl to improve the pad beneath the compost pile. The finished compost is applied to a nearby field.

4.3.1.5 Olson

Two TIs drain directly to JD 9, which flows through the middle of the Olson farm. Surface water receptors are shown in **Figure 3-13**. No surface waters are located within 1/2 mile of the facility or its land application areas.

JD 9 is over 500 feet to the east of Barn #3 (See fig. 2-15). Runoff from the feedlot property is directed to the southeast and southwest. Due to the small number of hogs on the feedlot, and the distance from open surface water, significant storm water impacts are not expected.

Scrape and haul from the barns occurs approximately once a week. Manure is applied during winter as long as conditions allow it. If conditions are unfavorable, Olson temporarily stockpiles the manure at the feedlot. The manure applied in the winter is incorporated before planting season begins (after snow melt). Impacts to surface waters for this site may be increased due to longer periods of manure exposure to precipitation during winter and the potential for drainage from the TIs.

Hog carcasses are composted at this facility. BAH inspection found that not enough bulking material was used and there was insufficient cover. Otherwise the compost site met the BAH requirements. BAH is working with Olson to remedy the deficiencies. The finished compost is applied to a nearby field.

4.3.1.6 Paul

The barn's perimeter tiles drain into a vegetated buffer area prior to discharging to a wetland located 800 feet away. There are thirty TIs in the land application areas associated with the Paul feedlot. The drainage from the TIs is into the nearby intermittent streams that eventually drain to the Pomme de Terre River, or to small wetlands, except for the manure land in section 15, Moore Township, which drains to JD 9 and the Chippewa River. Surface water receptors are shown in **Figure 3-14.**

Impacts from contaminated storm water are expected to be minimal at the Paul facility. Hogs and manure remain inside the barn at all times, minimizing contact with storm water. Storm water from the site is conducted via overland flow to adjacent fields east and south of the barn and remains on Paul property.

Impacts to the nearby wetland and the Pomme de Terre River from the Paul site are unlikely as long as proper setbacks and agronomic application rates are followed.

The storage capacity for the site exceeds the average total annual volume of manure generated. The land application areas appear to be sufficient to apply all the manure generated yearly.

Paul previously buried animal carcasses on the site, but in the fall of 2001 he changed to composting. The compost pile was located on the south side of the nearby wetland, in a flowpath directly between fields and the wetland. The pile did not comply with the prescribed setback from open water. For this and other reasons, the construction of the compost pile was not in compliance with BAH requirements. Paul has since removed the compost pile and applied the finished compost to the fields. Paul reports that animal mortalities now are rendered.

4.3.1.7 Schaefer

There are 31 TIs located on the Schaefer site and associated land application areas. One TI is located between the two HPP barns. Runoff from the site discharges into a vegetated area before reaching the TI. Perimeter tiles located around the concrete pits drain to the road ditch. The remaining TIs are located throughout the land application areas and drain into private ditches that eventually connect to JD 9.

Impacts from contaminated storm water are expected to be minimal at the Schaefer facility. Hogs and manure remain inside the barn at all times, minimizing contact with storm water. Storm water from the site is conducted via overland flow to adjacent fields and remains on Schaefer property or is directed to the vegetated catch basin before entering the TI.

There is farmable wetland on the Schaefer property and an intermittent stream to the southwest of the site. There are no other surface waters within 1/2 mile of the facility or land application areas. Locations of surface water receptors are shown **Figure 3-15**.

The storage capacity for the site exceeds the average total annual volume of manure generated. The land application areas appear to be sufficient to apply all the manure generated yearly.

Prior to the HPP project, the Schaefer operation was strictly a scrape and haul operation. Stockpiling of manure does occur when necessary at this facility. The manure is usually scraped and hauled directly to fields. However, since the start of the HPP project, the amount of manure from scrape and haul operations has been reduced from 5 tons annually to 0.5 tons annually. The barns with concrete floors are only used to house "slow growers" and other hogs culled from the herd.

Schaefer uses a licensed manure application service, Gibson Waste Removal. Gibson Waste Removal adds the pit additive, Liqui-blue™ to the concrete pits at a rate of 5 gallons per year. Potential impacts from this additive were discussed in **Section 4.3.1.2** and are not likely to impact surface waters at this facility.

Hog carcasses are composted at this facility. MPCA inspection noted that additional bulking material was necessary to cover the carcasses properly, and the compost pile was not operated correctly. Schaefer is currently working with the BAH to comply with requirements. The finished compost is applied to a nearby field.

4.3.1.8 Solvie

One TI is located within the area available for land application of manure. The TI outlets to the road ditch immediately adjacent to the property. The ditch eventually drains to a nearby unnamed wetland. Several surface waters and the Chippewa River are located either within 1/2-mile of the facility or in land application areas. Surface water receptors are shown in **Figure 3-16**. Solvie reports following required setbacks from sensitive features. As long as this practice is continued and manure is applied at agronomic rates, minimal impact to surface waters is expected.

Hogs and manure remain inside the barn at all times, minimizing contact with storm water. The manure basin is always exposed to contact with storm water and the contents are applied to fields with manure. Storm water from the buildings is conducted via overland flow to adjacent fields southwest of the barns and remains on Solvie property. Impacts from contaminated storm water are expected to be minimal at the Solvie facility as long as the manure basin is not allowed to overflow.

Prior to the HPP project, the Solvie operation involved scrape and haul operation as well as basin storage. The scrape and haul operation has been nearly phased out. The barn with concrete floor is only used to house hogs culled out of the herd, and only a minor volume of manure is generated there.

The storage capacity for the site exceeds the average total annual volume of manure generated. The land application areas appear to be sufficient to apply all the manure generated yearly.

Solvie uses a licensed manure application service, Gibson Waste Removal. Gibson Waste Removal adds the pit additive, Liqui-blue™ to the concrete pits at a rate of 5 gallons per year. Potential impacts from this additive were discussed in **Section 4.3.1.2** and are not likely to impact surface waters at this facility.

Solvie at one time composted mortalities, and the compost pile was reported by BAH to be operated according to BAH requirements. According to HPP, Solvie no longer composts, and uses rendering exclusively at this time.

4.3.1.9 Spohr

Twenty-nine TIs are located within land application areas for this facility. Storm water runoff from the site discharges into a grassy area before reaching a nearby. The TIs in Section 31, Horton Township drain to a small stream that discharges into the Pomme de Terre River. The remaining TIs drain into small wetlands or overland into neighboring fields. The TIs are checked for clogging and debris 4 times a year. If debris is found, it is removed and the tile function is restored. A surface water is located near the feedlot site but manure is not applied to fields near it. Locations of surface water receptors are shown **Figure 3-17.**

The HPP barn at the Spohr feedlot has a concrete storage pit with a total volume of 435,000 gallons. This is larger than the annual volume of manure produced at the site. Perimeter tile around this pit drains to the road ditch referred to above. The sump drains to a grassy area near the barn via overland flow.

Impacts from contaminated storm water are expected to be minimal at the Spohr facility. Hogs and manure remain inside the HPP barn at all times, minimizing contact with storm water. The barns and open lots used for horses, chickens, and injured hogs have scrape and haul operations performed as needed. Storm water from this area is directed through pathways between feedlot buildings. Storm water from the site is conducted via overland flow to adjacent fields and remains on Spohr property.

Since the start of the HPP project, the amount of manure from scrape and haul operations has remained constant at approximately 150 tons annually. The barns with concrete floors are only used to house culled hogs, chickens and horses.

Spohr uses a licensed manure application service, Gibson Waste Removal. Gibson Waste Removal adds the pit additive, Liqui-blue™ to the concrete pits at a rate of 5 gallons per year. Potential impacts from this additive were discussed in **Section 4.3.1.2** and are not likely to impact surface waters at this facility.

Hog carcasses are composted at this facility on an old barn open lot. The inspections by MPCA and BAH indicate that the site is compliant. The finished compost is applied to a nearby field.

4.3.1.10 Zeltwanger

Twenty-nine TIs drain to private ditches that eventually lead to unnamed wetlands or other private ditches. A National Wildlife Management Area is located within 3/4-mile of the facility. Surface water receptor locations are shown on **Figure 3-18.**

Stormwater runoff from the feedlot site is directed to the northwest towards the adjacent fields. Due to the small number of hogs on the feedlot, and site drainage that diverts water away from the barn areas and through vegetation prior to flowing into a field, storm water impacts are expected to be minimal. The short-term stockpiling area is a concrete pad, and is used only when conditions do not allow direct hauling to application fields. Drainage from this pad is through a vegetated area to a field.

The Zeltwanger facility is strictly a scrape and haul operation. Scrape and haul from the barns occurs approximately once a week. Manure is applied during winter as long as conditions allow. If conditions are unfavorable, Zeltwanger temporarily stockpiles the manure on a concrete pad. The manure applied in the winter is incorporated before planting season begins (after snow melt).

No surface waters lie near the feedlot, or within land application fields.

Hog carcasses are picked up by a rendering service at this facility. No impact to surface water is apparent from the mortality storage area. Inspection from the MPCA and BAH indicate site compliance with appropriate requirements.

4.3.2 Cumulative Effects

Cumulative effects within the project area would be potential excess nutrient and suspended solid loading within surface waters if setbacks and agronomic application rates are not followed.

The MPCA Detailed Manure Management Review and the MPCA Compliance Report (**Appendices F and G**) indicate that the farrowing facility and associated finishing sites are in compliance with requirements for applying manure at recommended agronomic rates and the applicants report that they comply with required setbacks from sensitive features. Impacts to surface water from these sites are minimized as long as reported practices are continued.

4.4 WILDLIFE AND HABITAT

The habitat in which the HPP project has been built was severely altered before the construction and operation of the project. The North Central Hardwood Forest (NCH) and Northern Glaciated Plains (NGP) ecoregions have been used extensively for agriculture and other purposes. Over 50% of the original wetlands have been drained by some estimates and converted to agricultural fields (Heiskary and Wilson 1989; Waters 1977). Little natural habitat remains due to conversion from the grasslands present over 100 years ago. The areas directly affected by the HPP project are largely cropland. Habitat disruption resulting from construction of the barns or of future barns for the project is or will be in previously altered fields occupied by few species.

The Danvers State Wildlife Management Area (Danvers WMA) is approximately 5 miles south of the HPP project sites. This area is of concern because runoff from some of the HPP sites is directed into JD 9. When JD 9 was originally built, it flowed through the Danvers WMA (MDNR 1993). In 1986, CD 83 was constructed, diverting the flow from the Danvers WMA and directing it into the Chippewa River, south of Benson. Overflow during times of high flow may enter the Danvers WMA but only minimal amounts of baseflow from CD 83 enter the wetland (MDNR 1993). Potential impacts to the Danvers WMA due to contaminated runoff from the HPP sites are therefore considered to be minimal.

Disease transmission to wildlife from pathogens contained in the manure spread on to fields has impact potential. The GEIS Technical Work Paper for Animal Health (Halverson 2001) refers to studies conducted in Europe identifying that liquid manure spreading can increase infection of wildlife habitat from feedlot sources. Pathogens, viruses, and other microorganisms present within manure may infect wildlife, such as deer that graze on the plants growing in manure treated soil. The World Health Organization identified liquid manure land application as a critical pathway for salmonella and other pathogens (Addis *et al* 1999). There is no evidence that this is occurring in the vicinity of the HPP project.

Potentially, vectors such as flies are thought to have the potential to transmit disease. This topic is in its infancy with regards to research. The literature databases of the USDA, EPA, MPCA, and Universities of Pennsylvania, Minnesota, Ohio, and Iowa were searched for any studies or ongoing research documenting disease transmission from feedlots to wildlife from vectors. Literature searches of these databases produced limited information on the topic. According to Minnesota Public Radio's transcript of its broadcast, 'The Invisible Web', one study suggested that resistant bacteria were present in wild Canadian geese populations (Losure 2000). However, how geese were exposed to the bacteria was not discussed. There currently is concern that altered proteins known as prions, which are thought to cause chronic wasting disease in elk farms, may be passed to wild deer populations from elk farms.

Disease transmission may also occur if animal mortalities are improperly managed. Wild animals such as eagles and coyotes may scavenge the carcasses and either contract diseases themselves or become carriers of pathogens and spread them in the environment. Flies near composting or burial sites may potentially transmit diseases present within the mortality material to wildlife, but the literature available on disease transmission in this manner is limited. Pathogens are known to be destroyed by composting, so finished compost is probably an insignificant source of diseases. Appropriate mortality management would minimize the potential for disease transmission to scavenging animals or for vector transmission.

Surface water run off may affect aquatic biota by carrying with it pathogens or harmful chemicals in addition to the nutrients addressed in **Section 4.2**. The harmful chemicals are typically pharmaceutical agents that are used on the animals and include antibiotics, hormones, and other medicines. A percentage (variable but often more than 25%) is excreted by animals without being metabolized (Wallinga 2002; see also Raloff 2002). Thus, manure may contain appreciable amounts of pharmaceutical chemicals that could impact plants and animals that come into contact with it. However, there is no evidence that any pharmaceutical use at HPP sites is contributing significantly to any such impact.

Bacteria and viruses present within liquid manure may cause illness or disease in certain species of wildlife. *Pfiesteria piscicida* (a dinoflagellate that can release nerve toxins) has been attributed to the presence and operation of poultry and hog feedlots. *Pfiesteria piscicida* is known to occur in brackish coastal waters from the Delaware Bay to North Carolina where nutrient concentrations are high (USEPA ND). Other *Pfiesteria*-like organisms occur along the southeast coast from Delaware to the Gulf of Mexico. These organisms are believed to be native, not introduced species, and are probably common inhabitants of estuarine waters within their range. These microbes have not been found in freshwater lakes, streams, or other inland waters, and are not known to exist in the HPP area.

Potential impacts to fish from endocrine disruptors are of more immediate concern. These are chemicals thought to originate in domestic wastewater or other waste disposal systems (eg, feedlots) that can mimic or disrupt hormonal functions in organisms. The exposure pathway is generally waste discharge to surface waters that are then consumed by animals or humans. Endocrine disruptors have been definitively linked to mutations in the reproductive systems of alligators, minnows, and other animals (Raloff 2002; Kamrin 1999), and levels of these substances known to cause such effects have been found in US surface waters (Kolpin *et al* 2002). A European Union-funded study in Nebraska found that endocrine disruptors originating from feedlots were impacting minnows downstream, causing female minnows to exhibit male reproduction characteristics and males to exhibit mutated reproductive characteristics (Raloff 2002). USEPA (1997) reviewed the problem from a "big picture" perspective. No chemicals are in use at HPP sites that are known to act as endocrine disruptors.

4.4.1 Site Specific Effects

With the exception of the Solvie site (see **Section 4.4.1.8**), the potential for impacts caused by HPP facilities to habitat or species that are endangered or of special concern as identified by the Minnesota Natural Heritage and Nongame Research Program (NHNRP) are minimal. Impacts on habitat and wildlife from new construction or land application areas are discussed in the following sections.

The MDNR-Glenwood does not believe that the impacts from manure land application will directly affect resident wildlife within the HPP project area as long as excess nutrients are not allowed to reach surface water. Typically, the resident wildlife are prairie birds and mammals, and fish within the surface waters. There is a concern regarding potential effects on fish populations if excess nutrients would reach surface waters, but this should not happen if manure is managed and applied according to the rules.

4.4.1.1 Farrowing Facility

The farrowing facility and associated land application areas are located near two naturally occurring surface waters, in addition to JD 9. JD 9 flows approximately 9 miles from the farrowing facility property before being diverted into CD 83 just before reaching the Danvers Wildlife Management Area (WMA). CD 83 flows from the Danvers WMA vicinity for an additional three miles before entering the Chippewa River. The MDNR-Glenwood did not express concern for wildlife or habitat within the farrowing facility property and associated land application sites as long as appropriate manure management practices are followed.

The farrowing facility injects its manure when land applying, thereby minimizing risk of contact with wildlife that may be the vicinity. The facility has a rendering service pick up dead animals or incinerates its animal mortalities. Feedlot operation and land application practices in place at the facility should have minimal impact on the habitat and surrounding wildlife.

4.4.1.2 Charles

The Charles finishing site and proposed manure land application sites are located west of a federal waterfowl production area (WPA) near the town of Hancock. However, the WPA will most likely not be affected by the feedlot operations.

Charles plans to inject manure when land applying, thereby minimizing risk of contact with wildlife that may be in the vicinity. The facility would compost its animal mortality in an enclosed silo according to prescribed practices, thereby reducing the potential for wildlife scavenging through carcasses. Feedlot operation and land application practices would conform to regulatory requirements and would therefore have minimal impact on habitat and surrounding wildlife.

4.4.1.3 Greiner

The Greiner finishing site and land application fields are located near Lake Emily and the Greiner WMA. The MDNR expressed a general concern with manure land application impact potential, but according to interviews with the Greiners and information submitted by them, the feedlot will have minimal impact on the Greiner WMA, so long as land application setbacks are followed and agronomic rate manure application is practiced.

The Greiners inject manure when land applying, thereby minimizing risk of contact with wild life that may be in the vicinity. The facility uses a rendering service to handle its animal mortalities. The operational and land application practices in place at the facility should have minimal impact on the habitat and surrounding wildlife.

4.4.1.4 Nohl

The Nohl finishing site and associated land application areas are located near JD 9. JD 9 flows approximately 9 miles and diverts into CD 83 just before reaching the Danvers Wildlife Management Area (WMA) and eventually enters the Chippewa River, an additional 3 miles from Danvers WMA. The DNR-Glenwood did not express concern for these areas and associated wildlife within them with regard to effects from finishing site activity.

Nohl injects manure when land applying thereby minimizing risk of contact with wildlife that may be in the vicinity. The facility composts its mortalities. However, inspections by MPCA and BAH identified the potential for animals scavenging in the compost pile due to inadequate cover. Nohl does not report any problems with animals scavenging in his pile and is working with the BAH to improve his compost operation. Feedlot operation and land application practices in place at the facility should therefore have minimal impact on the habitat and surrounding wildlife.

4.4.1.5 Olson

The Olson finishing site and associated land application areas are located near JD 9. JD 9 flows approximately 10 miles and diverts into CD 83 just before reaching the Danvers Wildlife Management Area (WMA), and eventually enters the Chippewa River, an additional 3 miles from Danvers WMA. The MDNR-Glenwood did not express concern for these areas and associated wildlife within them with regard to effects from finishing site activity.

The facility composts its animal mortality. There may be a potential incidence of animals scavenging in the compost pile due to inadequate cover, but Olson is working with the BAH to improve his operation. Feedlot operation and land application practices in place at the facility should have minimal impact on habitat and surrounding wildlife.

4.4.1.6 Paul

The Paul finishing site is located approximately 800 feet from a wetland. Drainage from the feedlot is ultimately directed towards the Pomme de Terre River that is located several miles from the feedlot site. Drainage from land application fields also flows to the Pomme de Terre River, with the exception of one field in section 15, Moore Township that drains to JD 9 and the Chippewa River. One land application site is located immediately adjacent to the Pomme de Terre floodplain.

The facility injects its manure when land applying, thereby the minimizing risk of contact with wild life that may be in the vicinity. The facility formerly buried or composted its mortalities, but currently renders its animal mortalities. Feedlot operation and land application practices in place at the facility should have minimal impact on habitat and surrounding wildlife

4.4.1.7 Schaefer

The facility injects its manure when land applying, thereby minimizing risk of contact with wildlife that may be in the vicinity. The facility composts its animal mortality. An inspection by MPCA identified the potential for animals scavenging in the compost pile due to inadequate cover. Schaefer does not report any problems with animals scavenging in his pile. BAH is currently working with Schaefer on compost practices. Feedlot operation and land application practices in place at the facility should have minimal impact on the habitat and surrounding wildlife.

4.4.1.8 Solvie

The Solvie feedlot is over a mile from the Chippewa River. Solvie owns land immediately adjacent to the Chippewa River, but does not apply manure there. The DNR NHNRP identified two species of mussels (Black Sandshell and Creek Heelsplitter) believed to inhabit the area both upstream and immediately downstream of the Solvie feedlot. The DNR NHNRP has expressed concern that land application and increased contaminated runoff may impact the existence of these species of special concern due to their sensitivity to increased siltation. The DNR-Glenwood also expressed a general concern about wildlife in this vicinity being affected if manure and additional runoff were to enter the Chippewa River. Since the feedlot is over a mile away and the land near the river is not used for manure disposal, the Solvie facility should pose a minimal threat to the above species.

The DNR NHNRP recommends that the facility take precautions to control contaminated runoff from the land application fields. Adherence to the required manure application setbacks would minimize the impacts to wildlife in the vicinity.

The facility uses a rendering service to manage mortalities.

4.4.1.9 Spohr

No protected waters or intermittent streams are located within the Spohr feedlot and associated manure application fields. However, a wetland is located across the road from the finishing site. The road provides a barrier to potential impacts on wildlife that may use this wetland. The MN DNR-Glenwood expressed a general concern about wildlife in this vicinity being affected if manure and additional runoff were to be not properly managed. Conversations with the operator indicate that the appropriate practices are employed.

The facility injects its manure when land applying, thereby minimizing risk of contact with wild animals that may be in the vicinity. Inspections of the facility have noted adequate cover used in the compost pile. Spohr does not report any problems with animals scavenging in his pile. Feedlot operation and land application practices in place at the facility should have minimal impact on the habitat and surrounding wildlife.

4.4.1.10 Zeltwanger

No protected waters are located within the land application fields or in the vicinity of the finishing site. There is however, a federal waterfowl production area located within ½-mile of a land application field (no TIs present) specified for use for land application of manure. Conversations with the operator indicate that the required setbacks are followed and minimal impacts to wildlife in the area are expected.

The facility landspreads the solid manure every week and does not incorporate the manure within 24 hours. The facility uses a rendering service to handle its animal mortality.

4.4.2 Cumulative Effects

Cumulative ecological effects should be minimal as long as reported manure application practices are continued and compost piles are managed according to BAH rules.

4.5 HUMAN HEALTH

Pathogens. Pathogens are known to be emitted from livestock buildings (Homes *et al* 1996), and they theoretically can cause disease in people living nearby. However, no direct evidence for this currently exists. Disease transmission to humans directly associated with feedlots via contact with contaminated soil or water or from crops in land application areas is thought to be rare. Diseases for which domestic animals are the primary host are primarily an occupational hazard for those working with animals or animal products (Earth Tech 2001a). Some incidences of human disease attributable to contact with livestock waste have been reported. However, these are more typically associated with food infections. There is no evidence that pathogens from HPP sites are causing disease in humans. A study of sufficient rigor to confirm this would likely be prohibitively costly and time consuming, however.

Pathogen resistance. Antibiotic resistant bacteria that may be transferred to humans comprise another concern with human health. The evidence seems clear that routine subtherapeutic use of antibiotics for growth promotion and disease prophylaxis at feedlots is contributing to this problem. The trend in Europe is to limit or ban the practice for this reason. The HPP facilities all use antibiotics in this way, and this use is typical of feedlots in the US.

There is no evidence, however, that the HPP facilities individually contribute significantly to this problem. No evidence surfaced during this EIS process that HPP was causing a specific pathogen resistance issue, and specific studies and surveillance to seek such evidence or rule it out could be quite costly and time consuming. At least, there have been no known cases of resistant infections in people in the area or in other ways connected to HPP or its products. A number of recent studies reported in the New England Journal of Medicine and elsewhere (see for example White *et al* 2001) report that resistant bacteria have been found within retail ground meats bought at supermarkets, and the Taiwan study cited earlier (Cheng-Hsun Chiu *et al* 2002) tied hospital cases of resistant disease directly to the feedlots of origin. However, no information like this exists for the HPP project. Perhaps more importantly, neither of the above studies called for subtherapeutic use of antibiotics to be eliminated at the specific facilities that were implicated, but instead called for an ultimate end to the practice industry-wide.

Some research exists on a method for slowing the development of antibiotic resistance, although the authors make it clear that this method will not solve the problem once and for all (Pittendrigh *et al* 2000).

Chemicals. No evidence was found in the literature that metal-containing compounds used at feedlots have caused adverse effects in humans. No known endocrine disruptors are used in HPP feedlot management.

Airborne particulates. Feedlot dust may contain any or all of the following: microbes, endotoxins, animal dander and hair, fecal matter, feed particles, and common soil. Available evidence indicates that such material is more of an occupational than environmental hazard (see for example Earth Tech 2001a). Numerous studies have documented adverse health effects of feedlot dust on feedlot workers. The potential accordingly exists for feedlot dust that is emitted from buildings into the environment to affect neighbors, but Addis *et al* (1999) found no research in the literature on impacts of feedlot dust emissions downwind of animal facilities in the Midwestern US. No evidence surfaced in this EIS process that dust from HPP facilities was causing adverse effects in the vicinity. A study of sufficient rigor to confirm this would likely be prohibitively costly and time consuming, however.

Vector-borne pathogens. Flies commonly associated with feedlots can acquire and transport disease organisms. However, it remains to be demonstrated that flies are significant in the transmission of disease from feedlots to the surrounding community (Addis *et al* 1999). There is no evidence that this is a problem at the HPP facilities. A study of sufficient rigor to confirm this would likely be prohibitively costly and time consuming, however.

Odors. Manure has been found to contain at least 168 volatile odorous compounds, and at least 26 of these have been found in the gaseous state in feedlot emissions (O'Neil and Phillips 1992) (other investigators have found more; Schiffman *et al* (2001), for example, found 331 different volatile odorous compounds in manure). In addition to its well-documented propensity for causing annoyance, odorous gases can cause human health impacts as well. Some VOOCs have been identified as respiratory tract, eye, or skin irritants (Addis *et al* 1999). Schiffman *et al* (1995) showed that feedlot odors can adversely affect the mental and emotional state of humans as well. There is, however, currently a great deal of uncertainty regarding the extent to which physical and mental effects result from direct chemical actions on tissues as opposed to learned aversion and the association of unpleasant sensations with objectionable odors. Odor related impacts can and do occur at air concentrations below the level of toxic exposure (Addis *et al* 1999); put differently, people can smell and be annoyed by odors at levels below those that would cause toxic effects.

There seems to have been little research aimed at comparing emitted concentrations of individual feedlot gases with concentrations shown to cause health effects; most such studies have focused on odor annoyance rather than health effects.

The ability of this EIS to address this issue is correspondingly limited. It is limited further by the fact that, as a cost cutting measure mandated by EQB, MPCA analyzed odor dispersion from the HPP facilities as a combination of odorous gases (rather than modeling the dispersion of each VOOC in isolation), and compared the results with the concentrations found by Zahn (1997) to be unpleasant to an odor panel (rather than comparing downwind concentrations of the individual VOOCs to threshold odor detection values from the scientific literature). Individual VOOCs were measured at each site, but were then combined at the laboratory into a single input value for the modeling analysis; the dispersion of this mixture was then modeled.

This means that this EIS analysis was not designed to predict the dispersion of individual gases away from the sources, and accordingly did not predict the concentrations of individual VOOCs at the fence line or at the nearest receptor. The analysis thus produced no values that can be compared with any of the available health benchmarks (few as they are).

A search of available resources (Gantzer 2003, personal communication) identified a small amount of data on measured concentrations of the same VOOCs as were measured at the HPP sites, downwind from a highly odorous (non-HPP) manure storage basin, measured by Zahn *et al* (1997) (it must be remembered that the HPP sites largely use deep pits, not earthen basins). The measurements were taken 100 meters from the basin, and are presented in **Table 4-81.** This table compares those emission concentrations with the few available reference concentrations that were found. Note that all of the concentrations measured 100 meters away from this highly odorous basin are below the reference values with the exception of the propanoic acid concentration, measured at 1140 ug/m^3, which exceeds the *proposed* Wisconsin 24-hour ambient air quality standard of 727 ug/m^3.

However, in order to make these numbers directly comparable, the fact that they are the result of different averaging times must be taken into account. The proposed Wisconsin standard is a 24-hour average, meaning that concentrations exceeding 727 ug/m^3 are acceptable in any 24-hour period as long as lower concentrations to offset them occur during that period as well. The concentration measured by Zahn was averaged over 15-30 minutes, and thus represents a more immediate snapshot of the propanoic acid concentration near the earthen basin.

The conversion factors that allow comparisons of different averaging times are somewhat problematic. As a crude approximate, USEPA (1992) suggests multiplying the hourly concentration (the measured Zahn number, in this case) by 0.4 to convert the hourly value to a

24-hour concentration. Doing this gives 456 ug/m^3, which is below the proposed Wisconsin 24-hour ambient standard.

The available evidence, then, does not indicate that VOOC emissions from the HPP sites would cause significant toxic exposure potential. It must also be remembered that this analysis is subject to a number of qualifiers:

- The reference values are mostly from other states, and may not be relevant to circumstances in Minnesota.

- The EPA conversion factor used above is at best a crude approximation of the difference between a 30-minute average and a 24-hour average, and is intended for use with hourly averages, not half-hour averages.

- The concentrations measured by Zahn came from a particularly odorous earthen basin, where emissions were likely considerably higher (and possibly different chemically) than those coming from the HPP sites, where manure is mostly stored in deep pits. It was, for example, found that replacing the old earthen basin at the Spohr site with a deep pit considerably reduced modeled emissions from the site.

4.5.1 Cumulative Effects

Water. The MPCA Detailed Manure Management Review and Compliance Report (see **Table 4-82**) indicate that prescribed land application practices are generally followed at the HPP project feedlots. This minimizes the risk of transport of contaminants off site to ground or surface waters, as long as practices reported are followed in the future. The risk of surface water receiving detectable levels of contaminants from project land application fields is minimized through adherence to manure application setbacks and recommended manure application rates. Chemicals used at the HPP feedlots are not known to act as endocrine disruptors. Cumulative public health impacts are therefore unlikely.

Airborne particulates and odors. Based on the foregoing, there is little reason to suspect that these contaminants represent a significant cumulative threat to public health.

Antibiotic resistance. Subtherapeutic use of antibiotics is practiced at all HPP facilities. Pathogen resistance to antibiotics is clearly occurring nationwide, and subtherapeutic use of antibiotics at feedlots clearly contributes to the problem. The GEIS documents dealing with human health issues (Addis *et al* 1999; Earth Tech 2001) document increasing concern about this issue, as well as calls from a variety of entities for the elimination of subtherapeutic use of antibiotics. However, the HPP contribution is probably not significant on an individual basis; the problem exists because such use is routine nationwide. The relevant scale for considering the issue of the cumulative effects of subtherapeutic use of antibiotics at feedlots is the entire industry. Eliminating such use at any one site will not eliminate the problem, and by definition cannot address the industry-wide impact of this practice. Earth Tech (2001), noting that action by the state of Minnesota acting alone may be illegal and would likely not be effective in the context of nationwide use, recommends increased surveillance and tracking of use, labeling, and support of federal initiatives to protect drugs used in humans from development of resistance.

Greenhouse gases. As noted above, the greenhouse phenomenon is a global issue that mitigation at feedlots on an individual basis cannot resolve. A programmatic, global approach is needed to address this issue. Individual feedlot projects probably do not contribute significantly to the problem.

4.6 Socioeconomic Issues

4.6.1 Land Use Compatibility

The HPP project is developed in an area that is zoned agricultural. The proposed project components do not require issuance of conditional use permits for the animal agricultural activities envisioned by the project.

The Minnesota Historical Society, State Historic Preservation Office was contacted in July 1997 to determine if the HPP project would potentially impact the cultural resources in the area. At that time, there were no known or suspected archeological properties that would be affected by the project. The State Historic Preservation Office was contacted again in September 2002 to confirm the assessment. The State Historic Preservation Office indicated that their opinion had not changed. The referenced correspondence can be found in **Appendix F**.

There are no schools, parks, churches, cemeteries, or other public access facilities within one mile of any of the HPP feedlots. The only public structures or facilities near any of the sites are the public roadways near each site.

There are numerous pre-existing odor sources present in the HPP project area. Those odor sources include pre-existing feedlot operations. Gantzer Environmental included these odor sources in the background odor assessment that is part of the air-modeling component of the EIS. The locations of the various odor sources that were modeled are shown on **Figure 3-1**.

4.6.2 GEIS Findings on Socioeconomic Issues

4.6.2.1 Social

Wright *et al* (2001) assessed the relationship between animal agriculture and the way in which people live, work, relate to one another, organize to meet their needs, and generally cope as members of society. They concluded that changes in animal agriculture in Minnesota clearly have an impact on society. These impacts were uneven within the context of an individual's physical and social proximity to animal agriculture, and were considered negative or positive depending on one's involvement in the agricultural industry. The impacts identified and analyzed involved (1) changes in animal agriculture; (2) quality of life; (3) community interactions; (4) future of animal agriculture; and (5) changes in population dynamics. Please refer to Wright *et al* 2001) for the full discussion.

4.6.2.2 Economic

According to the USDA, Minnesota's pork industry is the third largest in the United States. The Minnesota Pork Producers (MPP) consider the economics of the pork industry to extend to feed production, manufacturing, implement supplies, transportation, utilities, wholesale and retail, banking, insurance, and other supply service-oriented businesses. According to the State of Minnesota's Department of Agriculture (MDA), for every new position of employment in the pork industry, approximately 1.2 other jobs are created.

MDA (2002) recently performed a modeling study to estimate the direct, indirect, and induced economic impact of selected Minnesota livestock processing plants on their local and state economies. This study modeled combined economic impacts on those economies in the billions of dollars annually, depending on the assumptions in the modeling exercise.

The economic elements discussed in the state's GEIS on feedlots (Lazarus 2001) included agriculture structure and competitiveness. Topics included the number, location, and nature of feedlots; the business structures used by livestock operations; the ownership and control of livestock operations; the present market situation; and the competitiveness of Minnesota livestock producers in the national and international markets. The GEIS also attempted to assess the positive and negative economic effects of animal agriculture on other industries and businesses, communities, and the state as a whole.

The economic impacts of agriculture can be assessed in part by reviewing average employment by industry sector, average annual wage by industry, and the history of existing and projected agriculture feedlots. Employment-by-industry data for Stevens and Pope Counties is shown in **Table 4-81**. In total, the area supported more than 7,982 jobs in 1996. Of the industry sectors, service, trade, and government are the largest employers with a total of 5,850, almost seventy-five percent of the total jobs. Manufacturing would be the fourth-largest employment sector with 1,124 jobs.

The agricultural sector clearly has a presence in both counties, employing 319 people. As discussed earlier in this EIS, many additional sectors benefit from agricultural activities. In the short-term, the proposed project created several construction jobs. As the feedlots continue to operate and compete with hog production in other areas, they will maintain and possibly create jobs in the trade, manufacturing, transportation, and service sectors in the region.

4.6.2.3 Relevance to Hancock Pro Pork Project

The population, employment, and household projections are included in **Table 4-82** for Pope and Stevens Counties. According to the Minnesota Planning Agency, over the next twenty years, Stevens County should experience a moderate decrease in population, a moderate increase in housing, and a moderate decrease in employment. Pope County is also expected to lose some of its population and see a decrease in both housing and employment during the next twenty years.

Social. No evidence was found to indicate that implementing the HPP project would have significant effects of the type identified in the GEIS. There is no indication that the surrounding area's "social capital" has been affected by the project. The limits placed on the socioeconomic analysis by the EQB-ordered resolution of the cost dispute precluded an in-depth study of site-specific social effects.

Economic. Implementing the proposed project will probably not significantly impact populations, households, or employment in Stevens or Pope Counties. The limits placed on the socioeconomic analysis by the EQB resolution of the cost dispute precluded an in-depth study of site-specific social effects. The trend in hog farms in both Pope and Stevens Counties during the past twenty-five years (525 in 1978 and 127 in 1997) might continue. The size of the remaining farms will probably increase until the economy of scale is achieved. The trend occurring in Minnesota, including Pope and Stevens Counties, is a reduction in total number of farms along with an increase in the total number of animals per farm.

4.6.2.4 Summary of Social and Economic Impacts Requiring Mitigation

This section considers those impacts that have the potential for imposing induced or secondary effects on surrounding communities as a result of feedlot development. It includes any shifts in patterns of population movement and growth as well as changes in business and economic activity caused by the development of the feedlot.

Based on the size of the project, impacts to businesses, recreational areas, and surface transportation are expected to be minimal since the area has been used for agricultural purposes for the past several decades. Those area businesses currently in the agriculture business would not be significantly affected by the project. **Section 4.6.2** discussed the economic impacts of the proposed project and **Section 4.6.1** discusses compatible land uses.

For residents near the operation, the EIS findings would suggest that there are possible odor issues that would warrant review and/or mitigation.

4.7 SITE SPECIFIC COMPLIANCE – MANURE MANAGEMENT/FEEDLOT OPERATIONS

In this section, feedlot compliance is judged against the feedlot rules in effect before October 23, 2000 as well as the revised feedlot rules currently in effect. The previous and revised feedlot rules are summarized in **Section 2.4**. Permit issuance at specific sites may not be complete due to the EIS process.

A Detailed Manure Management Review (summarized in **Appendix F**) was conducted by the MPCA during October 2002 for all sites that are in operation in the HPP Project. The purpose of the review was to determine the level of compliance at the HPP feedlot operations regarding manure and soil testing, manure application to fields, and record keeping practices. A Compliance Inspection Report (**Appendix G**) was prepared by the MPCA to determine compliance with feedlots rules.

Additionally, the Board of Animal Health (BAH) has also inspected the HPP feedlots and determined if sites were compliant with the BAH animal mortality management regulations that the Board enforces.

Table 4-83 summarizes the Compliance Report and Summary of Detailed Manure Management Review findings for the HPP sites.

4.7.1 Farrowing Facility

The farrowing facility has agreed to comply with the spring manure application conditions in the 1998 Interim Permit, although the permit has expired. In addition to conditions in the Interim Permit, the farrowing facility must comply with any additional requirements in the revised Feedlot Rules (Minn. R. Chapter 7020). The farrowing facility is registered with Stevens County as required by the new state feedlot rules.

The farrowing facility has applied for coverage under the NPDES General Livestock Production Permit (MNG440000) and is currently awaiting approval. The NPDES General Permit is the standard operating permit for a facility with over 1000 AU capacity. The farrowing facility's Manure Management Plan (MMP) was updated, and a new application was submitted to MPCA to comply with the revised feedlot rules. The updated MMP is included in **Appendix B**. The MPCA is currently reviewing the permit documents, but cannot grant approval until the EIS process is completed. If the farrowing facility does not qualify for coverage under the General NPDES permit, HPP must apply for an Individual NPDES/SDS permit. The MPCA currently does not anticipate the need for the farrowing facility to apply for an Individual NPDES/SDS permit.

MPCA review of land application practices at the farrowing facility reveal that the site practices are compliant with regulations for manure and soil testing, manure application rates, and adherence to manure application setbacks. The farrowing site uses the land of other farmers for manure disposal. If the farrowing site is to continue to use other farmers' fields for manure application (such as Olson's), the farrowing site must have the appropriate field and application information within their MMP, perform field and manure testing, keep the appropriate land application records, and provide the field owners with the appropriate information for their records so that both the farmer and farrowing facility can show that nutrients from all sources were applied at agronomic rates. Therefore, HPP-FF must update their MMP annually and keep the updated MMP and annual manure application records available on site as required. Because HPP-FF has agreed to follow the conditions of the expired Interim Permit, they have been submitting the annual manure application records to MPCA each year.

Table 4-83 details requirements and site compliance with those requirements. HPP reports that it maintains setbacks from sensitive features. There is adequate manure application acreage for manure production at this facility.

Dead animal disposal practices at the farrowing facility appear to be compliant with applicable requirements. The facility's incinerator was earlier found to be non-compliant with Minn. R. 7011.1215 requiring an afterburner that maintains flue gases at 1,200^{o}F for a minimum of **.**3 seconds. The farrowing facility has since installed an afterburner to bring the incinerator into compliance. Pest control was found inadequate near barns and animal disposal areas during the recent inspection, and this was brought to the operator's attention. Animal burrows were subsequently filled in and traps were set to control vectors and pests.

Minnesota requirements for manure storage structures, feed storage areas and surface water drainage were met.

The facility has not reported its intent to pump and land apply manure to either Stevens County or the MPCA at least three days before pumping as required by the rules if the facility desires to be exempt from air quality requirements during this operation. The farrowing facility land applies manure by injection, which greatly attenuates air emissions from land application fields (Moseley *et al* 1998; Hanna *et al* 2000). Air impacts from fields are expected to be minimal.

4.7.2 Charles

The Charles site has not been constructed. The site's planned operations appear to comply with MN regulations according to the site's initial permit application. Actual compliance with regulations cannot be assessed until the site submits a new permit application in accordance with the new rules.

The Charles facility, if built, would land apply manure by injection, which greatly attenuates air emissions from land application fields (Moseley *et al* 1998; Hanna *et al* 2000). Air impacts from fields are expected to be minimal.

4.7.3 Greiner

The site is registered with the Pope County Feedlot Program. Greiner obtained the appropriate approval before construction of the HPP related barn.

MPCA review of the manure and soil testing records showed that they did not meet the requirements for record keeping for facilities with over 300 AU. Field location and approximate application rate information was obtained and reviewed and, based on estimates, nutrient application rates appeared to be in compliance with recommended agronomic rates based on expected crop yields. Greiner is required to keep records by the new rules, and is expected to comply with this requirement in the future. Greiner reports maintaining setbacks from sensitive features. There is adequate manure application acreage for manure production at this facility.

Minnesota requirements for manure storage structures, feed storage areas, pest control, and surface water drainage were met.

During the November 2001 MPCA inspection, agency personnel observed animal carcass residue near the barn although the facility reported that it was rendering mortalities. Greiner clarified that he had recently switched to using a rendering service and that the hog remains observed on the site comprised the old compost pile. During the October 2002 inspection, no hog remains were observed and the site was then termed compliant.

The facility has not reported its intent to pump and land apply manure to either Stevens County or the MPCA at least three days before pumping as required by the rules if the facility desires to be exempt from air quality requirements during this operation. The Greiner facility land applies manure by injection, which greatly attenuates air emissions from land application fields (Moseley *et al* 1998; Hanna *et al* 2000). Air impacts from fields are expected to be minimal.

4.7.4 Nohl

The site is registered with the Stevens County Feedlot Program. Nohl obtained the appropriate approval from the Stevens County Feedlot Program before construction of the HPP related barns.

Review of the manure and soil testing records indicate that the requirements for record keeping for facilities exceeding 300 AU capacity are met. Field location and manure land application rate information was obtained and reviewed, and nutrient application rates are in compliance with recommended agronomic rates based on expected crop yields. Nohl reports maintaining setbacks from sensitive features. There is adequate manure application acreage for manure production at this facility.

Minnesota requirements for manure storage structures, feed storage areas, pest control, and surface water drainage were met.

During the November 2001 MPCA inspection, an inadequate amount of cover material was noted on the compost pile. An inadequate amount of cover material was again noted on the compost pile during an October 2002 inspection. In addition, the compost pile is located on granular soil and is within a surface water flow path. Nohl is working with the BAH to construct an acceptable pad according to BAH rules so that surface water does not come into contact with compost pile material, and to implement better cover practices on the pile.

The facility has not reported its intent to pump and land apply manure to either Stevens County or the MPCA at least three days before pumping as required by the rules if the facility desires to be exempt from air quality requirements during this operation. The Nohl facility land applies manure by injection, which greatly attenuates air emissions from land application fields (Moseley *et al* 1998; Hanna *et al* 2000). Air impacts from fields are expected to be minimal.

4.7.5 Olson

The site is registered with the Stevens County Feedlot Program.

Because his facility is smaller than regulatory thresholds, Olson is not required to test manure or soil before applying the solid manure to his fields. Estimates of manure production indicate that Olson has adequate acreage to apply the manure according to recommended agronomic rates estimated using the University of Minnesota Extension Services published estimates. Olson reports maintaining setbacks from sensitive features. There is adequate manure application acreage for manure production at this facility. Manure from this facility is surface applied. Air emission impacts from surface application are expected to be minimal since this is a small facility that produces a relatively small volume of manure.

Site manure management data obtained from the farrowing and Olson operations indicate that these two facilities have in the past utilized a common field for land application of manure. This field is part of the Olson farm, and is located immediately south of the Olson feedlot site (*see* **Figures 2-5** and **2-17)**. Available evidence indicates that this has not resulted in overapplication of manure because both have always been required to apply manure at agronomic rates. However, as required in Minn. R. 7020, if the farrowing site is to continue to use fields on Olson's farm for manure application, the farrowing site must have the appropriate field and application information within their MMP, perform field and manure testing, and keep the appropriate land application records. Olson should also get a copy of the land application records for his files. For each cropping season, field owners (Olson in this case) should keep manure from different farms separate on land application fields as a best management practice and provide that information to the farrowing site for use in their MMP as required.

Olson's partial confinement barns have open lots, but have not been evaluated for an Open Lot Agreement (OLA), which Olson has not requested. An assessment for an OLA is not required until October 1, 2005. However, MPCA's initial observations concluded that the site does not appear to have a storm water impact problem due to the surface water runoff pattern that is directed toward an adjacent field and terminates there.

Minnesota requirements for feed storage areas and pest control were met.

During the November 2001 MPCA inspection, an inadequate amount of cover material was noted on the compost pile. During the October 2002 inspection, an inadequate amount of cover material was again noted on the compost pile and Olson was directed to increase the cover on the pile.

4.7.6 Paul

The site is registered with the Stevens County Feedlot Program. Paul obtained the appropriate approval from the Stevens County Feedlot Program before construction of the barn.

Review of the manure and soil testing records indicate that the requirements for record keeping for facilities with over 300 AU are met. Field location and application rate information was obtained and reviewed and nutrient application rates are in compliance with recommended agronomic rates based on expected crop yields. Paul reports maintaining setbacks from sensitive features. There is adequate manure application acreage for manure production at this facility.

Minnesota requirements for feed storage areas and pest control were met.

The sump drain from the perimeter tile drain around the manure pit was initially directed to drain into the wetland near the site. While not a compliance violation, this did pose a potential for a manure discharge to surface water. The MPCA requested that Paul redirect drainage and discharge water from the sump to a vegetated buffer, and this has been completed.

During the November 2001 MPCA inspection, an inadequate amount of cover material was noted on the compost pile. The compost pile was located close to the wetland and in the path of surface water flow towards the wetland. Soon after the November 2001 inspection, Paul eliminated this compost pile and began to bury his animal mortality. During 2002, Paul began rendering his animal mortality. During the October 2002 MPCA inspection, no violations were observed regarding the site's animal mortality management practices.

The facility has not reported its intent to pump and land apply manure to either Stevens County or the MPCA at least three days before pumping as required by the rules if the facility desires to be exempt from air quality requirements during this operation. The Paul facility land applies manure by injection, which greatly attenuates air emissions from land application fields (Moseley *et al* 1998; Hanna *et al* 2000). Air impacts from fields are expected to be minimal.

4.7.7 Schaefer

The site is registered with the Stevens County Feedlot Program. Schaefer obtained the appropriate approval from the Stevens County Feedlot Program before construction of the barn.

Review of the manure and soil testing records indicates that Schaefer has some of the records required for record keeping for facilities exceeding 300 AU capacity. Since the new rules require that such records be kept, Schaefer has been advised of this requirement, and it is expected that he will comply with this requirement in the future. Field location and application rate information was obtained and reviewed and nutrient application rates (from the available records) are in compliance with recommended agronomic rates based on expected crop yields. Schaefer reports maintaining setbacks from sensitive features. There is adequate manure application acreage for manure production at this facility.

During the October 2002 MPCA inspection, the manure was observed being pumped from the pits. No violations were observed during the pit emptying procedures.

Minnesota requirements for manure and feed storage areas were met.

Animal burrows were observed near the concrete pits. MPCA representatives recommended that the burrows be filled.

Deterioration of the fill immediately adjacent to the concrete pits were observed during an MPCA inspection and the MPCA representative recommended filling the holes to improve drainage away from the pits. Those corrections have been made.

During the November 2001 MPCA inspection, an inadequate amount of cover material was noted on the compost pile. Animal burrows were observed near the compost site. During the October 2002 MPCA inspection, the compost pile did not seem to working properly. The BAH was notified on both occasions. The BAH is currently working with Schaefer regarding operation of the compost pile.

The facility has not reported its intent to pump and land apply manure to either Stevens County or the MPCA at least three days before pumping as required by the rules if the facility desires to be exempt from air quality requirements during this operation. The Schaefer facility land applies most of its manure by injection, which greatly attenuates air emissions from land application fields (Moseley *et al* 1998; Hanna *et al* 2000). A small amount of manure from the older barns is intermittently surface applied. Air impacts from fields are expected to be minimal.

4.7.8 Solvie

The site is registered with the Pope County Feedlot Program. Solvie obtained the appropriate approval from the MPCA before construction of the barn.

Review of the manure and soil testing records indicates that Solvie has some of the records required for record keeping for facilities with over 300 AU. Since the new rules require record keeping, it is expected that Solvie will comply with this requirement in the future. MPCA followup to the inspection revealed that Solvie is now properly keeping land application records. Field location and application rate information was obtained and reviewed and nutrient application rates (from the available records) are in compliance with recommended agronomic rates based on expected crop yields. Solvie reports maintaining setbacks from sensitive features. There is adequate manure application acreage for manure production at this facility.

Manure storage structures consist of a concrete pit beneath the HPP barn and no violations were observed near that pit. The sidewalls of the pre-existing clay lagoon were noted to have trees and deep-rooted vegetation that were judged to be too close to the basin, potentially damaging the sidewalls. The MPCA representative recommended that a 5-foot perimeter be cleared of all trees and deep-rooted vegetation. Clean water diversions are also necessary to reduce the amount of clean water entering the basin. It appears that no discharges have occurred from the basin due to the above.

Minnesota requirements for feed storage areas and pest control were met.

During the November 2001 MPCA inspection, animal parts were observed in several locations and an inadequate amount of cover material was used at those locations. During the October 2002 MPCA inspection, the compost pile was consolidated and was judged to be functioning and operated properly. HPP now reports that Solvie no longer composts, and uses rendering exclusively to manage mortalities.

The facility has not reported its intent to pump and land apply manure to either Pope County or the MPCA at least three days before pumping as required by the rules if the facility desires to be exempt from air quality requirements during this operation. The Solvie facility land applies most of its manure by injection, which greatly attenuates air emissions from land application fields (Moseley *et al* 1998; Hanna *et al* 2000). A small amount of manure from the older barn is surface applied with immediate incorporation. Air impacts from fields are expected to be minimal.

4.7.9 Spohr

The site is registered with the Stevens County Feedlot Program. Spohr obtained the appropriate approval from the Stevens County Feedlot Program before construction of the barn. Review of the manure and soil testing records indicate that the requirements for record keeping for facilities exceeding 300 AU capacity are met. Field location and application rate information was obtained and reviewed and nutrient application rates are in compliance with recommended agronomic rates based on expected crop yields. Spohr reports maintaining setbacks from sensitive features. There is adequate manure application acreage for manure production at this facility. Minnesota requirements for manure storage structures, feed storage areas, pest control, and surface water drainage were met. During the November 2001 and October 2002 MPCA inspections, the site was found to be operating its compost pile according to animal mortality management requirements.

The facility has not reported its intent to pump and land apply manure to either Stevens County or the MPCA at least three days before pumping as required by the rules if the facility desires to be exempt from air quality requirements during this operation. The Spohr facility land applies most of its manure by injection, which greatly attenuates air emissions from land application fields (Moseley *et al* 1998; Hanna *et al* 2000). A small amount of manure from the older barns is surface applied with immediate incorporation. Air impacts from fields are expected to be minimal.

4.7.10 Zeltwanger

The site is registered with the Stevens County Feedlot Program.

Zeltwanger is required to keep records of soil tests, manure loading rates, and field location rates, none of which were provided. Estimates of manure production indicate that Zeltwanger has adequate acreage to apply the manure according to recommended agronomic rates estimated using the University of Minnesota Extension Services published estimates. Zeltwanger reports maintaining setbacks from sensitive features. There is adequate manure application acreage for manure production at this facility. Manure from this facility is surface applied. Air emission impacts from surface application are expected to be minimal since this small facility produces a relatively small volume of manure.

Minnesota requirements for manure storage structures, feed storage areas, pest control, and surface water drainage were met.

During the November 2001 and the October 2002 MPCA inspections no violations of animal mortality management regulations were observed. Zeltwanger reports that his mortalities are picked up for rendering.

4.7.11 Overall Compliance Issues

The HPP project was generally compliant with Minnesota requirements regarding feedlot operations and manure management practices. Although four of the sites did not have all of the required manure management records, the operators have been informed of this shortcoming and updated their records as applicable. Record keeping requirements are included in the revised feedlot rules, effective October 2000. All feedlot operators in the state must now comply with those requirements as appropriate.

4.8 POSITIVE/NEGATIVE EFFECTS OF PROJECT

4.8.1 Positive/Negative Effects of Project

The main benefits from the project are economic, largely to the HPP members, but also to the community.

The project was established in part to provide a stable supply of feeder pigs to the HPP members. This project will apparently provide that stable supply.

The project will produce additional jobs in the community, particularly at the farrowing/nursery facility. It will also provide additional opportunity for area businesses to provide products and services to the expanded operations.

The project may also allow the HPP members to better compete with hog producers outside of the HPP area. This project may also increase family income, owing to the expanded operation at many of the sites.

The Minnesota Department of Agriculture performed a modeling study (MDA 2002) of the economic impact of livestock processing plants in Minnesota. This study modeled combined economic impacts (direct, indirect, and induced) on the state and local economies in the billions of dollars annually.

The construction of new, deep pit barns has allowed the use of certain older facilities to be eliminated or greatly reduced. The Spohr manure basin has been replaced with a deep pit barn. This greatly reduced air emissions from the Spohr site. This may also provide less opportunity for leakage to ground water from the manure storage facilities. The older barns on the Schaefer site are now used only intermittently as housing for cull animals. This has considerably reduced the generation and land application of solid manure from this site.

As noted in **Section 2.2.3,** manure has value as a soil amendment, adding nutrients and organic matter to soil. Soil structure and water retention capability are enhanced by appropriate manure application.

4.8.2 Negative Effects of Project

The project will increase the volume of manure generated in the area owing to the expansion of the number of hogs raised at many of the sites. If not managed in accordance with applicable setbacks and appropriate loading rates, adverse impacts to ground water and surface water could occur. At present, the applicants report and the rules require adherence to setbacks and appropriate application rates. Aside from the manure generated at the farrowing/nursery site, the manure generation at the finishing sites should be unaffected by obtaining the feeder pig supply from HPP as opposed to another supplier.

Certain sites have land application areas that are underlain by granular soils. Application in these areas increases the chance for impact to shallow ground water. The MPCA and the counties currently require that land application on granular soils be limited to spring/early summer application, thus reducing the potential for shallow ground water impact.

Computer modeling has indicated that all sites, with the exception of Olson and Zeltwanger, will have an increase in air emissions from the expanded facilities. The modeling indicates that at the farrowing/nursery and Schaefer sites, exceedance of applicable air quality standards may occur.

The project uses subtherapeutic dosage of pharmaceuticals. This is common in the industry. There is consensus in the scientific community that this industry-wide practice is contributing to the development of pathogen resistance to antibiotics, although the sites probably do not contribute significantly to this problem on an individual basis.

Feedlots collectivley contribute significantly to greenhouse gas generation, but individual site contributions are insignificant.

4.8.3 Effects Potentially Requiring Mitigation

The predicted exceedance of the air quality standards at the farrowing/nursery site and the Schaefer site will require a review of alternatives to mitigate the anticipated emissions.

BAH reports that the facilities are in compliance with their rules, or are working to attain compliance, as the rules are enforced industry-wide. There is no mitigation proposed at this time.

5.0 MITIGATION MEASURES

5.1 SITE SPECIFIC MITIGATION MEASURES

In this section, each facility of the HPP project is reviewed to identify whether EIS findings in previous sections indicate the potential for significant environmental impacts. The results of this review will identify those conditions at each facility that may warrant assessment of mitigation alternatives to bring the facility into compliance or to protect against future violations. It is important to note that the discussion of predicted air quality violations and the associated mitigation needs are based on the computer modeling of each facility and not on data documenting an actual violation.

Minn.R. 7020.0300 subp. 23 defines a 300-foot buffer strip around wetlands and most intermittent streams and ditches as special protection areas. Minn. R. 7020.2225 subp. 6 places restrictions on manure application within special protection areas, including setbacks from the wetland, intermittent stream, or ditch and allowable phosphorus levels in the soil. All HPP operators must observe these requirements as appropriate, and they have reported that they do so.

5.1.1 Farrowing Facility

The farrowing/nursery facility is modeled to potentially violate the 5-day Minnesota ambient air quality standard (5-day standard) for hydrogen sulfide at the north and south property lines if the 21 ppb background concentration is included. The site also has the potential for off-site migration of annoying odors, based on the modeling results. The maximum hourly hydrogen sulfide concentration at the road right-of-way on the south side of the facility is modeled at 51.01 ppb. On the north property line the maximum hourly hydrogen sulfide concentration is modeled at 62.89 ppb. At both the north and south property lines the modeled concentrations with the 21 ppb background concentration are projected to exceed the 30-ppb standard more than twice within one or more 5-day periods.

The maximum tVOOC concentration at the north property line is 79.2 ug/m^3, which is above the 70 ug/m^3 threshold for annoying odors. However, by the time the odorous plume reaches the site's nearest neighbor approximately 1400 feet west of the site, its intensity is reduced to a detectable but non-annoying concentration, according to the modeling.

The facility is also required to update its MPCA feedlot permit application. HPP has submitted an updated permit application, dated June 21, 2001, which is currently being reviewed by the MPCA.

HPP reports that appropriate setbacks are observed at the farrowing site related to land application of manure. The facility has submitted annual manure management reports to the

MPCA and keeps the necessary records as required by the rules and feedlot guidance. HPP reports that the volume of manure that has been land applied on an annual basis has ranged from 0.58 to 5.86 million gallons. The facility reports that it has approximately 1,561 acres available for land application, which appears to be adequate to handle the volume of manure generated.

The farrowing site uses land application fields with both cohesive and granular soils. HPP has agreed to restrict fall application of manure to cohesive soils only. Therefore, no additional mitigation is required for application on granular soils unless the farrowing facility elects to apply manure on granular soils in the fall.

The facility reportedly freezes animal mortalities for subsequent composting and burns dead piglets (and occasional sows) in an on-site incinerator. The incinerator is now in compliance with all requirements.

5.1.2 Charles

The Charles site has not been built, but, if built as modeled, is anticipated to be in compliance with the air quality requirements when operational, based on air modeling. The predicted maximum concentrations of hydrogen sulfide and ammonia do not exceed regulatory levels at the property line.

The rules require that Charles conform to the specific setbacks during land application of manure. The Charles site is in an area of cohesive soil, so limitations on fall application are not applicable. The Charles site includes approximately 1,183 acres of land anticipated to be available for land application, which appears to be adequate for the volume of manure anticipated.

Charles plans on managing mortalities through composting.

5.1.3 Greiner

The Greiner site is modeled to be in compliance with the air quality requirements. The maximum modeled concentrations of hydrogen sulfide and ammonia do not exceed the regulatory levels at the property line.

The facility is registered with Pope County as required. Greiner reports that setbacks are complied with during land application of manure. The records provided by Greiner report annual manure volumes that have ranged from 280,000 to 360,000 gallons. Greiner reports that there are approximately 448 acres of land available for land application, which appears to be adequate for the volume of manure generated. The fields Greiner reportedly applies manure to are cohesive in nature.

Greiner manages mortalities through a rendering service.

Mitigation at this site is not required.

5.1.4 Nohl

The Nohl site is modeled to be in compliance with the air quality requirements. The predicted maximum concentrations of hydrogen sulfide and at the property line exceed the 30 ppm limit, but not for a frequency that would cause a violation of the 5-day standard.

The facility is registered with Stevens County as required. Nohl reports that setbacks are complied with during land application of manure, and that manure is applied to granular soil only in the spring/early summer. There is a potential to impact ground water if fall application of manure occurs on granular soil fields, and mitigation might be required in this event.

The records provided by Nohl report annual manure volumes that have ranged from 144,000 to 526,000 gallons. Nohl reports that there are approximately 1032 acres of land available for land application, which appears to be adequate for the volume of manure generated.

Nohl manages mortalities through composting. Inspection of the composting site by MPCA has identified that there was an inadequate amount of bulking material used in the compost pile and the pile was not placed on an impermeable pad. The BAH has requested that Nohl perform his composting on a compacted clay pad, which Nohl reportedly plans install. Nohl is working with the BAH to meet their requirements.

5.1.5 Olson

The Olson site is modeled to be in compliance with the air quality requirements. The predicted maximum concentrations of hydrogen sulfide and ammonia do not exceed the regulatory levels at the property line.

The facility is registered with Stevens County as required. Olson reports that setbacks are complied with during land application of manure. Olson has not been required to keep records, due to his facility size, but reports from experience that annual manure volumes have ranged from 415-480 cubic yards. Olson reports that there are approximately 200 acres of land available for land application, which appears to be adequate for the volume of solid manure generated.

Manure management data obtained from the farrowing and Olson operations indicate that these two facilities have in the past utilized a common field for land application of manure. This field is part of the Olson farm, and is located immediately south of the Olson feedlot site (*see* **Figures 2-5** and **2-17**). Available evidence indicates that this has not resulted in overapplication of manure because both have always been required to apply manure at agronomic rates. As required in Minn. R. 7020, if the farrowing site is to continue to use fields on Olson's farm for manure application, the farrowing site must have the appropriate field and application information within their MMP, perform field and manure testing, and keep the appropriate land application records. Olson should also get a copy of the land application records for his files. For each cropping season, field owners (Olson in this case) should keep manure from different farms separate on land application fields as a best management practice and provide that information to the farrowing site for use in their MMP.

Olson manages mortalities through composting. Inspection of the composting site by BAH initially noted that there was an inadequate amount of bulking material used in the compost pile. The MPCA Compliance report indicates the compost pile is now operated correctly.

5.1.6 Paul

The Paul site is modeled to be in compliance with the air quality requirements. The predicted maximum concentrations of hydrogen sulfide and ammonia do not exceed the regulatory levels at the property line.

The facility is registered with Stevens County as required. Paul reports that setbacks are complied with during land application of manure. The records provided by Paul report annual manure volumes that have ranged from 120,000 to 290,000 gallons. Paul reports that there are approximately 630 acres of land available for land application, which appears to be adequate for the volume of manure generated.

The MPCA inspection in November 2001 observed that the compost pile did not comply with setback requirements from surface water, and that the compost pile was placed in the drainage pathway from a field into the wetland. At the time of the BAH inspection on May 6, 2002, there were no signs of a compost pile near the surface water. Paul indicated that the compost pile had been removed and that he resumed burying animal mortality in the area next to the machine shed. Paul informed the MPCA during the October 2002 inspection that he now renders his mortality.

The Paul site had a direct discharge from the perimeter time system around the barns to a drain tile that led directly to the wetland at the site. If leakage from the storage pits had occurred, direct pumping of impacted water or manure could have resulted. Paul has now moved the outlet to a vegetated buffer area.

5.1.7 Schaefer

The Schaefer site is modeled to potentially violate the 5-day standard for hydrogen sulfide and has the potential for off-site migration of annoying odors. The maximum hourly hydrogen sulfide concentration (assuming a background concentration of 21 ppb) on the north property line is 31.31 ppb, and on the west property line it is 38.01 ppb for the current two-barn configuration (**Table 4-49**). The corresponding concentrations (with background) projected for the three-HPP finishing barn configuration are 35.21 ppb and 40.03 ppb, respectively (**Table 4-51**). Both the east and south property line concentrations (with background) are less than 30 ppb under both the two- and three-barn scenarios. For the two-barn configuration, only the west property boundary is projected to exceed the 30-ppb standard more than twice within any 5-day period. On the other hand, if the third HPP finishing barn is built, the 30- ppb standard is projected to be exceeded more than twice in any 5-day period along both the north and west property lines.

With the two-barn configuration, the maximum estimated tVOOC concentration is 83.55 ug/m^3 along the west property line. With an additional finishing barn, the estimated tVOOC concentration along the property line increases to 85.95 ug/m^3. Both of the projected concentrations exceed the 70ug/m^3 threshold representing annoying odors. Whether a third finishing barn is built or not, the maximum projected tVOOC concentration at the nearest neighbor, approximately 900 feet northwest of the barns, is less than the annoyance threshold of 70 ug/m^3.

The facility is registered with Stevens County as required. Schaefer reports that setbacks are complied with during land application of manure. The records provided by Schaefer report annual manure volumes that have ranged from 270,000 to 606,000 gallons. Schaefer reports that there are approximately 1,345 acres of land available for land application, which appears to be adequate for the volume of manure generated.

The easternmost land application fields used by Schaefer are located in an area of granular soil. If manure were to be applied on granular soils in the fall, there would be the potential to impact ground water. If Schaefer plans on applying manure in the fall to these fields, the threat to ground water would need to be addressed.

Schaefer manages mortalities through composting. The most recent BAH inspection did not observe active composting but noted that the pile location was acceptable. MPCA inspection noted that the compost pile did not appear to be operating correctly. The BAH has been notified and is working with Schaefer to improve the operation.

5.1.8 Solvie

The Solvie site is modeled to comply with the air quality requirements. The predicted maximum concentrations of hydrogen sulfide and ammonia do not exceed regulatory levels at the property line.

The facility is registered with Pope County as required. Solvie reports that setbacks are complied with during land application of manure. The records provided by Solvie report annual manure volumes that are approximately 900,000 gallons of manure, which includes direct precipitation into the storage basin. Solvie reports that there are approximately 1,040 acres of land available for land application, which appears to be adequate for the volume of manure generated. Some of the Solvie fields are granular in nature. If manure was applied on granular fields in the fall, there is the potential to impact ground water.

The MPCA inspection in November 2001 revealed a burial site with animal burrows evident and non-compliance with the animal disposal guidelines for burial (did not have three feet of cover). Solvie reports that he has buried mortalities in the past in different areas. This burial site has since been closed. Solvie composted at one time, but has reportedly ended this practice, and now uses rendering for mortality management.

5.1.9 Spohr

The Spohr site is modeled to comply with the air quality requirements. The predicted maximum concentrations of hydrogen sulfide and ammonia do not exceed the regulatory levels at the property line.

The facility is registered with Stevens County as required. Spohr reports that setbacks are complied with during land application of manure. The records provided by Spohr report annual manure volumes that have ranged from approximately 240,000 to 296,000 gallons of liquid manure and approximately 150 tons of manure/straw mixture. Spohr reports that there are approximately 1,000 acres of land available for land application, which appears to be adequate for the volume of manure generated.

None of the Spohr fields have granular soils.

Spohr manages mortalities through composting. Inspection of the composting site by BAH did not note any deficiencies with the composting operation.

5.1.10 Zeltwanger

The Zeltwanger site is modeled to be in compliance with the air quality requirements. The predicted maximum concentrations of hydrogen sulfide and ammonia do not exceed the regulatory levels at the property line.

The facility is registered with Stevens County as required. Zeltwanger reports that setbacks are complied with during land application of manure. Zeltwanger is required to keep records based to his facility size but has not provided any records for this report. Since the new rules require record keeping, Zeltwanger is expected to comply with this requirement in the future. He notes that from experience that annual manure volume of 1,600 tons of manure/straw mixture. Zeltwanger reports that there are approximately 692 acres of land available for land application, which appears to be adequate for the volume of solid manure generated.

Zeltwanger reportedly manages mortalities through a rendering service.

5.2 PENDING REGULATIONS THAT COULD EFFECT OPERATIONS OR COMPLIANCE

There are no pending regulations or laws that would have an effect on the project or the assessment of compliance.

On December 16, 2002, the Environmental Protection Agency (EPA) announced final rules for regulating livestock waste runoff from agricultural feeding operations. The new rules may impact the HPP project in the future. In Minnesota, MPCA is the state NPDES permitting authority that implements the federal NPDES program. The revised feedlot rule (Minn. R. ch. 7020) is the primary rule governing feedlots in Minnesota. At present, MPCA is authorized to implement the NPDES program using the revised feedlot rule. Therefore, all feedlots with more than 1000 animal units are required to obtain an NPDES permit in Minnesota. The farrowing facility is the only HPP facility with more than 1000 AU at this time.

There are ongoing efforts on both the national and international level to address the issue of subtherapeutic use of pharmaceuticals in the animal agriculture industry and the migration of endocrine disruptors in the environment. There are no pending regulations at either the state or federal level that would affect the use of pharmaceuticals in the animal agriculture industry. There has been federal legislation proposed in the past that would restrict the use of pharmaceuticals. Future changes in the law regarding this issue could affect the use of pharmaceuticals at the farrowing/nursery and by the project members.

5.3 MITIGATION MEASURES RECOMMENDED FOR CONSIDERATION

The EIS analysis has identified conditions at four facilities that require an assessment of mitigation measures or modifications to operating practices. The four sites that require consideration of mitigation are the farrowing/nursery site, and the Schaefer, Nohl and Solvie finishing sites.

The farrowing/nursery site and the Schaefer finishing site require a review of mitigation to deal with modeled violations of air quality standards at their compliance boundaries.

Some of the spreading fields used by the farrowing/nursery site and the Schaefer, Nohl and Solvie sites have granular soils. Land application of liquid manure on granular soils has the potential to impact ground water in the area. The listed applicants will need to take steps to protect ground water if fall application on granular soil fields is to occur.

Mitigation Measures

The measures to be assessed to deal with anticipated air quality violations include the following, in no particular order:

- Engineering controls (e.g. reduction of pit storage surface area, biofilters, non-thermal plasma, and manure treatment.
- Contractual or regulatory mitigation (e.g. easements and/or variances);
- Institutional mitigation (e.g. right of way relocation and roadway closure);
- Operational changes (e.g. diet manipulation, pit additives, and temperature control);

The measures to protect shallow ground water from impact from fall application of manure on granular fields include:

- Operational changes (e.g. move fall application to cohesive fields or develop a manure management plan outlining how fall application will not threaten ground water).

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6.0 MITIGATION ALTERNATIVES

As part of its Order resolving the EIS cost dispute, the Environmental Quality Board (EQB) mandated that a focused EIS document be prepared addressing the specific needs of this project. The EQB and MPCA Citizens Board also directed that the Generic Environmental Impact Statement on Animal Agriculture be used as a data source for the EIS analysis to the maximum extent possible, relying on other data sources only where necessary to fill data gaps. For these reasons, mitigation alternatives are described only for those issues identified in **Section 5.0** as posing a potential for environmental impact from this project, and mitigation alternatives analyzed are largely those addressed in the GEIS. The issues for which mitigation alternatives are discussed include emissions emanating from pit barns, protection of ground water during manure application and management of animal mortalities.

6.1 METHODS FOR MITIGATING PIT BARN EMISSIONS

Two GEIS documents, Jacobson *et al* (1999) and Earth Tech (2001a), provided detailed descriptions of the mitigation and emission control technologies currently available or under development within the field of animal agriculture. These two resources are the primary sources for the following descriptions of the operational methods available for the mitigation of pit barn emissions. A summary of these mitigation alternatives is also provided in Table 6-1.

6.1.1 Biofilters

Agricultural air emissions are considered to be highly biodegradable (Earth Tech 2001a), and biofilters take advantage of this fact. Biofilters function by passing contaminated air through media that is laced with aerobic microorganisms, which generally are the ubiquitous environmental microflora rather than any specialized inoculum. The microorganisms transform the contaminants to carbon dioxide, waters, salts, and biomass (Jacobson *et al* 1999). The technology is simple in concept; it is known for example that injection of manure in cropland greatly reduces the odor and other problematic gases from manure land application (Hanna *et al* 2000; Lessard *et al* 1997; Goulding *et al* 1996; Moseley *et al* 1998), and the reason is that the soil is acting as a biofilter.

Feedlot biofiltration has been well known and viable in Europe since at least the 1960s, and has been attracting interest in this country as well (Leson and Winer 1991, Janni *et al* 1998, both cited in Jacobson *et al* 1991). It can be done relatively cheaply, as evidenced by the fact that Nicolai and Janni (1997, 1998) have built successful biofilters from wooden fence posts, shipping pallets, and compost and kidney bean straw for the media. The same workers documented very high odor, hydrogen sulfide, and ammonia reduction rates in the biofilters they built and tested (Janni *et al* 1998; Nicolai and Janni 1998; Janni *et al* 1998).

Biofilters are relatively easy to operate and maintain. Media needs to be changed every several years, and must be kept moist, although Janni and Nicolai (1998) found that normal precipitation was sufficient for this purpose. Simple irrigation of the media can be employed if rainfall proves insufficient. Rodent and vegetation control is critical, in order to prevent channeling of airflow within the media. Spent media can be land applied, similar to manure.

Biofiltration is a proven odor control technology in industrial applications (Curran *et al* ND), as well as for fan ventilated livestock facilities (Jacobson *et al* 1999), and several such applications on curtain sided barns in Minnesota also appear to be working well (David Schmidt, UM Extension, personal communication). It appears to be a viable option in this case, particularly at the Hancock farrowing site, where the nursery barn, a fan ventilated building, appears to be the primary source of problematic emissions. Nicolai and Janni (1997) estimated the cost for a breeding, gestation, and farrowing facility at $0.28 per piglet.

6.1.2 Non-Thermal Plasma

Non-thermal plasma is a relatively new technology that is currently being researched by the University of Minnesota's Biosystems and Agricultural Engineering Department (Jacobson *et al* 1999). Emission reductions are achieved by creating highly reactive chemical species that convert targeted compounds to non-toxic molecules. Ruan *et al* (1997; cited in Jacobson *et al* 1999) showed 100 percent removal of NH_3 and H_2S concentrations during laboratory testing that employed a packed bed plasma system to treat gaseous samples collected from swine farms. It would potentially have application to feedlot gases collected from deep pit barns. This control technology is, however, still in its formative stage, and additional research is needed to determine its efficiency and economic feasibility.

6.1.3 Aerobic Treatment

Aerobic treatment processes have been described in detail by Jacobson *et al* (1999). The science behind aerobic treatment is well understood and aerobic treatment of livestock waste has seen resurgence over the past several years. New technologies include low-rate aeration systems, aerobic treatment following solids separation, aerobic treatment following anaerobic treatment, and facultative treatment by means of shallow aeration of the liquid phase and deep anaerobic treatment of the settleable solids. The primary disincentive to aerobic treatment has been the high cost of supplying oxygen to the waste.

Aerobic treatment is typically applied to separated liquid manure or dilute effluents that have been moved from the collection pit to a lagoon or digester tank. Screening or mechanical mixing may be required prior to aeration to deal with larger solids in the manure. Aeration creates a strong ozidizing environment in the waste, which decomposes the organic compounds associated with feedlot odor.

The fate of the nitrogen component of the slurry in an aerobic process is of particular importance. Nitrogen in livestock slurries is approximately equally divided between organic and inorganic (ammoniacal) nitrogen. The fate of nitrogen compounds during aeration is dependent on the treatment time, temperature and dissolved oxygen concentration (Svoboda, 1995; cited in Jacobson *et al* 1999). Ammoniacal nitrogen can be conserved or oxidized to nitrite and nitrate. Nitrate nitrogen in the treated slurry can be utilized as an oxygen source during storage, helping to prevent the development of anaerobic conditions in storage. There is a potential for the release of ammonia if the aeration level is not controlled properly, however.

The amount of oxygen required to oxidize organic matter in the manure can be determined from the biochemical oxygen demand (BOD). The minimum oxygen capacity should be twice the total daily BOD loading for complete oxidation of organic matter and also for converting ammonia to nitrate through the nitrification processes, with a hydraulic retention time of 10 days or more (NZAIE, 1984; cited in Jacobson *et al* 1999). Lower oxygen levels have been recommended as a lower cost alternative for partial odor control from livestock manure.

Biosolids will be produced during aerobic treatment, typically at a higher rate than would be typical for anaerobic treatment. These biosolids must be collected, transported, processed, stored, and utilized separately. There is a significant potential for odor production associated with the management of biosolids, although this may be minimized if the material is injected into soil.

Properly done, aerobic treatment is effective, and is currently in use on farms in the US. However, its use is not common due to relatively high capital and operating costs, and it can be labor intensive (Jacobson *et al* 1999). It typically requires that the manure be contained in a basin or container of some sort, within which the aeration process actually takes place. If a new container is needed for this purpose, this could be a significant infrastructure investment at the HPP facilities. If aeration could be performed in the existing manure pits, the cost may not be excessive, although a site specific evaluation would be required. An oxygenator for deep pits has been described by Gantzer *et al* (ND).

6.1.4 Anaerobic Treatment

Alone among the known feedlot air emission control methods, anaerobic treatment has the potential for recovery of some or all of the costs involved in treating the manure to reduce problematic emissions. In fact, properly designed and operated, anaerobic digestion may be a profit center for the farming operation (CAEEDAC 1999). The process produces methane, which can be burned to produce electricity, hot water, and/or space heat for use on the farm or elsewhere. Chynoweth *et al* 1998) reviewed the use of anaerobic digestion worldwide.

Anaerobic treatment can be performed in an open air "anaerobic lagoon," which is simply a lined basin that is managed to maintain low oxygen conditions in the water column. Such an application is not a good fit for the Hancock project, due in part to the need for very large basins, to which the manure would have to be moved to make the process work properly. Additionally, cold weather greatly limits the anaerobic activity; there is no control over environmental conditions; most of the nitrogen is lost to the atmosphere as ammonia; and, only very careful and daily management can prevent process imbalances that can cause significant odor release (Jacobson *et al* 1999). A successful anaerobic lagoon application (with biogas collection) at a 4000-sow farrow-to-wean facility in North Carolina has been described by Saele (ND), who indicates that such facilities may have the best chances for success in the southern US, where mild winter temperatures permit anaerobic digestion year round (see also Kramer 2002).

A more favorable anaerobic application at HPP facilities would involve contained treatment in a reactor vessel, rather than an open basin. Such anaerobic treatment has seen extensive development in Europe and especially in Germany, primarily due to favorable laws guaranteeing fixed rates for the electricity generated by utilization of the methane produced by the process (in 2002 there were 1650 farm-scale anaerobic digester installations in Germany alone, according to Kramer (2002)). One of the advantages of anaerobic treatment is that the nitrogen in the spent digestate is mainly in the form of ammonia, and therefore, directly available for plant uptake. All of the phosphorus would also remain in the digestate, since it is not volatile. Weed seeds and some pathogens are destroyed by the process, and vermin are not attracted to the digested waste (Jacobson *et al* 1999).

According to Krieg & Fischer Ingenieure GmbH (www.kriegfischer.de), there are numerous anaerobic biogas plants currently in operation in Germany, most of them agricultural, farm-scale plants. There are also several large-scale, centralized facilities in Denmark serving most of the livestock farms within a 6-mile radius (Jacobson *et al* 1999). At the time that the GEIS Literature Summary was prepared, there were reported to be 28 digesters operating in the US and 10 more under construction or planning. There were at that time no operating digesters in Minnesota.

Development since then has been rapid. A very successful digester has been installed and is now operating at a dairy in Isanti County (Nelson and Lamb 2000), and another has just been constructed at a dairy in Nicollet County. Kramer (2002) lists three midwestern US feedlot anaerobic digesters under construction, eight in startup, and six in operation, at the time of publication. Of these, one is a 2800 head swine finishing operation in startup, one is a 8300-head swine finishing facility in full operation, and one is a 5000 sow gestation-farrow facility, also in full operation. The others listed by Kramer are dairies. Many more digesters are in use nationwide (USEPA ND).

A typical farm-scale anaerobic digester/biogas system would consist of a sump to collect and transfer manure, an insulated, gas-tight steel or concrete digester tank, a container or outdoor basin to collect and store the spent digestate, and accessory equipment to collect and process the gases generated in the digester for the production of electricity and heat. At the Isanti County dairy, the product gas is burned in a diesel engine, which powers a generator for electricity production and also produces hot water and space heat for the facility. The digestate must be land applied, but its odor is greatly reduced while retaining most of the nutrient properties (Nelson and Lamb 2000).

There is now a significant number of feedlot anaerobic digesters in operation nationwide, and many of them were partially funded by the USEPA AgSTAR program, a federal program developed to encourage livestock producers to include methane recovery in their site management (Saele ND; USEPA ND).

Feedlot anaerobic digestion has not been a success everywhere it has been tried, but this may relate more to poor design and/or management than inherent flaws in the process (Jacobson *et al* 1999; Rozdilsky 1998). The best chances for success would involve good design, construction, and management (as evidenced by the success in Isanti County), deployment at a relatively large feedlot (Parsons 1984; cited in Jacobson *et al* 1999 recommends use at a 400-hog or larger facility), and management by a trained operator, who could be the feedlot manager, as is the case at the Isanti County dairy. The equipment is relatively complex and the initial investment is relatively high. The Isanti County unit was built with federal funding assistance. A significant digester consulting, design, and construction industry is now in existence, and Kramer (2002) has tabulated many firms who specialize in this area, as well as sources of funding and technical assistance to help get a project underway.

Anaerobic digestion in a reactor vessel would pose a significant infrastructure investment at the HPP sites. However, it is undeniably effective, and, if properly conceived and designed, also poses considerable cost recovery potential.

6.1.5 Easement

Minnesota Statutes, Chapter 116.0713 *Livestock Odor* identifies that “State ambient air quality standards are applicable at the property boundary of a farm or a parcel of agricultural land on which a livestock production facility is located, except that if the owner or operator of the farm or parcel obtains an air quality easement from the owner of land adjoining the farm or parcel, the air quality standards must be applicable at the property boundary of the adjoining land to which the easement pertains. The air quality easement must be for no more than five years, must be in writing, and must be available upon request by the agency or the county feedlot officer. Notwithstanding the provisions of this paragraph, state ambient air quality standards are applicable at locations to which the general public has access. ”

In general, this means that a feedlot operator whose facility is found to cause actual or potential exceedances or violations of air quality standards may mitigate the problem, not by reducing or treating emissions, but by moving the compliance boundary farther away from the emission source by means of odor easements, if the adjoining landowner(s) agree.

6.1.6 Variance

Minnesota Statutes Chapter 116.07, Subdivision 5, allows that “The pollution control agency may grant variances from its rules as provided in Section 14.05, subdivision 4, in order to avoid undue hardship and to promote the effective and reasonable application and enforcement of laws, rules, and standards for prevention, abatement, or control of water, air, noise and land pollution, adopted pursuant to said administrative powers and under the provisions of this chapter.” As outlined in Minn. Stat. 14.055, subd. 2, the agency may attach any conditions to the variance that it determines are needed to protect public health, safety, or the environment and those conditions are then considered an enforceable part of the rule to which the variance applies. This would not reduce the emissions, but would instead resolve the potential exceedances by eliminating the applicability of air quality requirements to the facility.

6.1.7 Right-of-Way Relocation

The relocation of rights-of-way is fairly common in the hard rock and aggregate mining industries where roads (and even cities) have been moved so that the material beneath them can be mined. This action has not, to MPCA’s knowledge, been utilized in Minnesota as mitigation for an air quality standards violation, presumably due to the cost and the availability of alternative means for mitigation. This is an issue in this case because the road adjoining the farrowing site on the south is a “location to which the public has access” within the meaning of Minn. Stat. 116, meaning that air quality standards must be enforced there. This road could be relocated to the south as a means of moving the compliance boundary away from the emission source. This would resolve the issue, not by reducing emissions, but by moving the compliance boundary farther from the source.

6.1.8 Diet Manipulation

While “…several researchers believe that our ability to modify livestock diets to significantly reduce odors is a promising mitigation measure...,” “…significantly more research is required to identify practical, cost effective dietary changes for each species" (Jacobson *et al,* 1999). Published research on this subject is limited. Most published research results have focused on dietary modification to reduce ammonia emissions, with only a few studies attempting to determine the effects of diet modification on odor or other feedlot emissions. Since the modeled violations identified in this EIS analysis involve, not ammonia, but hydrogen sulfide, there is little indication that this mitigation method is a good fit for this project.

Livestock diets have been manipulated by means of feed additives, changes in feeding management practices, selective feed ingredient use, enhanced precision in diet formulation, and dietary electrolyte balance. The results have been mixed, inconsistent, and/or not replicable. In some cases, various percentage reductions in various emission gases have been documented. In others, no changes have been observed, and in some, emissions actually increased. Some diet manipulation experiments resulted in decreased production of one or more pollutant parameters but simultaneous increases in others (*see* Jacobson *et al,* 1999; Earth Tech 2001a).

Research in this area appears to be in an early stage of development. While a variety of chemical additives and practices have been tried, and some show some promise, none have yet been shown to consistently and reliably reduce feedlot air emissions in the field on a continuing, cost effective basis. Results have often been reported as percentage decreases or increases, but the reported ranges are sometimes quite wide; Sutton *et al* (1999; cited in Earth Tech, 2001a) found that reduced-protein diets in hogs reduced ammonia production by 28-79%, for example. Not only is it not yet clear how a feedlot operator should employ diet manipulation to achieve results at the upper limit of this range on his particular feedlot, but knowledge of percentage reductions is only useful when it can be related to the mass of pollutants produced and the effects on air concentrations at the compliance boundary, and when it can be demonstrated that this percentage reduction can be reliably repeated in the field at reasonable convenience and cost. Further research may produce the answers to those questions.

6.1.9 Manure Pit Additives

Various chemical and biological additives have been introduced to manure pits to modify the biological and chemical activity in the pit in an effort to reduce emissions as well as to perform other functions such as facilitating breakdown of solids. Two additives are currently in use or have been proposed for use at the Hancock Pro Pork finishing facilities, Liqui-Blue™ and Barrier®. Information concerning these additives is provided in **Section 2.1.1.2**.

Manure pit additives generally fall under one of the following general categories: microbiological; masking; counteractants; adsorbents; absorbents; and chemical reactants. The following descriptions are taken from the Animal Agriculture GEIS Literature Review on Air Quality (Jacobson *et al* 1999).

* Microbiological additives generally are mixed cultures of enzymes or microorganisms designed to enhance the degradation of solids and reduce the volatilization of ammonia and/or hydrogen sulfide. These additives typically are intended to work either by metabolizing the odor causing material in manure, or by inhibiting odor causing biological processes by altering the enzyme structure in the manure.

* Masking agents cover one smell with another and are typically made from a mixture of compounds also having a strong, but less undesirable odor of their own. Generally speaking, masking agents can be effective for use as a short-term solution to an odor problem, but their viability as a long-term solution is limited by their degradability by the microorganisms present in manure. In addition, masking agents always increase the total odor level, and they do nothing to reduce the concentration of the contaminants in the emission, should those contaminants be present at concentrations exceeding the air quality standards.

* Counteractants do not react chemically with the malodor, but reduce the perceived odor level by eliminating the objectionable characteristics of the malodor. Counteractant chemicals neutralize the odors from phenols, amine, mercaptan, aldehydes, solvent odors, aromatics, and organic fatty acids. They usually lower or maintain the same odor level. Their effectiveness is not always predictable.

* Adsorbents and absorbents are biological or chemical materials that can collect odorous compounds on their surfaces (adsorb) or interiors (absorb). Examples are *Sphagnum* peat moss, sawdust, rice straw, sodium bentonite, and certain natural zeolites. Absorbents with a large surface area, such as sphagnum peat moss, have been found to reduce odor in some lagoons.

* Chemically-based additives act by chemically altering odorous compounds or enzymes and may also kill the bacteria that produce volatile organic compounds. Most chemical additives fall into one of four classifications. The four classifications and examples of each as identified by Jacobson *et al* (1999) are:

- *"Oxidizing Agents:* chlorine (as gas or sodium hypochlorite), potassium permanganate, and hydrogen peroxide will oxidize sulfides and inhibit sulfide production. Ozone has also been used as an oxidizing agent.

- *Precipitants:* iron and zinc salts will react with sulfides to form insoluble compounds. Ferrous and ferric chloride have been used for that purpose. This keeps hydrogen sulfide our of the air by making the sulfide non-volatile.

- *pH Control:* sodium hydroxide or lime can be added to manure to raise the pH, inhibiting sulfide production and preventing hydrogen sulfide off-gassing, but probably increasing ammonia production.

- *Electron Acceptors:* electron acceptors are taken up preferentially to the sulfate ion, and thus prevent sulfide formation. Sodium nitrate can be used for this purpose.

Early researchers rarely found any of the pit additive products tested to be effective in predictably and reliably reducing odor levels in swine manure. While, more recently, some experimenters have documented significant reductions in odors in tests of various pit additives, it has also been found that success in the laboratory does not necessarily translate to success in the field. The microbiological additives, for example, generally require fairly narrow manure temperature, moisture and pH ranges and relatively high application frequencies in order to optimally perform. Easily controlled in the lab, these conditions may be hard to replicate and manage successfully under operational conditions on the farm. Further, "although there exist bacterial genera or species that can decompose odorous compounds like VFAs [volatile fatty acids] to reduce odor emission, little success has been reported in using these microbes as manure additives to control odor generation in the field" (Jacobson *et al,* 1999).

In the case of manure additives, as with diet manipulation, there have been some promising results. However, this area of research is also still early in the process of developing practical application practices and technology for use in the field, and, so far, the reported percentage ranges for emission reductions have not been translated to reductions to acceptable levels at the compliance boundary.

The record regarding pit additives as practical feedlot emission controls is mixed at best. Despite the fact that some additives show potential, many others are considered of only marginal benefit in reducing feedlot odors (Earth Tech, 2001a).

6.1.10 Oil Sprinkling

Sprinkling of various types of vegetable oils inside animal buildings has been shown to effectively reduce airborne dust levels. The main thrust of research in this area has been concerned with occupational exposure to dust, rather than mitigation of dust emissions from feedlot buildings. However, a number of researchers such as Jacobson *et al* (1998), noting that many odorous feedlot gases preferentially adhere to airborne dust particles, have evaluated whether lowering the dust generation by oil sprinkling would also reduce odor emissions from a pig nursery barn. However, this gave only mixed results. If oil sprinkling is employed, dust is generally prevented from ever becoming airborne, and therefore will probably not be capable of adsorbing the odorous gases, which themselves are airborne and therefore readily air-entrained and exhausted by the barn ventilation system. Concern also exists regarding worker safety due to slippery floors and the additional time needed to clean the pens between groups of pigs.

6.1.11 Reduction of Emitting Surfaces

According to Voermans *et al* (1996; cited in Earth tech, 2001a), the emitting surface is equal to the sum of the areas of the manure pit and the fouled surfaces of walls, solid floor, slats, and animals. Theoretically, reducing this total area should result in lowered emission rates of odorous gases. A mitigation method becoming popular in Europe is use of V-shaped gutters under the slats in pig housing facilities. The experiments by Voermans *et al* (1996) showed ammonia emission reductions between 43 and 70 percent were achieved by altering the dimensions of the storage lagoon to reduce the emitting surface. Reduction of emitting surface provides a simple method for new or expanding feedlots to make reductions in air emissions without excessive additional costs (Earth Tech, 2001a). There is no evidence to date on the reduction of hydrogen sulfide emissions by use of this method, nor is it known how much the emitting surface would have to be reduced in order to achieve regulatory compliance at the fenceline.

6.1.12 Temperature Control

Earth Tech (2001a) notes that summer ammonia emission rates from feedlots is higher than the winter rate, indicating that reducing manure temperature may reduce the rate in summer as well. Voermans *et al* (1996; cited in Earth tech, 2001a) documented ammonia emission reductions of up to 50 percent by lowering the temperature of the manure. The optimum temperature for maximum reduction is not clear, nor is it clear that this method is capable of reducing emissions to below concentrations of concerns, nor is a practical and reliable means to achieve it in the field; however, additional research in this area could provide the answers. Since the air emission issues at the HPP sites involve hydrogen sulfide and odorous gases rather than ammonia, this does not appear to be a good fit for this project.

6.1.13 Shelterbelts/ Windbreak Walls

Shelterbelts are rows of trees or other vegetation, historically placed for wind and snow protection. They also provide a visual barrier. According to Jacobson *et al* (1999), a few commentators have expressed the opinion that shelterbelts may have value in feedlot odor reduction, either by trapping dust and odorous gases, or by diluting odors through airflow disruption. There is little research actually documenting the efficacy of shelterbelts in odor control, however, and whatever beneficial effects they provide would not be available until the vegetation matures, at least 3-10 (or more) years. What research exists appears to cast some doubt on the ability of windbreaks to reliably control emissions at a significant level (James

Sullivan 2003, personal communication). More development work is needed to determine proper placement, size, vegetational makeup, and actual performance.

Windbreak walls may be built with various media typically covering a wood or steel frame. A variation of a windbreak wall used in North Dakota utilizes a frame constructed of wood and "chicken wire" that is filled with straw. Typically, they are placed immediately downwind of the building exhaust fans, in order to interrupt the airflow away from the buildings. Their odor mitigation capabilities are based on limiting the movement of building dust away from the feedlot, either by trapping it in the wall media, or by reducing forward momentum of airflow, thus causing entrained dust to settle out of the airflow. This relies on the tendency, noted above, of feedlot gases to preferentially adhere to dust particles. Windbreak walls also force vertical dispersion (and thus dilution) of the exhausted plume. They are currently employed on 200 farms in Taiwan, and research is currently being conducted in this country to evaluate their effectiveness. So far, a number of factors have rendered a determination of their effectiveness difficult (Jacobson *et al* (1999), and it is not clear to what extent they mitigate odor impacts.

6.2 MITIGATION OF OPERATIONAL ISSUES

6.2.1 Mitigation of Threat to Ground water from Fall Application of Liquid Manure on Granular Soils

There is a potential to impact shallow ground water beneath fields with granular soils if manure is applied in the fall (Pain 1994). This risk can be reduced or eliminated through one or more of the following:

- Restrict fall application to fields with cohesive soils.
- Prepare a manure management plan that illustrates how fall application of liquid manure will be conducted so as not pose a threat to shallow ground water.

6.2.2 Management of Animal Mortalities

Compost pile construction and operations at compost sites within the HPP project do not strictly comply with compost site requirements in the BAH animal mortality regulations. Construction of covered compost piles on impervious, weight bearing pads with roofs overhead, temperature monitoring and recording in daily logs, use of adequate bulking material over and under animal carcasses, and a written composting protocol at each site would be required to strictly comply with animal composting regulations. BAH does not usually require these things if inspections show, in the inspector's judgement, that the compost pile is working correctly and does not pose obvious environmental impact potential. BAH may require them if in its judgement they are required to correct a problem at a given site.

BAH's rules also provide for enforcement action and fines for repeated failure to come into compliance. However, BAH prefers to work with operators at problem sites to correct the problems, and performs follow up inspections to assure that compliance is being achieved. BAH's regulatory program is almost entirely complaint driven; staff limitations prevent a routine inspection program.

Site specific inspections by a BAH personnel at compost sites within the HPP project indicate satisfactory compliance with BAH mortality management policies.

6.3 MITIGATION OF SOCIAL AND ECONOMIC IMPACTS

In order to mitigate the socioeconomic impacts associated with new feedlot development and operation, the GEIS (Wright *et al* 2001) recommends that existing institutions with credibility in rural areas do the following:

1. Explore with producers, community leaders, and other stakeholders ways to expand livestock production that (1) demonstrate the connection between livestock production and community viability, (2) respect neighbors and their quality of life, and (3) protect and enhance the natural environment.

2. Initiate discussion groups, policy seminars, and conferences for producers, community leaders, policy makers, and other state and local stakeholders, where the many issues of livestock expansion can be discussed and mutually acceptable alternatives developed.

3. Institute improved responsiveness, local presence, and better coordination among state agencies at the most local level through state initiatives and increased funding for staff activities.

4. Develop more programs to assist small and mid-sized producers who are not using confinement animal production systems to fulfill environmental stewardship responsibilities.

5. Working with producers, establish and promote marketing alternatives for small-sized producers and those not engaged in contract production.

6. Initiate a comprehensive examination of the meat and poultry procession industries in Minnesota, identifying the connections [among] production, processing, and social and community impacts.

6.4 APPLICATION TO HANCOCK PRO PORK FACILITIES

Of the mitigation measures summarized above, only certain measures would address the issues at a specific site. A listing of those measures or technologies that are applicable for each site is provided below. In addition, the Nohl, Olson and Solvie facilities had noted deficiencies with their animal mortality practices. The deficiencies are judged to be minor in nature and should be easy to correct. In addition, the facilities that pump liquid manure have not been notifying the County or State of their pumping schedule as required to take advantage of the air quality exception during pumping and land application. They are not required by law to do this, but must do so if they want to take advantage of the pumping exemption in the law. This, again, can easily be corrected by making minor changes to operating practices, if they choose to do so.

6.4.1 Farrowing Facility

To address the pit barn emissions, the following technologies or measures are appropriate for consideration, in no particular order:

- Air Filtration/Biofilters
- Aerobic Treatment
- Anaerobic digestion in a reactor vessel
- Variance
- Right of Way Relocation

Other air emission control methods may be considered on a case-by-case basis, but would require more of a demonstration of potential for success than has been found to date in the literature or documented field experience. Data on empirical chemistry or biological action, parameters controlled, successful trials at field scale, convenience and ease of application, lack of unwanted side effects, and potential to achieve compliance with prescribed thresholds would all need to be included in the evaluation. Selection of a variance or road relocation may in addition require that the farrowing facility obtain an odor easement or additional land from nearby landowners.

To address the potential threat to ground water from fall application on granular soil, the following may be considered:

- Apply manure only in the spring on granular soil.

- Prepare a Manure Management Plan for MPCA approval that describes procedures that will protect ground water during fall application on granular soil.

6.4.2 Alan Charles Finishing Facility

No mitigation is required at this facility.

6.4.3 Gary Greiner Finishing Facility

No mitigation is required at this facility.

6.4.4 John Nohl Finishing Facility

To address the potential threat to ground water from fall application on granular soil, the following should be considered:

- Apply manure only in the spring on granular soil.

- Prepare a Manure Management Plan for MPCA approval that describes procedures that will protect ground water during fall application on granular soil.

6.4.5 Mike Olson Finishing Facility

No mitigation is required at this facility, except that to address the field overlap issue, the HPP farrowing site (and any other source of manure applied to Olson's land) must show in its Manure Management Plan how manure applied on his land that originates from other feedlots will be managed to eliminate the potential for groundwater impacts (see **Section 6.4.1)**.

6.4.6 David Paul Finishing Facility

No mitigation is required at this facility.

6.4.7 Stanley Schaefer Finishing Facility

The following technologies or measures appear to be appropriate for consideration to address the pit barn emissions:

- Air Filtration/Biofilters
- Aerobic Treatment
- Anaerobic digestion in a reactor vessel
- Easement
- Variance

Other air emission control methods may be considered on a case-by-case basis, but would require more of a demonstration of potential for success than has been found to date in the literature or documented field experience. Data on empirical chemistry or biological action, parameters controlled, successful trials at field scale, convenience and ease of application, and potential to achieve compliance with prescribed thresholds would all need to be included.

To address the potential threat to ground water from fall application on granular soil, the following should be considered:

- Apply manure only in the spring on granular soil.
- Prepare a Manure Management Plan for MPCA approval that describes procedures that will protect ground water during fall application on granular soil.

6.4.8 Jere Solvie Finishing Facility

If in the future Solvie elects to land apply manure on granular soils, to address the potential threat to ground water from fall application on granular soil, the following should be considered:

- Apply manure only in the spring on granular soil.
- Prepare a Manure Management Plan for MPCA approval that describes procedures that will protect ground water during fall application on granular soil.

6.4.9 Wayne Spohr Finishing Facility

No mitigation is required at this facility.

6.4.10 John Zeltwanger Finishing Facility

No mitigation is required at this facility.

6.4.11 Permit conditions

Sections 6.1-6.4 analyze the available and feasible potential permit conditions applicable to the HPP sites. Upon the conclusion of the environmental review process, the appropriate regulatory authorities will develop specific mitigation methods to be employed where they are needed. These will be chosen from the list above.

7.0 ALTERNATIVES ANALYSIS

7.1 NO-BUILD

The No-Build scenario assumes that the HPP project is not built and that none of the HPP members would expand their respective operations. Under this scenario, only Olson, Zeltwanger, Spohr, Schaefer, and Solvie would have hog operations in the area. Under this scenario there are no modeled air quality violations or discharge sumps leading to surface water bodies. There could be similar operational deficiencies related to animal mortalities, but, as discussed previously, these could be easily managed and corrected. There would be no need to assess or implement the mitigation measures noted in **Section 6.0**.

7.2 AS-BUILT WITHOUT MITIGATION

The As-Built scenario with no mitigation would consist of a ten-facility operation that has predicted air emissions above established standards at two of the ten sites. Only one site, the farrowing/nursery site, is predicted to violate air quality standards in areas of public access. These exceedances are predicted by modeling, not actually measured; it is not confirmed that emission exceedances actually exist, although the magnitude of the modeled exceedances would suggest that they do. With no mitigation, there is the potential that the public that uses the roadway south of the farrowing facility could experience odors and hydrogen sulfide concentrations above levels of concern. In addition, the Schaefer neighbor to the west could also experience exposure to air emissions above levels of concern when near the Schaefer barns.

7.3 MITIGATED AS-BUILT

The EIS analysis has identified conditions at four facilities that require an assessment of mitigation measures or modification to operating practices. The four sites that require consideration of mitigation are the farrowing/nursery site, and the Nohl, Schaefer and Solvie finishing sites. The farrowing/nursery site and the Schaefer finishing site require a review of mitigation to deal with predicted exceedances of air quality standards at their compliance boundaries. The farrowing/nursery site, and the Schaefer, Nohl and Solvie finishing sites need to address the risk to ground water from fall application of manure on granular soil fields if they choose to use those fields for fall application.

The measures to be considered to deal with predicted air emission exceedances include the following:

- Engineering controls (biofilters, air filtration, aerobic treatment, anaerobic digestion in a reactor vessel);

- Contractual or regulatory mitigation (easements and/or variances);
- Institutional mitigation (right of way relocation and roadway closure);

The measure to deal with the potential to impact ground water from fall application of liquid manure on fields underlain with granular soil includes:

- Operational changes (commit to fall application of liquid manure on only cohesive soil, or prepare a Manure Management Plan for fall application on granular soil).

7.3.1 Farrowing Facility

A group of alternatives appear to be feasible and likely effective in reducing the predicted emissions from the barns at the site. The modeling suggests that the majority of emissions emanate from the nursery barn and the mitigation measures would accordingly need to be focused on that barn. The list of alternatives is discussed below.

- Engineering controls (windbreak walls, biofilters, non-thermal plasma, aerobic treatment, and anaerobic digestion in a reactor vessel).

HPP could implement engineering controls at the facility to reduce the emissions generated, treat or disperse the emissions, or treat the manure. Treatment of emissions through biofilters is a viable method of achieving the needed reduction in emissions from the site. Technology such as non-thermal plasma and anaerobic treatment would likely require significant change to the existing structures and capital expenditures to install and operate the equipment. As noted above, anaerobic digestion may allow some cost recovery, and there may be government funding assistance available. Aerobic treatment may not require significant infrastructure changes if an approach similar to that described by Gantzer Environmental *et al* (ND) is used.

- Contractual or regulatory mitigation (easements and/or variances);

HPP could petition the MPCA for issuance of a variance from the applicable air quality standards. If approved, this would address the issue by modifying standards applicable to this site.

- Obtain easements at property boundaries; and
- Institutional mitigation (right of way relocation and roadway closure).

HPP could petition Stevens and Swift Counties to either relocate the roadway leading past the site farther to the south or close the roadway in front of the facility and turn it into a private access road. HPP would also likely need to purchase sufficient property to move the compliance point a sufficient distance south of the roadway, or obtain an easement for the purpose from the current property owner.

To address the threat to ground water from fall application of liquid manure to granular soil fields, the farrowing/nursery site could either commit to conduct fall application only on fields comprised of cohesive soil, or rewrite its Manure Management Plan for MPCA approval that would outline procedures for fall application on granular soil fields that would not threaten ground water.

7.3.2 Stanley Schaefer Finishing Facility

A group of alternatives appear to be feasible and likely effective in reducing the predicted emissions from the barns at the site. The modeling suggests that the predicted violation of standards is due to barn proximity to the property line. Mitigation measures would thus likely need to be focused on all three barns at the site, although they may not be required at all of the barns to achieve the needed reduction in emissions. The list of alternatives is discussed below.

- Engineering controls (windbreak walls, biofilters, non-thermal plasma, aerobic treatment, and anaerobic digestion in a reactor vessel).

Schaefer could implement engineering controls at the facility to reduce the emissions generated, treat or disperse the emissions, or treat the manure. Treatment of emissions through biofilters is a viable method of achieving the needed reduction in emissions from the site. Technology such as non-thermal plasma and anaerobic treatment would likely require significant change to the existing structures and capital expenditures to install and operate the equipment. As noted above, anaerobic digestion may allow some cost recovery, and there may be government funding assistance available. Aerobic treatment may not require significant infrastructure changes if an approach similar to that described by Gantzer Environmental *et al* (1995) is used.

- Contractual or regulatory mitigation (easements and/or variances);

Schaefer could attempt to obtain an easement from the adjacent property owner. If obtained, this would address the issue by obtaining contractual approval for the emissions to migrate onto private property.

To address the threat to ground water from fall application of liquid manure to granular soil fields, Schaefer could either commit to conduct fall application only on fields comprised of cohesive soil or prepare a Manure Management Plan for MPCA approval that would outline procedures for fall application on granular soil fields that will not threaten ground water.

7.3.3 John Nohl Finishing Facility

Some of the fields used by Nohl for manure application have granular soils. To address the threat to ground water from fall application of liquid manure to granular soil fields, Nohl could either commit to conduct fall application only on fields comprised of cohesive soil, or prepare a Manure Management Plan for MPCA approval that would outline procedures for fall application on granular fields that will not threaten ground water.

7.3.4 Jere Solvie Finishing Facility

Some of the fields used by Solvie for manure application have granular soils. While Solvie reports that he does not currently apply to granular soils, he may elect to do so at some future point. In this event, to address the threat to ground water from fall application of liquid manure to granular soil fields, Solvie could either commit to conduct fall application only on fields comprised of cohesive soil, or update his Manure Management Plan for MPCA approval to outline procedures for fall application on granular fields that will not threaten ground water.

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