Pondera Colony

Source Water Delineation and Assessment Report

11/99

Pondera Colony
Public Water System

PWSID # MT0003744

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List of Acronyms

BMP - Best Management Practices

CAFO - Confined Animal Feeding Operation

CECRA - Comprehensive Environmental Cleanup and Responsibility Act

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

LUST - Leaking Underground Storage Tank

MCL - Maximum Contaminant Level

MBMG-GWIC - Montana Bureau of Mines and Geology – Ground Water Information Center

MPDES - Montana Pollutant Discharge Elimination System

NPDES - National Pollutant Discharge Elimination System

PWS - Public Water System.

RCRA - Resource Conservation and Recovery Act

SMCL - Secondary Maximum Contaminant Levels

SWDAR - Source Water Delineation and Assessment Report.

SWPP - Source Water Protection Plan

SWL - Static Water Level

SOC - Synthetic Organic Compounds

TMDL - Total Maximum Daily Load

UST - Underground Storage Tank

VOC - Volatile Organic Compounds

See glossary at end of text for definitions of acronyms and other terms used in this report

INTRODUCTION

This Delineation and Assessment Report was completed by James Swierc with the Source Water Protection Program at the Department of Environmental Quality with the assistance of William Waldner and David Waldner with Pondera Colony. This Source Water Delineation and Assessment Report was prepared for the Pondera Hutterite Colony Public Water Supply, PWS ID# 3744, located in Pondera County.

PURPOSE

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Pondera Colony PWS as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182).

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is "delineation and assessment". Delineation is a process of mapping source water protection areas, which contribute water used for drinking. Assessment involves identifying locations or regions in source water protection areas where contaminants may be generated, stored, or transported, and then determining the relative potential for contamination of drinking water by these sources. The primary purpose of this source water delineation and assessment report is to provide information that helps the Pondera Colony PWS complete a source water protection plan to protect its drinking water source.

Limitations

This report was prepared to assess threats to the Pondera Colony public water supply, and is based on published information and information obtained from local residents familiar with the community. The terms "drinking water supply" or "drinking water source" refer specifically to the source of the Pondera Colony public water supply and not any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the area of the Pondera Colony public water supply are identified. Only potential sources of contamination in areas that contribute water to its drinking water source are considered.

The term "contaminant" is used in this report to refer to constituents for which maximum concentration levels (MCLs) have been specified under the national primary drinking water standards, and to certain constituents that do not have MCLs but are considered to be potentially represent health threats.

CHAPTER 1
BACKGROUND

The Community

The Pondera Hutterite Colony is located in Pondera County, in north-central Montana, as shown in Figure 1. The nearest town with commercial services is Valier (population 519), located approximately 10 miles northeast of the colony. There are approximately 83 residents at the colony. The economy of the colony relies on the production of a variety of agricultural products.

The Colony complex comprises several residential buildings, a kitchen building, and several other facilities that support the agricultural activities at the colony. A map showing the layout of the colony is included with Appendix A. There are two wells for the PWS. The initial well is located on the southeastern part of the colony complex adjacent to the water storage tank. The second well is located approximately one-half mile north of the storage tank, outside of the central part of the colony.

Domestic wastewater is treated in a two-cell lagoon treatment system located north of the main colony buildings. Animal waste from the barns is collected and stored in a central storage harvestore, and disposed by land application as fertilizer to cropland.

Geographic setting

Pondera Colony is located in the foothills to the east of the central part of the Rocky Mountain Front Range (see Figure 1). The mountains in this area represent a significant feature with peaks that rise over 4,000 feet above the plains. The colony is located on a bedrock bench between and away from any major drainages. An eastward flowing irrigation canal is present south of the colony. The colony is located in the unglaciated region between the recent continental glaciers to the east, and mountain glaciers to the west.

The climate is typical of northern Montana, with a limited amount of precipitation averaging 12.02 inches a year as measured at the weather station at the Conrad Airport. The wettest months are May and June averaging 1.88 and 2.69 inches monthly, respectively. The driest months are October through March, with monthly averages ranging from 0.32 to 0.61 inches per month. The temperature ranges from an average high of 82.5 °F in July (minimum July average of 49.6 °F) to an average of 30.9 °F in January (minimum January average of 5.8 °F).

General description of the Source Water

The Pondera Colony water system uses two wells for their PWS. The main well is located within the central part of the colony, and the backup well is located approximately one-half mile north of the main part of the colony (Figure 1). The area is located within the Two Medicine River watershed (USGS Hydrologic Unit Code 10030201), located within the Lower Missouri River Watershed Management Region for Montana.

There are no published reports on ground water hydrology in the vicinity of Pondera Colony. The PWS wells are approximately 160 and 140 feet deep. Based on the lithology reported on the well logs (Appendix A) and regional geology, the source is interpreted to be sandstones in the Two Medicine Formation. The aquifer is interpreted to be confined, with a static water level reported at approximately 20 feet below the ground surface. Ground water flow in the PWS source aquifer near the colony is considered likely to flow generally southeastward following topography towards the Two Medicine River.

The Public Water Supply

The main supply well is located approximately within the main colony complex, with an active backup well located approximately one-half mile north of the colony. The configuration of the public water supply for

Pondera Colony includes a storage tank located in the water storage building adjacent to the main colony well. Water is disinfected with chlorination before it enters the storage tank, which feeds to the colony distribution system. Since Pondera Colony is relatively new, a formal sanitary survey has not been completed. Information on the water system was obtained from planning document, included in Appendix A.

The water system for Pondera Colony serves the resident population of 83 people through 5 active service connections located in the colony residential and other buildings. An additional service connection at the colony is considered inactive at this time. The general layout of the colony buildings and distribution system is depicted in Appendix A. The primary well (Source 002) pumps water to a storage tank that feeds water to the colony. The backup well (Source 003) is used intermittently, as needed, depending on the needs of the colony and the yield of the well. A gravity distribution system feeds water to the service connections in the colony. The water is disinfected with hypochlorination before it enters the storage tank.

The well lithology and construction logs for the main well and the backup well are included in Appendix B. The system operator estimates water usage averages approximately 8,500 gallons per day, or about 6 gallons per minute.

Water Quality

Every PWS is required to perform monitoring for contamination to their water supply. The monitoring constituents include coliforms and other signs of pathogenic organism, nitrates, metals and for multiple chemicals. The monitoring schedule depends on many factors such as the size and source water for a PWS, the number of sources (e.g. wells), and the population served. Each PWS has a specific monitoring program tailored to their system that follows the general protocols for operation of a PWS defined by DEQ. A review of the DEQ PWS database indicates that monitoring results for the Pondera Colony PWS show no violations or exceedences of any drinking water quality standards. The only detected compound that is regulated is nitrate, which can occur naturally or from human and animal waste. The health standard for nitrates, the MCL, is 10 mg/L. The monitoring results for the potable water supply indicate nitrate levels ranging from 0.15 mg/L to 0.82 mg/L over the last five years.

CHAPTER 2
DELINEATION

The source water protection area, the land area that contributes water to Pondera Colony is identified in this chapter. Three management areas are identified within the source water protection area. These three regions, the control zone, inventory region, and recharge region, are delineated for both wells. The control zone, also known as the exclusion zone, is an area at least 100-foot radius around each well. The inventory region for the confined aquifer is defined as an area with a 1,000-foot radius around each wellhed. The recharge region represents the area where the source aquifer for the Pondera Colony water system wells is replenished.

Hydrogeologic Conditions

There are no published reports on the hydrogeology of the immediate area around Pondera Colony. The following discussion of the hydrogeologic setting of the area is based on available information on the area, and assumptions based on basic principles of hydrogeology. The assumptions are discussed in the following. A generalized geologic map of the area around Pondera Colony, adapted from Ross et. al. (1955), is depicted in Figure 2. Additional geologic information was obtained from well logs for the area from the Ground Water Information Center at the Montana Bureau of Mines (Appendix B).

The Pondera Colony is located on a bedrock plain above the valleys of any of the major drainages that have incised into the bedrock surface of the area. The Two Medicine River is located to the south and southeast of the main colony area. The aquifer is present in sandstones of the Two Medicine Creek Formation (see well logs in Appendix B). Fracture flow may represent the primary porosity for the aquifer, especially in more fine-grained layers. The primary aquifer for the Pondera Colony is considered confined in consolidated sandstone bedrock. Based on this criteria, the aquifer is classified as having a ***low*** source water sensitivity to contamination.

Ground water flow in the vicinity of Pondera Colony is considered to be generally south to southeast, following topography. The source wells do not have a high continuous yield, suggesting that ground water flow in the aquifer is relatively slow. The aquifer is recharged by infiltration of surface water and precipitation into the subsurface in the upgradient area west of the well. Ground water flow in the aquifer occurs in the primary porosity of the sandstone, and in fractures in the bedrock which provide secondary porosity. Shales and other fine-grained rock units within the Two Medicine Formation may keep the local aquifer system perched above any deeper regional systems that may be present in the area.

Conceptual Model and Assumptions

Ground water is recharged from infiltration of surface water and precipitation into the subsurface in the area west and northwest of the Pondera Colony PWS wells. Ground water flow in the area generally follows the topographic gradient to the southeast towards the Two Medicine River.

Well(s) Information

The well logs for the source wells for the Pondera PWS is included in Appendix B. The wells are 160 and 140 feet deep. Important information on the well is summarized in Table 1. According to the well logs, the yield of each well is 16 gpm.

Table 1. Source well information.

Information	Well 1	Well 2
PWS Source Code	002	003
Well Location	T29N, R6W, Sec 29 ccd	T29N, R6W, Sec 29 bab
MBMG #	128522	128524
Water Right #	81147	81148
Date Well was Completed	March 30, 1992	June 26, 1992
Total Depth	160 feet	140 feet
Perforated Interval	Not listed	40 to 60 feet and 100 to 120 feet
Static Water Level	21.8 feet bgs	17 feet bgs
Pumping Water Level	120 feet bgs	140 feet bgs
Drawdown	95.2 feet	123 feet
Test Pumping Rate	16 gpm	16 gpm
Specific Capacity	0.17 gpm/foot drawdown	0.13 gpm/foot drawdown

Methods and Criteria

The source water protection management areas were defined for a confined aquifer in accordance with the requirements of the DEQ Source Water Protection program (DEQ, 1999). In order to support source water protection planning efforts, an informal recharge zone is delineated based on a one-mile radius around the PWS well, biased towards the area hydrologically upgradient from the wells. The complete recharge area is considered to be the Two Medicine River watershed area to the west of Pondera Colony.

Delineation Results

The delineated management zones for the wells are depicted in Figure 3. The control zone comprises an area of a 100-foot radius around each wellhead. The inventory zone reflects an area with a 1,000-foot radius around the wellheads. The recharge area reflects the area to the east of the colony PWS wells, with a one-mile radius buffer area depicted to help with assessing susceptibility and management options.

As a tool to support source water protection planning for Pondera Colony, ground water flow rates are conservatively estimated using the uniform flow equation. The data used for the assessment, assumptions and calculation summaries are included in Appendix C. Based on these estimates, ground water flow rates are an estimated 485 feet (0.09 miles) for a one year time of travel, and 925 feet (0.18 miles) for a three year time of travel.

Limiting Factors

The lack of site and regional hydrogeologic data represent the greatest potential source of error to accurate delineations of the management zones for the water sources at Pondera Colony. The inventory zone expanded to a one-mile radius provides a conservative approach that helps to minimize the potential effects from the lack of hydrologic data for the area.

CHAPTER 3
INVENTORY

An inventory of potential sources of contamination was conducted for the Pondera Colony PWS within the control and inventory regions. Potential sources of all primary drinking water contaminants and Cryptosporidium were identified, however, only significant potential contaminant sources were selected for detailed inventory. The significant potential contaminants in the Pondera Colony PWS inventory region are nitrates and pathogens from animal barns and the sewer system at the colony, and herbicides/pesticides and fertilizer from cropped agricultural land.

The inventory for Pondera Colony PWS focuses on all activities in the control zone, certain sites or land use activities in the inventory region, and general land uses and large facilities in the recharge region.

Inventory Method

The inventory for Pondera Colony was obtained by visiting the colony, and discussing colony activities with representatives from the colony. Information on the PWS, land use, agricultural chemical storage and application, and waste disposal practices were identified at this time.

Urban and agricultural land uses were identified from the University of Montana GAP landuse analysis project (Redmond et. al., 1998). The land use assessment data predates the construction of Pondera Colony, and indicates the colony location as cropped agricultural land. Major transportation routes through the area, including railroad lines, were also identified. This information is depicted in Figure 4.

As part of the standard inventory process, the information in available databases on environmental sites was reviewed. EPA's Envirofacts System was queried to identify EPA regulated facilities located in the Inventory Region. This system accesses facilities listed in the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), Permit Compliance System (PCS) and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS). DEQ Databases were queried to identify the following in the inventory region: Underground Storage Tanks (UST), hazardous waste contaminated sites (DEQ hazardous waste site cleanup bureau), landfills , abandoned mines, and active mines including gravel pits. Any information on past releases and present compliance status was noted.

No facilities were identified with this search.

Inventory Results/Control Zone

The control zone for the main PWS well is located within the colony grounds. The control zone for the second PWS well is within an area that is cropped agricultural land. Neither control zone is fenced or otherwise identified around the wellheads. The primary potential contaminant sources result from the application of farm fertilizers, herbicides or pesticides.

Inventory Results/Inventory Region

The inventory region for the main PWS well includes the buildings in the main colony complex area west of the well. Potential contaminants sources to the PWS wells are shown in Figure 5 and summarized in Table 2. The potential contaminant sources in the inventory zone include spilled fuels and other farm chemicals, human and animal wastes, crop fertilizers and herbicides. The primary hazards are spills of fuels or temporarily stored pesticides and herbicides, spills of animal wastes stored for land application, excess application of herbicides

and runoff from the cropped areas, and from land application of animal wastes.

The inventory region for the backup PWS well is primarily cropland, including the area west of the well. Potential contaminants sources to the backup PWS well, as identified in the inventory zone, include animal wastes, crop fertilizers and herbicides. The primary hazards are excess application of herbicides and runoff from the cropped areas (Table 2), and from Land Application of animal wastes.

Inventory Results/Recharge Region

The recharge region for the main PWS well includes the main colony building area, and the surrounding area comprised primarily of agricultural cropland, with some areas used for open range cattle grazing. The recharge area for the backup PWS well is primarily cropland and open agricultural land. A one-mile buffer zone around the wells is depicted in Figure 4 to aid in assessing the relative threats of the potential contaminant sources in the region. Use of weed control herbicides and fuels for farm machinery are the contaminants of concern in the recharge region. For the main colony PWS well, the colony buildings and animal process areas are also located within the recharge area. The colony buildings and process areas are depicted in Figure 5, with their location relative to the PWS wells and the inventory zones.

Table 2. Significant potential contaminant sources**.**

Source	Hazard
Control and Inventory Zones – Main PWS Well (Source 002)	
Chicken, Dairy and Calf Barns	Leaking Sewer Lines or Waste Collection System
Cropped Agricultural Land	Land Application of Animal Waste Spills and Excess Application of Herbicides
Fuel/Chemical Storage	Spills
General Colony Area	Waste Chemical spills
Control and Inventory Zones – Backup PWS Well (Source 003)	
Cropped Agricultural Land	Land Application of Animal Waste Spills and Excess Application of Herbicides
Recharge Area – Main PWS Well (Source 002)	
Additional Barns	Leaking Sewer Lines or Collection System
Corral Runoff Collection Area	Leakage or infiltration
Harvestore for Hog/Dairy Manure	Leakage or spill in handing waste material
Slaughterhouse	Leaching from Animal Wastes
Housing	Leaking Sewer Lines
Wastewater Treatment Lagoons	Leakage from lagoons
Fuel/Chemical Storage	Spills
Recharge Area – Both PWS Wells (Source 002 and Source 003))	
County Roads	Spill or Accident from Transported Chemicals or Fuels
Colonywide	Waste Chemical Spills
Cropped Agricultural Land	Land Application of Animal Waste Spills and Excess Application of Herbicides

Inventory Update

The certified operator should update the inventory every year for his records. Changes in land uses or potential contaminant sources should be noted and additions made as needed. The complete inventory should be submitted to DEQ every five years.

Inventory Limitations

The potential sources of contaminants for Pondera Colony are taken from data and reports that are readily available. Consequently, unregulated activities or unreported contaminant releases may have been missed. The use of multiple sources of data, however, should help assure that contaminant sources that are identified represent the major threats to the source water for Pondera Colony.

CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case the Pondera Colony PWS.

The goal of Source Water Management is to protect the source water by 1) controlling activities in the control zone, 2) managing significant potential contaminant sources in the Inventory Region, and 3) ensuring that land use activities in the Recharge Region pose minimal threat to the source water. Management priorities in the Inventory Region are determined by ranking the significant potential contaminant sources identified in the previous chapter according to susceptibility. Alternative management approaches that could be pursued by the Pondera Colony PWS to reduce susceptibility are recommended.

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to the Pondera Colony PWS wells (Table 3). Hazard is rated by the proximity of a potential contaminant source to the well(s). Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant (Table 4).

Table 3. Relative susceptibility to specific contaminant sources based on hazard and barriers.

Presence Of Barriers	**Hazard**		
	High	**Moderate**	**Low**
No Barriers	Very High Susceptibility	High Susceptibility	Moderate Susceptibility
One Barrier	High Susceptibility	Moderate Susceptibility	Low Susceptibility
Multiple Barriers	Moderate Susceptibility	Low Susceptibility	Very Low Susceptibility

For confined aquifers, hazards for point sources are assigned based on the presence of other wells in the inventory zone, and how the PWS well and other wells in the area are constructed. If the PWS well is not sealed through the confining layer, than the relative hazard for any potential contaminant source within the 1,000-foot inventory area is assigned a relative hazard of high, and those within the one-mile buffer zone are assigned a relative hazard of moderate. If the PWS well has a seal through the confining layer, but other wells are present in the 1,000-foot inventory zone that do not have a seal, then the relative hazard is moderate for point sources in this area and low for potential sources within the remainder of the buffer zone. If all wells in the inventory region have effective seals through the confining layer, then the relative hazard is considered low for point sources within the 1,000-foot inventory area, and very low for other sources within the buffer zone.

When the location of septic systems are known, they are treated as point sources, with hazards assigned based on the above criteria. For non-point sources, the relative hazard is assigned the same for both confined and unconfined aquifers. For residential areas with multiple septic systems with only estimated locations and thus an estimated density, they are treated as non-point sources with hazards assessed following non-point source

criteria. For non-point sources, primary hazard levels are assigned based on the relative concentration of the sources within the inventory zone, based on the following table:

Source Type	***High Hazard***	***Moderate Hazard***	***Low Hazard***
Septic Systems	> 300 per sq. mi.	50 – 300 per sq. mi.	< 50 per sq. mi.
Municipal Sanitary Sewer (% Land Use)	> 50% of region	20% – 50% of region	< 20% of region
Cropped Agricultural Land(% Land Use)	> 50% of region	20% – 50% of region	< 20% of region

The well construction information the Pondera Colony PWS wells indicate that proper seals were installed around both wellheads, consistent with requirements for PWS well installation. According to records from MBMG-GWIC, the only other wells within a one-mile radius are approximately 10 shallow monitoring wells from the Montana Salinity Control Project, and 2 additional shallow wells (Appendix B). None of these wells are installed to the aquifer depth of the Pondera Colony PWS Well. Based on this criteria, any point potential contaminant sources within the inventory zone would be assigned a relative susceptibility hazard of low. The hazard from cropped agricultural land is rated as high, since the majority of the inventory region is active agricultural land.

There are no natural barriers for the main PWS well, as the well log indicates predominantly gravel at the surface, overlying sandstone bedrock material. For the backup PWS well, a natural barrier from agriculture is clay-rich soils that may adsorb and attenuate any excess fertilizer or herbicides applied to the cropland. Well logs for this PWS well (Appendix B) indicate topsoil over 34 feet of clay. In addition, since the use of chemicals in the colony is limited, an additional barrier of using best management practices (BMPs) for chemical use is assigned as a barrier for both wells.

The results of the susceptibility assessment are summarized in Table 4, with recommended management actions. The results indicate that cropped agricultural land and related activities represent the greatest relative hazard for contamination to both PWS well. The location of the backup PWS well away from the central part of the colony provides a measure of protection to potential impacts to water quality in the wells.

Table 4. Susceptibility assessment of significant potential contaminant sources**.**

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Control and Inventory Zone – Main PWS Well (Source 002)						
Chicken, Dairy and Calf Barns	Pathogens and Nitrate	Infiltration and Runoff	Low	None	Moderate	Dispose of Waste Outside Inventory Region
Cropped Agricultural Land	SOCs/Nitrates	Leaching and Runoff	High	BMPs for handling	High	Apply Chemicals According to Label Instructions
Fuel/Chemical Storage and General Colony Grounds	VOCs, SOCs; Various other	Spills	Low	BMPs for handling	Low	Recycle / Dispose of Waste Chemicals Properly
Control and Inventory Zone – Backup PWS Well (Source 003)						
Cropped Agricultural Land	SOCs/Nitrates	Leaching and Runoff	High	Clay-rich soils, BMPs for handling	Moderate	Apply Chemicals According to Label Instructions
Recharge Area (Main PWS Well (Source 002)						
Additional Barns and Slaughterhouse	Pathogens and Nitrates	Spills, Infiltration	Very Low	None	Low	Dispose of Waste Outside Inventory Region
Corral Runoff Collection Area	Pathogens and Nitrate	Leakage	Very Low	None	Low	Monitor operation and performance of storage cell
Harvestore	Pathogens and Nitrate	Leakage	Very Low	None	Low	Monitor integrity of storage unit, Dispose of waste outside inventory region
Housing	Pathogens and Nitrate	Leakage from sewage lines	Very Low	None	Low	Monitor integrity of sewer lines
Human and Animal Waste Lagoons	Pathogens and Nitrate	Leakage	Very Low	None	Low	Monitor operation and performance of lagoons
Fuel/Chemical Storage	VOCs, SOCs	Spills	Very Low	BMPs for Handling	Very Low	Recycle / Dispose of Waste Chemicals Properly
County and Colony Access Roads	VOCs, Pathogens and Nitrate	Spills	Very Low	None	Low	Develop emergency response plan
Colonywide	VOCs, SOCs	Spills	Very Low	None	Low	Recycle / Dispose of Waste Chemicals Properly
Cropped Agricultural Land	SOCs, Nitrates	Infiltration and Runoff	Low	BMPs for handling	Very Low	Communicate with upgradient landowner, apply chemicals according to label instructions
Recharge Area (Backup PWS Well Source 003)						
County and Colony Access Roads	VOCs, Pathogens and Nitrate	Spills	Very Low	Low Permeability Soils	Very Low	Develop emergency response plan
Cropped Agricultural Land	SOCs, Nitrates	Infiltration and Runoff	Low	Low Permeability Soils; BMPs for handling	Very Low	Communicate with upgradient landowner, apply chemicals according to label instructions

REFERENCES

Alden, W.C., 1932. Physiography and Glacial Geology of Eastern Montana and Adjacent Areas; U.S. Geological Survey Professional Paper 174.

Fetter, C.W., 1994. Applied Hydrogeology, Macmillan College Publishing Co., New York, NY.

Heath, R., 1982. Basic Ground Water Hydrology, U.S. Geological Survey Water Supply Paper 2220.

Montana Department of Environmental Quality (DEQ), 1999. Montana Source Water Protection Program.

Redmond, R.L., M.M Hart, J.C. Winne, W.A. Williams, P.C. Thornton, Z. Ma, C.M. Tobalske, M.M. Thornton, K.P. McLaughlin, T.P. Tady, F.B. Fisher, and S.W. Running, 1998. The Montana Gap Analysis Project: final report. Unpublished report. Montana Cooperative Wildlife Research Unit, The University of Montana, Missoula.

Ross, C.P., Andrews, D.A., and I.J. Witkind, 1955. Geologic Map of Montana; United States Geological Survey, in cooperation with the Montana Bureau of Mines and Geology.

Todd, D.K., 1980, Ground Water Hydrology, John Wiley and Sons, New York, NY.

United States Environmental Protection Agency (EPA), 1993. Seminar Publication – Wellhead Protection: A Guide for Small Communities, EPA/625/R-93/002.

GLOSSARY*

Acute Health Effect. A negative health effect in which symptoms develop rapidly.

Alkalinity. The capacity of water to neutralize acids.

Aquifer. A water-bearing layer of rock or sediment that will yield water in usable quantity to a well or spring.

Barrier. A physical feature or management plan that reduces the likelihood of contamination of a water source from a potential contaminant source

Best Management Practices (BMPs). Methods for various activities that have been determined to be the most effective, practical means of preventing or reducing pollution.

Biennial Reporting System (BRS). An EPA database that contains information on hazardous waste sites. The data can be accessed through the EPA Envirofacts website.

Chronic Health Effect. A negative health effect in which symptoms develop over an extended period of time.

Class V Injection Well. Any pit or conduit into the subsurface for disposal of waste waters. The receiving unit for an injection well typically represents the aquifer, or water bearing interval.

Coliform Bacteria. A general type of bacteria found in the intestinal tracts of animals and humans, and also in soils, vegetation and water. Their presence in water is used as an indicator of pollution and possible contamination by pathogens.

Community. A town, neighborhood or area where people live and prosper.

Confined Animal Feeding Operation (CAFO). Any agricultural operation that feeds animals within specific areas, not on rangeland. Certain CAFOs require permits for operation.

Confined Aquifer. A fully saturated aquifer overlain by a confining unit such as a clay layer. The static water level in a well in a confined aquifer is at an elevation that is equal to or higher than the base of the overlying confining unit.

Confining Unit. A geologic formation present above a confined aquifer that does not allow the flow of water, maintaining the pressure of the ground water in the aquifer. The physical properties of a confining unit may range from a five-feet thick clay layer to a shale that is hundreds of feet thick.

Comprehensive Environmental Cleanup and Responsibility Act (CECRA). Passed in 1989 by the Montana State Legislature, CECRA provides the mechanism and responsibility to clean up hazardous waste sites in Montana.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Enacted in 1980. CERCLA provides a Federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. Through the Act, EPA was given power to seek out those parties responsible for any release and assure their cooperation in the cleanup. The Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) provides information about specific sites through the EPA Envirofacts website.

Delineation. The process of determining and mapping source water protection areas.

Geographic Information Systems (GIS). A computerized database management and mapping system that allows for analysis and presentation of geographic data.

Hardness. Characteristic of water caused by presence of various calcium and magnesium salts. Hard water may interfere with some industrial processes and prevent soap from lathering.

Hazard. A relative measure of the potential of a contaminant from a facility or associated with a land use to reach the water source for a public water supply. The location, quantity and toxicity of significant potential contaminant sources determine hazard.

Hydraulic Conductivity. A constant number, or coefficient of proportionality, that describes the rate water can move through an aquifer material.

Hydrology. The study of water and how it flows in the ground and on the surface.

Hydrogeology. The study of geologic formations and how they effect ground water flow systems.

Inventory Region. A source water management area for ground water systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified three year ground water travel time.

Leaking Underground Storage Tank (LUST). A release from a UST and/or associated piping into the subsurface.

Maximum Contaminant Level (MCL). Maximum concentration of a substance in water that is permitted to be delivered to the users of a public water supply. Set by EPA under authority of the Safe Drinking Water Act to establish concentrations of contaminants in drinking water that are protective of human health.

Montana Bureau of Mines and Geology – Ground Water Information Center (MBMG/GWIC). The database of information on all wells drilled in Montana, including stratigraphic data and well construction data, when available.

Montana Pollutant Discharge Elimination System (MPDES). Database system to track entities that discharge wastewater of any type into waters of the State of Montana.

National Pollutant Discharge Elimination System (NPDES). A national database system to track entities that discharge wastewater.

Nitrate. An important plant nutrient and type of inorganic fertilizer that can be a potential contaminant in water at high concentrations. In water the major sources of nitrates are wastewater treatment effluent, septic tanks, feed lots and fertilizers.

Nonpoint-Source Pollution. Pollution sources that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. Nonpoint sources of pollution, such as the use of herbicides, can concentrate low levels of chemicals into surface and/or ground waters at increased levels that may exceed MCLs.

Pathogens. A microorganism typically found in the intestinal tracts of mammals, capable of producing disease.

Point-Source. A stationary location or fixed facility from which pollutants are discharged.

Permit Compliance System (PCS). An EPA database that provides information on the status of required permits for specific activities for specific facilities. The data can be accessed through the EPA Envirofacts website.

Public Water System. A system that provides water for human consumption through at least 15 service connections or regularly serves 25 individuals.

Pumping Water Level. Water level elevation in a well when the pump is operating.

Recharge Region. A source water management region that is generally the entire area that could contribute water to an aquifer used by a public water supply. Includes areas that could contribute water over long time periods or under different water usage patterns.

Resource Conservation and Recovery Act (RCRA). Enacted by Congress in 1976. RCRA's primary goals are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner. The Resource Conservation and Recovery Information System (RCRIS) provides information about specific sites through the EPA Envirofacts website.

Secondary Maximum Contaminant Levels (SMCL). The maximum concentration of a substance in water that is recommended to be delivered to users of a public water supply, based on aesthetic qualities. SMCLs are non-enforceable guidelines for public water supplies, set by EPA under authority of the Safe Drinking Water Act. Compounds with SMCLs may occur naturally in certain areas, limiting the ability of the public water supply to treat for them.

Section Seven Tracking System (SSTS). SSTS is an automated system EPA uses to track pesticide producing establishments and the amount of pesticides they produce.

Source Water. Any surface water, spring, or ground water source that provides water to a public water supply.

Source Water Assessment Report. A report for a public water supply that delineates source water protection areas, performs an inventory of potential contaminant sources within the delineated areas, and evaluates the relative susceptibility of the source water to contamination from the potential contaminant sources under "worst-case" conditions.

Source Water Protection Areas. For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply. For ground water sources, the area within a fixed radius or three-year travel time from a well, and the land area where the aquifer is recharged.

Spill Response Region. A source water management area for surface water systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified four-hour water travel time in a stream or river.

Static Water Level (SWL). Water level elevation in a well when the pump is not operating.

Susceptibility (of a PWS). The relative potential for a PWS to draw water contaminated at concentrations that would pose concern. Susceptibility is evaluated at the point immediately preceding treatment or, if no treatment is provided, at the entry point to the distribution system.

Synthetic Organic Compounds (SOC). Man made organic chemical compounds (e.g. herbicides and pesticides).

Total Dissolved Solids (TDS). The dissolved solids collected after a sample of a known volume of water is passed through a very fine mesh filter.

Toxic Release Inventory (TRI). An EPA database that compiles information about permitted industrial releases of chemicals to air and water. Information about specific sites can be obtained through the EPA Envirofacts website.

Transmissivity. A number that describes the ability of an aquifer to transmit water. The transmissivity is determined by multiplying the hydraulic conductivity time the aquifer thickness.

Unconfined Aquifer. An aquifer containing water that is not under pressure. The water table is the top surface of an unconfined aquifer.

Underground Storage Tanks (UST). A tank located at least partially underground and designed to hold gasoline or other petroleum products or chemicals, and the associated plumbing system.

Volatile Organic Compounds (VOC). Chemicals such as petroleum hydrocarbons and solvents or other organic chemicals which evaporates readily to the atmosphere.

* Definitions adapted from EPA's Glossary of Selected Terms and Abbreviations (http://www.epa.gov/ceisweb1/ceishome/ceisdocs/glossary/glossary.html)

Estimates of Ground Water Flow Rates

Methods and Criteria

The source water protection areas were delineated using the uniform flow equation. The lack of any specific data on hydrologic characteristics of the area limits the accuracy of the calculated estimates of hydrologic flow rates. The use of the uniform flow equation assumes that flow within the sandstone is uniform through primary porosity, and that the fracture system enhancing effective porosity is uniform through the aquifer. To address the uncertainties in the flow system, all estimated property values reflect conservative assumptions to ensure that proper management zones reflect all potential contaminant sources that may impact the Pondera Colony water supply.

Model Input

The hydrologic parameter values used for the flow rate calculations are summarized in Table 3 and described in the following, with the criteria for selection of each value:

- ***Transmissivity***: The transmissivity value is calculated from the specific yield of the PWS well using the method described in Driscoll (1980) for confined aquifers, where:

  Q/s = T/2000; or T = 2000 Q/s

  Q = pumping rate, gpm – 16 gpm

  s = drawdown, in feet – 100 feet note: Q/s = specific capacity

  T = Transmissivity, in gpd/ft

  The estimated value for Transmissivity is 320 gpd/ft, which equals 43 ft^2/day
- ***Thickness***: The thickness of the aquifer for the water source was estimated as 10 feet, based on the approximate thickness of the lowest sandstone screened for the PWS wells.
- ***Hydraulic Conductivity***: A value for hydraulic conductivity is estimated using the basic relationship

  T = Kb, where T = transmissivity – 43 ft2/day

  b = aquifer thickness – 10 feet

  The estimated value for the hydraulic conductivity (K) is 4.3 ft/day. A rounded value of 5 ft/day is used as a conservative estimate for this assessment.
- ***Hydraulic Gradient***: The hydraulic gradient was estimated at 50 feet/mile, or 0.01 feet/feet.
- ***Porosity***: The value for effective porosity is estimated from Heath (1989) at 20%.
- ***Pumping Rate***: The pumping rate was estimated at 16 gpm, based on estimated well yield.

Results

Ground water flow in the PWS aquifer, based on the above assumptions, travels an estimated distance of 485 feet (0.096 miles) in a one-year period. The three year time of travel distance is estimated at 9,25 feet (0.18 miles).

Pondera Colony Public Water Supply
Summary of Time of Travel Calculations

Property		**Units**	
porosity	n	percent	0.2
Hyd Cond	K	ft/day	5
Hyd Grad	I	ft/ft	0.01
Pumping Rate	Q	gpm	16
		ft3/day	3080
Aquifer Thickness	b	feet	10
Distance Upgradient to Null Point			
Null Distance	Xl	feet	980
		miles	0.19
Lateral limits of Zone of Contribution			
Boundary Limits	Y	feet	3080
		miles	0.58

Time of Travel Calculations

Distance Traveled		**Time of Travel**	
feet	miles	days	years
1000	0.19	1406.74	3.40
100	0.02	48.48	0.05
500	0.09	570.78	1.05
1000	0.19	1406.74	3.40
2500	0.47	4167.76	13.78
5000	0.95	8978.01	35.34
5280	1.00	9522.90	37.92
7500	1.42	13865.10	58.97
10000	1.89	18784.44	83.58
10560	2.00	19889.12	89.17
15000	2.84	28670.22	134.30
15840	3.00	30334.83	142.95
21120	4.00	40813.48	197.84
31680	6.00	61818.56	309.30
485	0.09	363.82	1.00
925	0.18	1094.15	3.00
2005	0.38	3653.20	10.00