

Hidden Lake Colony Public Water System

PWSID # MT0003932

Source Water Delineation and Assessment Report

11/99

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David Hofer,
Certified Operator

P.O. Box 188
Cut Bank, Montana 59427

phone: (406) 336-3695



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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 David Hofer with Hidden Lake Colony. This Source Water Delineation and Assessment Report was prepared for the Hidden Lake Hutterite Colony Public Water Supply, PWS ID# 3932, located in Glacier County. Hidden Lake Colony is located within the Blackfeet Indian Reservation.

Purpose

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Hidden Lake 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 Hidden Lake Colony PWS complete a source water protection plan to protect its drinking water source.

Limitations

This report was prepared to assess threats to the Hidden Lake 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 Hidden Lake 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 Hidden Lake 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 potentially represent health threats.

The classification of significant potential contaminant sources is based on the hydrogeologic setting, the integrity of the PWS well and other wells in the area, and the location and type of potential contaminant sources. The classification of a PWS source as highly susceptible to contamination from a specific significant potential contaminant source is not meant to imply that the well is currently or will be contaminated by that or any other potential source. The classification of susceptibility is meant to provide a relative measure of the potential for that contaminant source to impact water quality in the aquifer and PWS well under worst-case conditions.

CHAPTER 1

BACKGROUND

The Community

The Hidden Lake Hutterite Colony is located in Glacier County, in north-central Montana ([Figure 1](#)). The colony is located within the external boundaries of the Blackfeet Indian Reservation. The nearest town with commercial services is Cut Bank (population 12,121), located approximately 12 miles east of the colony. There are approximately 75 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 active wells for the PWS. The active well is located approximately one mile south of the main colony complex, at the location of the homestead of the former owners of the property. The second PWS well was installed and activated with the system in the second half of 2000. The new well is located several hundred feet northwest of the older well.

Domestic wastewater is treated in a two-cell lagoon treatment system located east of the main colony buildings. Liquid animal waste from the barns is collected and stored into a harvestore for storage prior to disposal by land application. Solid animal waste is disposed with the liquid waste by land application to cropland. The location of the wastewater treatment cells in relation to the main colony complex and the PWS wells is shown in Figure 1.

Geographic Setting

Hidden Lake Colony is located in the foothills to the east of the central part of the Rocky Mountain Front Range in Glacier National Park. 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 the southern edge of the Seville Flats, a thin terrace of unconsolidated alluvium that represents the former floodplain level of the drainage system present at a time before ice-age glaciation covered parts of the area. Glacial deposits are present covering the bedrock in the area south and west of Hidden Lake Colony.

Spring Creek and Flat Coulee flow east in the closest drainage to the colony, located in the same valley approximately one mile south of the colony. The colony PWS wells are located along the Two Medicine Irrigation Canal, which flows east on the north side of the valley hillside parallel to Spring Creek ([Figure 1](#)). The Two Medicine Canal brings water from the Two Medicine River across the watershed boundary into the Cut Bank Creek watershed. The major surface water bodies in the vicinity include Carlow Lake located approximately one mile north of the colony and Mission Lake located approximately two miles south of the colony in the Flat Coulee drainage. The Two Medicine Canal flows around the north side of Mission Lake.

The climate is typical of northern Montana, with a limited amount of precipitation averaging 11.8 inches a year as measured at the Cut Bank Airport. The wettest months are May and June averaging 1.9 and 2.7 inches a monthly, respectively. The driest months are October through March, with monthly averages ranging from 0.3 to 0.5 inches per month. The temperature ranges from an average high of 79.5°F in July (minimum July average of 49.9°F) to an average of 27.6°F in January (minimum January average of 6.7°F).

General Description of the Source Water

The Hidden Lake Colony water system currently uses two wells for their PWS. The wells are located approximately one mile southeast of the central part of the colony ([Figure 1](#)). The newest well was installed in May 2000, with a well log included in Appendix A. This well is located approximately 750 feet north of the

Two Medicine Canal. The older well is located at a former homestead in the area, on the edge of the Spring Creek Valley approximately 500 feet south of the Two Medicine Canal. A review of well logs for the area from the Montana Bureau of Mines and Geology – Ground Water Information Center (MBMG-GWIC) did not indicate any well log for the older Hidden Lake Colony PWS well. Several well logs for wells owned by the colony were identified; however, none of these matches the location of the older PWS Well.

A study performed by the United States Geological Survey (USGS) in the late 1950s evaluated the geology and ground water resources of the Two Medicine Irrigation District. This study focused primarily on the Seville Bench and surrounding area north of Hidden Lake Colony (Paulson and Zimmerman, 1965). As part of the study, water quality samples were collected from many wells in the area, including a well in the approximate location of the older Hidden Lake Colony PWS well. This well was installed in 1932, and is listed as approximately 50 feet deep, with no well log available. The backup PWS well appears to be installed to the same approximate depth as several newer wells owned by Hidden Lake Colony located on the bench closer to the main part of the colony. These wells are installed to sandstones of the Two Medicine Formation, a confined bedrock aquifer at a depth of approximately 200 feet below the ground surface. Based on the surface elevation of the newer PWS well, this well is also screened at the same approximate depth in the Two Medicine Formation as other wells.

The PWS wells are located near the springs that are the source for Spring Creek. The wells are constructed to obtain water from the sandstones in the Two Medicine Formation. Recharge to the Two Medicine Formation is interpreted to occur from areas to the west where the formation is exposed at the surface. However, additional ground water recharge to the wells may occur from the spring, or from recharge from stream loss from upper Spring Creek and/or the Two Medicine Canal. The sandstones in the Two Medicine Formation represent a confined aquifer. The shallow nature of the PWS well with the potential for recharge from surface water sources results in classification of the source aquifer for Hidden Lake Colony as unconfined for this assessment.

Ground water flow in the bedrock aquifer near the colony is considered likely to flow generally east following the topography of the area. Ground water flow in the unconfined alluvial aquifer would be generally to the east, and confined to the limits of alluvium in the valley where the PWS well is present. The area is located within the Cut Bank Creek watershed (USGS Hydrologic Unit Code 10030202), located within the Lower Missouri River Watershed Management Region for Montana. The Two Medicine Canal carries water from the Two Medicine River watershed into the Cut Bank Creek Watershed.

The Public Water Supply

The PWS supply wells (Source 002 and 003) are located approximately one mile south of the main colony complex. Information on the PWS for Hidden Lake Colony is reviewed in a sanitary survey completed for the colony in September 2001. The information reported on the PWS is obtained from this report, DEQ records, and from information gathered during a site visit by the author. A copy of the sanitary survey is included in Appendix A. Well lithology and construction logs are included in Appendix B. The system operator estimates water usage averages approximately 7,000 gallons per day, or about 5 gallons per minute.

The water system for Hidden Lake Colony serves the resident population of 75 people through 5 active service connections located in the colony residential and other buildings. An estimated 2 additional service connections at the colony are considered inactive at this time. The general layout of the colony buildings and distribution system is depicted in Appendix A. The configuration of the public water supply for Hidden Lake Colony includes a cistern storage tank located in a building on the south side of the main colony complex. Water is pumped from the supply well through the distribution system, with excess water flowing into the cistern which helps maintain pressure through the system. The water is currently not treated or disinfected.

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 Hidden Lake 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 agricultural, 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 1.52 mg/L to 9.36 mg/L over the last five years.

While the detected concentrations of nitrates are below regulatory limits, the levels are higher than the state average for nitrates in ground water. While the nitrates may be from natural sources, they may also result from runoff from agriculture on the area west of the colony, upgradient from the PWS source. The levels of nitrates in the water source should represent a concern for Hidden Lake Colony, especially if they are from agricultural sources upgradient from the colony. If the nitrate source is from agricultural activities, the source aquifer may also be threatened by trace levels of pesticides and/or herbicides that may be used in the same agricultural activities. Water quality monitoring results from the well should be thoroughly reviewed to ensure that there are no health threats associated with use of the water by the population of Hidden Lake Colony.

The assessment of the hydrogeology of the area presented in Paulson and Zimmerman (1965) includes sampling from the well believed to be the older backup Hidden Lake Colony PWS well. The results of the chemical analysis of water from this well are listed in Table 1. The data results show an elevated nitrate concentration of 15 mg/L, but the potential sources of this are not reviewed with the report as nitrate had not been identified as a health concern at the time the report was prepared. This data is considered representative of water from the well; however, the results may reflect some error or variability from actual conditions as more rigid quality controls are currently followed for sampling and analysis of water samples. In addition, the sample was collected in 1956, or 45 years ago; and ambient water quality conditions may have changed over time.

A regional review of water quality and availability on the Blackfeet Reservation is presented in Cannon (1996). The presented water quality data includes analysis of a spring located approximately 10 miles east of Hidden Lake Colony. The spring flows from the Two Medicine Formation, the same aquifer source as the PWS well for the Hidden Lake Colony. Table 1 lists the data results for the sample from this location. The results show a relatively high level of total dissolved solids, including elevated levels of nitrates. The source of the nitrates is unknown, but the presence away from Hidden Lake Colony suggest that the source may be natural.

Table 1 – Background Water Quality in Hidden Lake Colony Area

Sample Date	Location	Fe Mg/L	Ca mg/L	Mg Mg/L	Na mg/L	K Mg/L	HCO ₃ mg/L	SO ₄ mg/L	Cl mg/L	F mg/L	SiO ₂ mg/L	NO ₃ mg/L	TDS mg/L	Specific Conduct µS/cm
8/2/56	33-8-25bda (well)	0.11	31	30	33	1.6	274	31	6.5	0.6	8.5	15	291	513
6/11/92	32-6-7-add (spring)	<0.003	11	11	290	1.9	180	450	35	1.0	5.8	7.8	931	1470

Locations are listed with Township, Range and Section, with section location based on BLM system

Analytes are: Fe – Iron; Ca – Calcium; Mg – Magnesium; Na – Sodium; K - Potassium; HCO₃ – Bicarbonate; SO₄ – Sulfate; Cl – Chloride; F – Fluoride; SiO₂ – Silica; NO₃ – Nitrate as Nitrogen; TDS – Total Dissolved Solids

Data from Cannon., 1996

The chemistry of the well water in the old well is similar to the chemistry of water from samples collected from the Two Medicine Canal. This information resulted in the conclusion that water from the well may be derived in part from leakage from the base of the canal, to the local shallow aquifer.

CHAPTER 2 DELINEATION

The source water protection area, the land area that contributes water to Hidden Lake Colony is identified in this chapter. Several management areas are identified within the source water protection area. The primary regions are the control zone, inventory region, and recharge region, which are delineated for the well. The control zone, also known as the exclusion zone, is an area at least 100-foot radius around the well. The inventory region for an unconfined aquifer is defined as the area upgradient from the well which represents a three-year time of travel distance for water flowing within the aquifer. The inventory region for a confined aquifer is defined as an area of a 1,000-foot radius around the wellhead. The recharge region represents the area where the source aquifer for the Hidden Lake Colony water system wells is replenished. Due to uncertainties in the hydrogeology of the source aquifer for the Hidden Lake Colony PWS, a one-mile buffer zone is delineated to aid in the susceptibility assessment.

Hydrogeologic Conditions

The first published report on the hydrogeology of the area around Hidden Lake Colony is Paulson and Zimmerman (1965). This document focused on the hydrogeology of the Two Medicine Irrigation District, and evaluated the nature and interaction of surface water with shallow ground water in the Seville Flats. A limited review of the hydrogeology of the bedrock system is also presented. Cannon (1996) presents an overview of water resources of the entire Blackfeet Indian Reservation. The following discussion of the hydrogeologic setting of the area is based on Paulson and Zimmerman (1965), Cannon (1996) and assumptions based on basic principles of hydrogeology. The assumptions are discussed in the following. A generalized geologic map of the area around Hidden Lake Colony, adapted from Cannon (1996), 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 Hidden Lake Colony PWS sources are located south of a gravel terrace surface referred to as the Seville Flats. Parts of older terrace deposits are located within the Spring Creek Valley. The PWS wells are located in the northern part of the Spring Creek Valley into the Two Medicine Formation. The Two Medicine Formation represents the bedrock exposed in the walls of the Spring Creek Valley, and is present underneath the Seville Flats. Alluvium of unknown thickness is present in the base of the Spring Creek Valley representing a local, unconfined aquifer in the valley. This aquifer is recharged by the spring source and is most prominent in the area around the older PWS well. For purposes of this assessment, this unconfined aquifer is considered to represent the basal portion of the Spring Creek Valley, from below the Mission Lake Dam upstream (west) from the older PWS well. The true source aquifer is not known; however, water chemistry from the well suggests that water is from stream loss from the adjacent Two Medicine Canal (Paulson and Zimmerman, 1965). Recharge to a shallow aquifer may also occur from springs; however the chemistry of water from the Two Medicine Formation appears to be different than water from the older PWS well. Since the PWS well was installed before development of the current standards requiring sanitary seals around wells, recharge to the well may occur from a spring or surface water body. Based on this information, the primary aquifer for the Hidden Lake Colony is considered for this assessment as unconfined and is classified as having a **high** source water sensitivity to contamination. The bedrock aquifer within the Two Medicine Formation away from areas where mixing with surface water may occur is classified as having a low source water sensitivity to contamination.

Water for the newer well is interpreted to come from the confined aquifer in the Two Medicine Formation. Since the older PWS well appears to draw water from a shallow ground water source, the actual source aquifer may reflect water from both a bedrock aquifer in the Two Medicine Formation, and shallow ground water in alluvium in the area. Ground water in the bedrock aquifer is considered likely to occur under confined aquifer conditions, with flow in the vicinity of Hidden Lake Colony considered to be generally east, following the

general topography and surface drainage direction of the area. The bedrock aquifer is recharged by infiltration of surface water and precipitation into the subsurface in the area to the west of the well. Recharge to the bedrock aquifer may also occur from stream loss in Cut Bank Creek, the Two Medicine Canal and the Two Medicine River. The spring that feeds Spring Creek is considered likely to produce water from the Two Medicine Formation as well, reflecting the confined nature of ground water flow within sandstones of the formation. Shales and other fine-grained rock units within the Two Medicine Formation may keep the local bedrock aquifer system perched above any deeper regional systems that may be present in the area.

The shallow ground water in the alluvium likely flows in a generally northeast direction which may or may not coincide with the flow direction in the bedrock aquifer system. The shallow ground water system is more likely to receive recharge locally, and fluctuate with variations in precipitation and flow rates in surface water bodies. In general, shallow ground water may flow from Mission Lake in the Flat Coulee Valley coincident with the direction of streamflow in the valley. The walls to the valley may act as aquifer boundaries, with vertical recharge from the shallow alluvium into the deeper bedrock system.

Conceptual Model and Assumptions

Ground water in the shallow alluvial system occurs in the Flat Coulee Valley. Ground water in the bedrock aquifer system represents a regional aquifer, and is recharged from the shallow ground water system, stream loss and infiltration of surface water and precipitation into the subsurface in the area west of the Hidden Lake Colony PWS well. Ground water flow in both the shallow alluvial and bedrock aquifers in the area generally follows the topographic gradient of the area, to the east, but may have different flow directions.

Well Information

There is no well log available for the older source well for the Hidden Lake PWS. A well log from the newer source well is included in Appendix A. Well logs from additional wells owned by Hidden Lake Colony from the area are included in Appendix B. Since there is no available well log for the older source well, the only available information on the well is obtained from Paulson and Zimmeraman (1965), which presents only a limited amount of information. The data for both wells is summarized in Table 2. The yield of the well is estimated at 14 gpm based on the estimated rate of water usage at the colony

Table 2. Source well information.

Information	Well 1	Well 2
PWS Source Code	002	003
Well Location	T33N, R8W, Sec 25 abcc	T33N, R8W, Sec 25 bacb
MBMG #	<i>Not listed</i>	183119
Water Right #	<i>Not listed</i>	C111556-00
Date Well was Completed	1930	5-18-00
Total Depth	50 feet	120 feet
Perforated Interval	<i>Not listed</i>	100 – 120 feet
Static Water Level	18 feet	41 feet
Pumping Water Level	<i>Not listed</i>	81 feet
Drawdown	<i>Not listed</i>	40 feet
Test Pumping Rate	<i>Not listed</i>	30 gpm
Specific Capacity	<i>Not listed</i>	1.3 gpm/foot

Delineation Methods, Criteria and Results

Source water protection areas for unconfined aquifers are primarily delineated using the uniform flow equation, following the criteria in the Montana Source Water Protection Program (DEQ, 1999). However, lack of any area data, and the complexities of the potential interaction of surface and shallow ground water in the PWS well with deeper ground water in the Two Medicine sandstone make calculations of ground water flow rates impractical. As a result, the delineation of the inventory zone for the well is based on the following criteria:

- 1,000-foot and one-mile buffer zones are delineated around the PWS wellheads to represent the inventory zone for the Two Medicine Formation as a source aquifer.
- The limits of shallow alluvium that may comprise an aquifer in terrace gravels on the Seville Flats and within alluvium in the Flat Coulee drainage are mapped as the inventory zone for the unconfined aquifer. The location of the source springs for Spring Creek are also identified within the zone.
- A surface water buffer zone of ½ mile width on each side of the Two Medicine Canal is delineated for a distance of 10 miles upstream from the PWS well.

This approach is considered appropriate as a conservative method to establish an inventory zone to help identify potential contaminant sources that may effect water quality in the Hidden Lake Colony PWS wells. The delineated inventory zones for the wells are depicted in [Figure 3](#). The recharge area reflects the area to the east of the colony PWS wells.

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 source at Hidden Lake Colony. The inventory zone is expanded to account for uncertainties in the flow direction.

CHAPTER 3 INVENTORY

An inventory of potential sources of contamination was conducted for the Hidden Lake 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 Hidden Lake Colony PWS inventory region are nitrates, pathogens and herbicides/pesticides and fertilizer from cropped agricultural land and from the operations at the main colony complex.

The inventory for Hidden Lake 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 Hidden Lake 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 United State Geological Survey land use classification project (USGS, 2000). 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.

The only facility identified with this search is the confined animal feeding operation at the main complex of the Hidden Lake Colony.

Inventory Results/Control Zone

The control zone for the PWS wells are located south of the main colony grounds. The control zones are not fenced or otherwise identified around the wellhead. The primary potential contaminant sources result from agricultural activities.

Inventory Results/Inventory Region

The inventory region for the PWS wells includes the agricultural areas to the west of the well. Potential contaminants sources to the PWS wells are summarized in Table 3. The potential contaminant sources in the inventory zone include spilled fuels and other farm chemicals, and crop fertilizers and herbicides. The primary hazards are spills of animal wastes during transportation to the field for land application, excess application of herbicides and runoff from the cropped areas, and from the actual land application of animal wastes.

Inventory Results/Recharge Region

The recharge region for the PWS wells is comprised primarily of agricultural cropland, with some areas used for open range cattle grazing. Use of fertilizers, and weed control herbicides and fuels for farm machinery are the contaminants of concern in the recharge region.

Table 3. Significant potential contaminant sources.

Source	Hazard
<i>Control and Inventory Zones</i>	
Cropped Agricultural Land	Land Application of Animal Waste Spills and Excess Application of Herbicides
Main Colony Complex – Confined animal feeding operation and sewage system	Leakage from lagoons or improper waste management
<i>Recharge Area</i>	
County Roads and Highways	Spill or Accident from Transported Chemicals or Fuels
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 Hidden Lake 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 Hidden Lake 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 Hidden Lake 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 Hidden Lake 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 Hidden Lake Colony PWS wells (Table 4). 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 5).

Table 4. 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 unconfined aquifers, relative hazards for point sources are assigned based on the estimated time of travel distance from a potential contaminant source to the PWS well. Potential sources located within a one-year time of travel distance are assigned a relative hazard level of high. Sources within a one to three year time of travel distance are assigned a relative hazard of moderate. Other potential sources within the recharge zone are assigned a relative hazard of low.

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 based on the relative concentration of the sources within the inventory zone, based on the following table:

<i>Source Type</i>	<i>High Hazard</i>	<i>Moderate Hazard</i>	<i>Low Hazard</i>
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 conceptual model for the Hidden Lake Colony PWS wells evaluates the aquifer system as unconfined, with recharge locally occurring from stream loss in the Two Medicine Canal. There are no time-of-travel calculations to support classification of hazards in the area. However, the only potential contaminant sources identified are agricultural activities, as a non-point source with a relative hazard level of high; and the activities at the colony. The distance of the colony away from the PWS wells, but within the modified inventory zone of a one-mile radius around the wellheads, results in assignment of a relatively susceptibility hazard of moderate to the colony activities.

In order to provide information to assess the potential for contamination into the bedrock aquifer from other wells in the area, the MBMG-GWIC database was queried. According to records from MBMG-GWIC, the only other wells within a one-mile radius are approximately nine wells installed to various depths. Six of these wells are shallow monitoring wells from the Montana Salinity Control Project, and three additional wells are owned and operated by the Hidden Lake Colony for stockwater and other uses (Appendix B). The number and location of monitoring wells for the Hidden Lake permitted CAFO were not indicated in this database query. The only wells installed to the aquifer depth of the Hidden Lake Colony PWS Wells are the 3 wells owned by Hidden Lake Colony; all of which were installed after 1993 and are assumed to meet the standards for a sanitary seal. As a result, none of these wells are considered likely to pose a threat to the source aquifer for the Hidden Lake Colony PWS.

There are no barriers identified for the impact of contaminants from agricultural activities as a potential contaminant source to the source aquifer for the PWS well. The CAFO permit for Hidden Lake Colony requires ground water quality monitoring, which represents a management barrier to the source aquifer from the colony activities.

The results of the susceptibility assessment are summarized in Table 5, with recommended management actions. The results indicate that cropped agricultural land and related activities represent the greatest relative hazard for contamination to the PWS wells. The location of the PWS wells away and downgradient from the central part of the colony provides a measure of protection to potential impacts to water quality in the wells.

Table 5. Susceptibility assessment of significant potential contaminant sources.

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Control and Inventory Zone						
Colony Animal (CAFO) and Sanitary Waste Management	Nitrates and Pathogens	Spills or Leakage	Moderate	CAFO Permit Monitoring Wells and Sampling Program	Moderate	Continue monitoring program on ground water quality in area
Cropped Agricultural Land	SOCs/Nitrates	Leaching and Runoff	High	None	Very High	Communicate with upgradient landowner, apply chemicals according to label instructions
Recharge Area						
Cropped Agricultural Land	SOCs, Nitrates	Infiltration and Runoff	Moderate	None	High	Communicate with upgradient landowner, apply chemicals according to label instructions

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