

**Shelter Bay Estates
Public Water Supply**

PWS ID # MT0003376

***SOURCE WATER DELINEATION
AND ASSESSMENT REPORT***

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EXECUTIVE SUMMARY

This Source Water Delineation and Assessment Report (SWDAR) was prepared as required by the Federal Safe Drinking Water Act and in accordance with Montana's Source Water Assessment Plan. The Department of Environmental Quality (DEQ) is completing assessment and delineation reports for all public water systems in Montana. Source water assessment is the first step towards source water protection. These reports are intended to provide information and help public water system staff/operator, consumers, and community citizens to develop strategies to protect drinking water sources. The information provided includes the delineation of the area most critical to maintaining safe drinking water (the Inventory Region), an inventory of significant potential sources of contamination within this area, and an assessment of the relative threat that these sources pose to the water system.

This PWS uses groundwater as its source of drinking water and operates 1 well to provide water to its residents and visitors. This system has 2 additional wells that are currently inactive and intended to be for emergency use. According to the Source Water Protection Program (DEQ, 1999) the aquifer used by this public water supply is considered to have **moderate sensitivity** to potential contamination, since the aquifer appears to be unconfined and present within the deep fractured bedrock.

As part of this assessment, three types of source water protection areas are mapped or delineated. They are: the Control Zone, the Inventory Region, and the Recharge Region. The Control Zone (sometimes called the exclusion zone) is a 100-foot radius circle around the wellhead(s). The goal of management in the Control Zone is to avoid introducing contaminants directly into the well or immediate surrounding areas. The Inventory Region is the area that is expected to contribute groundwater to the wells over the next few years (DEQ, 1999); in this case it is the area is a part of the watershed around and above the well. The Recharge Region represents the area that is expected to contribute water to the well over long periods, but in this case it is the entire local watershed is covered by the Inventory Region, so no separate Recharge Region was delineated. Potential sources of contamination were inventoried within the Control Zone and Inventory Region and the results are as follows:

Potential sources of contamination within the Control Zone of the well were never found.

The inventory process found several sources of potential contamination located within the Inventory Region, but all of them were associated with the subdivision's sewage collection and treatment system. The sewer mains that run the length of the subdivision are considered a potential source of contamination because they have the potential to leak. The lagoons are also considered a potential source of contamination as they may fail and chronically or catastrophically leak. The 3 areas of surface spray application of treated septic effluent are also considered potential contaminant sources because there is potential that the effluent being applied could be inadequately treated. Since each of these potential sources of contamination is located within the subdivision, they are assigned a high hazard of contamination. Multiple barriers are believed to be in place between each of these potential contaminant sources and the PWS well intake. As such, it appears that the source water (and the PWS well) are **moderately susceptible** to contamination that could come from one or more portions of the sewer system. It should be noted that the water quality monitoring supports the lower susceptibility rating as this

sewer system has been in operation for more than a decade and has not had any impact on water quality seen in the public water supply.

The susceptibility analysis is intended to provide the operator with information on what the greatest risk or threats to the source water are. Maps included in this report show where the potential contaminant sources that pose a threat to the source water are located relative to the public water supply wells. The assessment is focused on the more significant potential contaminant sources. Refer to Section 5 of the report.

Mitigating and managing some of the potential sources of contamination identified within the Inventory Region can be beyond the scope of what PWS operator(s) and/or owner(s) can accomplish or have the authority to change unless the region is completely within the boundaries of the property or there are only a limited number of landowners involved. The DEQ Source Water Protection Program acknowledges this and recommends that whenever possible, public water supplies work together and work with local, county, and state officials to find ways to protect their source water. To this end, the Source Water Protection Program offers assistance to individual public water supplies and communities in developing source water protection plans. These plans use delineation and assessment reports like this one as a starting point to develop and implement strategies to protect source water, identify alternate sources of water, and develop emergency procedures. The plans can be developed as stand-alone documents or they can be developed as components of larger community level planning efforts. A plan as described above can build a case for groundwater monitoring waivers.

The costs associated with contaminated drinking water are high, and prevention is vastly preferable to treatment. Public awareness is a powerful tool for protecting drinking water. The information in this report is intended to help increase public awareness about the relationship between land use activities and drinking water quality.

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1.0 INTRODUCTION

The primary purpose of this source water delineation and assessment report (SWDAR) is to provide information that helps public water supplies (PWS) protect their drinking water sources. Source water assessment is the first step towards source water protection. The Montana Source Water Protection Program is intended to be a preventative, practical, and cost-effective approach to protect public drinking water supplies.

This Source Water Delineation and Assessment Report (SWDAR) is intended to meet the technical requirements for delineation and assessment of this Public Water System as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 [U. S. Code Title 42, Chapter 6A, Subchapter XII, Part E, § 300j-13-(a) Source Water Assessment].

Jeffrey Frank Herrick, a hydrogeologist with the Montana Department of Environmental Quality (DEQ) Source Water Protection Program, completed this Source Water Delineation and Assessment Report. Information on the PWS was obtained from the most recent sanitary survey and other public sources. Additional references are detailed at the end of this report.

2.0 BACKGROUND

This public water supply is located within the Flathead Indian Reservation and Lake County of western Montana. It is found along the west shore of Flathead Lake approximately 28.8 miles north of Polson (at the south end of Flathead Lake) and around 13.8 miles south of Somers (at the north end of Flathead Lake). Refer to [Figure 1](#), [Figure 2](#), and [Figure 3](#). This PWS (public water supply) is classified as a Community Non-Transient PWS, as it serves more than 25 year-round residents. It serves a population of 50 people (16 residents and roughly 40 transients) through 27 active residential service connections (according to the DEQ PWS database and the 2001 Sanitary Survey). The PWS provides water to the residents and visitors to the Shelter Bay Estates subdivision (refer to [Figure 4](#)). This subdivision is also serviced by a centralized sewer collection and treatment system. The lagoons of this sewage treatment system are located in the eastern corner north of Lot 10. After the effluent leaves the lagoons, it is disinfected by chlorination, then land applied in 1 of 3 spay irrigation area (the author indicated these areas on [Figure 7](#)).

2.1 PHYSICAL SETTING

2.1.1 Geography and Geology

The geology, hydrogeology, and groundwater resources of the Flathead and Mission valleys are described in several detailed reports including: LaFave (2000), Smith (2000a, 2000b), Tuck and others (1996), Kendy and Tresch (1996), Briar and others (1996), Slagle (1988), Makepeace (1994), Donovan (1985), Boettcher (1982), Thompson (1988) and Abdo (1997). The PWS is located along the southern shore of Flathead Lake ([Figure 1](#), [Figure 2](#), and [Figure 3](#)). The elevation in the area of the PWS is generally between the lake elevation (~2,900 feet above mean sea level) and 3,100 feet above MSL. The Mission Valley extends north from St. Ignatius area to southern end of Flathead Lake. Flathead Lake occupies the entire valley between the Mission Mountains and the Salish Mountains north of Polson and south of Somers. The lake is oriented roughly north to south, and is generally more than 7 miles wide and about 31 miles long (north to south).

Mountain peaks in the Mission Mountains rise to more than 9,000 feet while the Salish Mountain peaks range between 5,000 and 6,000 feet above sea level.

The Mission and Flathead valleys are part of a large linear geologic depression referred to as the Rocky Mountain Trench. The trench extends for about 900 miles from near St. Ignatius north into the Yukon (Alt and Hyndman, 1986). The geology surrounding the Mission Valley and Flathead Lake is complex and the older bedrock is extensively faulted and fractured. Very old Precambrian bedrock is exposed in the surrounding mountains and also forms the floor of each valley. The valley centers and beneath Flathead Lake the bedrock is buried beneath relatively thick deposits of much younger sedimentary deposits. The deposits are as much as 800 feet thick in portions of the Mission Valley (LaFave, 2000). Groundwater is widely used as the water supply for private residents and for public water supplies in this area. Wells encounter water at various depths below the valley floors indicating that there is often more than one aquifer or saturated sedimentary deposit being used to supply water. Smith (2004) divided the geologic deposits that host these aquifers into several hydrogeologic units. While groundwater can be obtained from all of these hydrogeologic units, aquifers within the shallow and deep alluvium are usually the most productive. Where they are present, the aquifer(s) within the shallow stream deposited alluvium are generally unconfined water table aquifers. The aquifers within the deeper water-bearing units are often confined and exhibit the classic situation where water levels in well casings will rise under pressure above the elevation of the top of the aquifer. If the pressure is sufficient, the well will flow without pumping and is considered an artesian well. The confining units are often relatively thick silt and clay layers that overlie the deep alluvium, and in some places they directly overlie fractured bedrock. In this situation, the fractured bedrock can host the deep confined aquifer. The thick sequences of fine-grained sediments present above the deep aquifer (whether covering deep alluvium or fractured bedrock) help to protect this deep aquifer from potential contaminant sources at or near the land surface. The shallow and deep aquifers receive recharge from a variety of sources including: precipitation and snowmelt, irrigation water applied to fields, water loss from stream and canals, and possibly from other aquifers, and in the case of the deep aquifer, it includes from the underlying bedrock. A majority of this recharge to the deep aquifer probably occurs in the uplands surrounding Flathead Lake or along the margins of Flathead Lake and the Mission and Flathead Valleys. This is where mountain creeks are exiting the bedrock lined mountain stream valleys and entering the valleys and where confining units may or may not be present above the deeper aquifers.

Of the geologic maps found describing the geology of the area around this PWS, the best was included in the SWDAR as [Figure 5](#). The map was borrowed from the Geologic and Structural Maps of the Wallace 1x2 Degree Quadrangle, MT and ID (MBMG 1986). The geologic map confirms that Shelter Bay Estates is constructed upon the local bedrock. Soil in the area, where present, is shallow due to glacial scouring and removal.

An examination of well logs for this PWS and other nearby wells does not clearly demonstrate that a confined aquifer is present beneath the Shelter Bay Estates. The approximate locations for area wells are plotted on [Figure 6](#). The geology of the area is comprised of the local Precambrian bedrock, where water-bearing fractures are relatively difficult to predict. As such, the wells of the area were drilled to a number of different

depths and the water-bearing fractures were found anywhere from 50 to 900 feet bgs (below ground surface). In addition, the static water levels appear random. The Shelter Bay Estates has used 2 previous wells that are now inactive (not connected to the water supply, but are maintained for emergency use). These are identified as Well 1 SW and Well 2 Lot 14. Of the MBMG GWIC logs provided, it is not clear which well log should belong to Well 2 as there are 2 logs of the appropriate depth and both are identified as Shelter Bay Partners wells. The well logs for these 2 wells, the well log for Shelter Bay Estates (Well 3 Lot 12), and the logs for many of the other area wells are found in Appendix C. [Figure 6](#) displays the approximate locations of these area wells.

The Shelter Bay Estates PWS Well 1 SW is deep, at 962 feet deep and was finished 21 November 1984. Two well logs for 125 feet deep boreholes were found, with one finished on 08 February 1984 and the other 09 February 1984. Based on comments made by the PWS operator, one of the logs represents a test hole that was subsequently abandoned, and the other probably represents a borehole that was subsequently drilled deeper to become Well 1 SW. The PWS Well 2 Lot 14 doesn't appear to have a well log, but is probably around 1020 feet deep with a very low yield (~8 gpm). Well 1 and Well 2 are currently inactive and only maintained for emergency use. Well 3 Lot 12 is the active PWS well and was drilled to 231 feet bgs, and was finished on 09 August 1989. All of the wells are clearly bedrock wells and withdraw water from the fractures within the bedrock. This aquifer is interpreted to be an unconfined water table aquifer or possibly a semi-confined aquifer. Fractured bedrock aquifers have a tendency to be unpredictable in that the orientation and openness of the fractures will often dictate groundwater flow, water-bearing fractures can be difficult to find, and the aquifer may or may not behave in a way consistent with confined aquifers. Water entering the well might be coming laterally or vertically (upward and/or downward) through interconnected open fractures. The chaotic nature and unpredictability of water levels in area wells underscores the difficulty in determining whether any particular fracture set is providing water to a well and especially if this aquifer is best characterized as being under confined, semi-confined, or unconfined conditions. Groundwater flow directions within the fractured bedrock aquifer in this area adjacent to Flathead Lake are expected to be generally from the highlands toward the lake and subparallel to surface water flow in the larger streams. Groundwater flow beneath the Shelter Bay Estates might also be toward the lake, which would be to the southwest. Recharge of the local bedrock probably occurs in the small watershed above the subdivision. The original well logs for the PWS wells area found in Appendix B of this report. MBMG GWIC (Ground Water Information Center) lithologic logs for the PWS wells and other area wells are also provided in Appendix C. A map of the locations of area wells is found on [Figure 6](#). Note that the locations of the wells as provided by the MBMG are rough approximations based on driller's descriptions. There is no information available that describes the potential influence of the lake on water entering the PWS wells. This is to say, it isn't clear if water from the lake can or does reach the PWS wells during high demand, but the author believes that this is unlikely. Recharge to the local aquifer probably occurs in the higher elevations within the watershed northeast of the PWS.

Additional information on the hydrogeology of the area is provided in Section 2. 1. 3.

2.1.2 Climate Summary

Climate in the area is typical of intermediate elevation intermontane valleys in western Montana. Annual total precipitation is 15.3 inches, and is most abundant in May and June. The area receives an annual average of 25.3 inches of snow, mainly in December and January. The climate summary is based upon records from the climate station at Polson. Climate data is provided by the Western Regional Climate Center, operated by the Desert Research Institute of Reno, Nevada. See Table 1 for additional climate information.

Table 1. Climate Summary

Polson, Montana (246635), Period of Record : 7/ 1/1906 to 9/30/2005

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	31.3	36.5	45.2	56.1	65.0	72.7	82.1	80.8	68.8	56.4	41.5	34.0	55.9
Average Min. Temperature (F)	19.2	21.9	27.3	34.3	40.8	47.7	53.0	52.1	44.3	36.1	27.8	22.6	35.6
Average Total Precipitation (in.)	1.02	0.85	0.95	1.25	1.94	2.26	1.04	1.09	1.37	1.16	1.19	1.17	15.30
Average Total Snowfall (in.)	8.8	3.8	2.7	0.4	0.0	0.0	0.0	0.0	0.0	0.3	2.8	6.6	25.3
Average Snow Depth (in.)	5	4	1	0	0	0	0	0	0	0	1	3	1

Source: Western Regional Climate Center, wrc@drri.edu

2.1.3 Source Water

The geology of the area is typical for glaciated terrains of the region, in that the bedrock highs are generally scoured and ground-off by the foot of the glacier and lower areas may be covered by a mantle of glacial till and/or glacial lake sediments. The PWS wells are completed in deep fractured bedrock that is probably best characterized as a water table or unconfined aquifer. This deep bedrock aquifer will be treated much like an entirely unconfined aquifer during the susceptibility determination that happens in Section 5 of this report. The presence of a confining sedimentary layer above the aquifer and the pressure of the water in the well casing are important definitions of confined aquifers. An examination of static water levels in the area do not demonstrate a situation where the groundwater is clearly under sufficient pressure that the water level in the wells is pushed above the top of the aquifer. The static water levels recorded in well logs for the area are chaotic and there doesn't appear to be any laterally extensive confining units. The Shelter Bay Estates PWS wells were constructed with steel casing that extends deep into the bedrock, but the intakes draw water from very different sets of water-bearing fractures. According to DEQ Source Water Protection Program criteria and the author's judgment, the aquifer is considered to have a moderate sensitivity to contamination at the ground surface.

The local aquifer receives recharge from a variety of sources including precipitation and snowmelt. It may also receive some water from the lake. A majority of this recharge to the aquifer that is used by this PWS probably occurs within the small watershed northeast of the subdivision.

2.2 THE PUBLIC WATER SUPPLY

2.2.1 Water Supply Facilities

This PWS uses 3 wells located as indicated on [Figure 4](#), [Figure 6](#), and [Figure 7](#). Note that Wells 1 and 2 are currently inactive and intended for emergency PWS use. The PWS pumps water from the Well 1 to two (2) buried metal 14,000-gallon water tanks (reservoirs) that are located beside each other at the location indicated on [Figure 4](#) and [Figure 7](#). Due to their elevation the tanks are able to provide pressure for the distribution system (to which they drain directly). The PWS distributes water through 27 residential service connections, serving an estimated total population of 50 (16 residents and around 40 transients). The PWS does not appear to chlorinate or otherwise treat the water prior to distribution. This public water supply is classified as a Community Non-Transient PWS since it serves more than 25 year-round residents.

Table 2. List of Facilities

Shelter Bay Estates PWS – MT0003376

Facility	PWS Facility ID per the DEQ PWS Database	Notes
Well 1 1984 SW Emergency	WL002 With EP502 entry point for Well 1	Inactive, located in the south central part of the subdivision near Lot 3 off of Park Road (see Figure 4).
Well 2 1995 N Lot 14 Emergency	WL003 With EP503 entry point for Well 2	Inactive located in the northern subdivision across from Lot 14 (see Figure 4).
Well 3 1989 E Lot 12	WL004 With EP504 as the entry point / sample point for Well 3	Active located in the eastern part of the subdivision on Lot 12 (see Figure 4).
Storage Facility 1 E (east)	ST001	Active 14,000 gallon steel buried ground tank, located in the central portion of the subdivision (see Figure 4). Tanks are located next to each other.
Storage Facility 2 W (west)	ST002	Active 14,000 gallon steel buried tank, located in the central portion of the subdivision (see Figure 4). Tanks are located next to each other.
Common Header	CH001 With EP505 sample point for water coming out of either or both storage tanks	Inactive Common header receives flow from the water tanks ST001 and ST002 and is located near the tanks and is before water enters distribution.
Pump Facility	None	No additional pump facility is connected to this systems
Pressure Control Assembly	None	No additional pressure facility is connected to this systems, pressure is provided by the elevation of the water tanks.
Treatment	None	No treatment is applied to the water in this PWS
Distribution System	DS001 w/ SP001 Sample Point for distribution	Active Serves the entire subdivision.

Note:

- Please refer to the 2001 DEQ PWS Sanitary Survey for further details on the layout of this system. The Sanitary Survey is found in Appendix B.
- The DEQ PWS Database also summarizes this information along with water quality data and an output of this database is found in Appendix A.

2.2.2 Supply Well Information

Information on well construction was provided by the lithologic and well construction logs on file with the Montana Bureau of Mines and Geology (MBMG) Ground Water Information Center (GWIC) and the original well logs found along with the 2001 Sanitary Survey and other supporting documentation. Well logs are available through the MBMG GWIC web site (see References section). The pertinent details are summarized below. The lithologic logs for the wells indicate that they are installed into the local fractured bedrock. Bedrock was encountered at between 2 and 9 feet bgs in the PWS wells.

**Montana Source Water
Protection Program**

**Shelter Bay Estates
Rollins, Montana**

Table 3. Source/Well Information

Shelter Bay Estates PWS

Information					
MBMG GWIC Well Log Title for Well	Shelter Bay Partners	Shelter Bay Partners	Shelter Bay Partners		Shelter Bay Estates
Original Well Log Title for Well	Straninger d.b.a. Shelter Bay Partners, Owner is Jack L Green II	Shelter Bay Partners	Shelter Bay Partners		Shelter Bay Estates Landowners Assoc.
PWS Source Code & Name	WL002 aka Well 1 1984 SW Emergency	None	None	WL003 aka Well 2 1995 N Lot 14 Emergency	WL004 aka Well 3 1989 E Lot 12
Comment	Inactive , This might be a redrill of one of the 125 foot deep wells at right.	Abandoned	Abandoned	Inactive , No Well Logs were found	Active PWS well
MBMG GWIC #	79247	79245	79246	Unknown	79248
Water Right #	None listed	None listed	None listed	Unknown	None listed
Date Well was Completed	21 November 1984	08 February 1984	09 February 1984	1995 (?)	09 August 1989
Total Depth (feet bgs)	962	125	125	~1020	231
Casing Depth (feet bgs)	141 Open rock hole between 141-962	-2-125	-2-125	Unknown	225 Open rock hole between 225-231
Depth of Grout Seal (feet bgs)	0-141 with cement	No record on log	No record on log	Unknown	0-119 with cement
Perforated Interval (feet bgs)	No record of perforations, so the casing is assumed to be Open Bottom. The intake interval is assumed to be the entire length of the open hole between ~141-962'	95-115	105-125	Unknown	188-208 Casing was left with an open bottom
Static Water Level (feet bgs)	23	36	40	Unknown	108
Pumping Water Level (feet bgs)	368	56	59	Unknown	138
Drawdown (feet bgs)	345	20	19	Unknown	30

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Table 3. Source/Well Information

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Original Well Log Title for Well	Straninger d.b.a. Shelter Bay Partners, Owner is Jack L Green II	Shelter Bay Partners	Shelter Bay Partners		Shelter Bay Estates Landowners Assoc.
PWS Source Code & Name	WL002 aka Well 1 1984 SW Emergency	None	None	WL003 aka Well 2 1995 N Lot 14 Emergency	WL004 aka Well 3 1989 E Lot 12
Test Pumping Rate (gpm)	30	20	30	~8	100
Specific Capacity (gallons/minute/foot)	0.09	1.0	1.6	Unknown	3.3
Source of Information	MBMG GWIC Well Logs & Original Well Logs	MBMG GWIC Well Logs & Original Well Logs	MBMG GWIC Well Logs & Original Well Logs	Personal Communication with Terry Druyvestein 04/2006	MBMG GWIC Well Logs & Original Well Logs

Note:

- 1) All of the MBMG GWIC well logs are found in Appendix C and the original PWS well log is found in Appendix B of this SWDAR.
- 2) The author was not able to find well logs for Well 2 1995 N Lot 14 Emergency.
- 3) [Figure 6](#) depicts the location of area wells, with the names labeled as found in the MBMG GWIC.

2.3 WATER QUALITY

Public water systems must conduct routine monitoring for contaminants in accordance with Federal Safe Drinking Water Act requirements. A community public water supply must sample in accordance with schedules specified in the Administrative Rules of Montana (ARM). Monitoring includes coliform bacteria, lead, copper, nitrate, nitrite, volatile organic chemicals (including hydrocarbons and chlorinated solvents), inorganic chemicals (including metals), synthetic organic chemicals (including pesticides), and radiological contaminants. Transient, non-community PWSs are required to conduct routine monitoring only for pathogens (including coliform bacteria) and nitrate.

Monitoring schedules are available online at the following Internet URL: <http://nris.state.mt.us/wis/swap/swapquery.asp>. Water quality monitoring data from the past 10 years was reviewed for this report and is summarized in this section. Analytical results are maintained in a DEQ's database and reported in units of milligrams per liter (mg/L, equivalent to one part per million) or micrograms per liter ($\mu\text{g/L}$, equivalent to one part per billion). The results are compared to quality standards established by the US EPA. Maximum Contaminant Levels (MCLs) are enforceable standards limiting the amount of a contaminant in drinking water.

2.3.1 Public Water Supply Monitoring Results

Coliform bacteria haven't been detected within the past 10 years in the water samples. Nitrate levels are low, well below the MCL of 10 mg/L. The reported concentrations in the period reviewed ranged from not detected to 1.32 mg/L. No other inorganic or organic chemicals have been detected in elevated levels the past 10 years.

The water quality analysis summary report is found in Appendix A.

2.3.2 Background Water Quality Monitoring Results

Basic background water quality data is summarized by LaFave (2004) for lower part of the Flathead Lake area and encompasses parts of Lake, Sanders, and Missoula counties. The reader should refer to the Montana Groundwater Assessment Study by LaFave for additional information. Based on the information available from the DEQ's water quality database for this public water supply, the groundwater used by this system appears to be high quality water. A summary of background water quality parameters was collected by the MBMG from the William F. Zelezny well in 2003 and the data from this sampling is found in with the MBMG GWIC well logs in Appendix C.

3.0 MANAGEMENT AREA DELINEATION

3.1 GENERAL DISCUSSION

This report delineates three source water management areas. The goal of source water management is protection of the source water in the management areas by 1) controlling activities in the Control Zone(s), 2) managing significant potential contaminant sources in the Inventory Region, and 3) ensuring that major land use activities or other significant activities in the Recharge Region pose minimal threat to the source water. Methods and criteria for

delineating source water protection areas for public water supplies are specified in the Montana Source Water Protection Program (DEQ, 1999).

3.2 DELINEATION RESULTS

Control Zone – A 100-foot radius Control Zone is delineated around the wellhead for each well.

Inventory Region – The Inventory Region is generally the area that is expected to contribute to the water supply over a period of several years. For unconfined aquifers, a 3-year groundwater time-of-travel is often calculated, based upon the well and aquifer characteristics. For wells drawing water from unconfined aquifers, the distance of potential contaminant sources from the well(s) and the percentage of the land occupied by potential non-point sources of contamination are important in the determination of hazard. For a confined aquifer, the Inventory Region is based on a 1,000-foot fixed radius circle around the wellhead(s). In the situation where a well is drawing water from a confined aquifer, the seal around the outside of that well's casing and the seal of other nearby wells is of greatest importance in determining the actual hazard posed by any nearby potential contaminant sources (point or non-point). This is in accordance with the Source Water Protection Program (DEQ, 1999) guidelines. In the case of this PWS, a 3-year groundwater time-of-travel distance could not be calculated with any confidence as the geology is made up of irregularly fractured bedrock. The formulas for the calculation of groundwater velocity (and travel time) do not apply to fractured bedrock as the aquifer characteristics are not predictable. As such, the Inventory Region was simply drawn as a modified line drawn around the small watershed above the PWS wells. This region is presented on [Figure 7](#). It should be noted that the area uphill from the subdivision is essentially empty of potential contaminant sources and most of those present will be located within the boundaries of the subdivision.

Recharge Region – Since the Inventory Region extends to up to and includes the local watershed, a Recharge Region was not delineated for this report.

4.0 INVENTORY

Prior to assessing the public water supply's susceptibility to contamination, an inventory of potential contaminant sources is conducted using information that is publicly available. To this end, potential contaminant sources within the Control Zone and Inventory Region were inventoried. The inventory focuses on businesses, facilities, and other operations that generate, use, store, or transport potential contaminants, as well as certain land uses. The methods and data sources used in the inventory process are explained below. It is important for the reader to understand that the sources identified in this section are considered potential sources of contamination to the drinking water. It should not be assumed that they have released contaminants into the groundwater or environment but they have the potential to do so. If contaminant releases are documented for any of the inventoried sites, it will be mentioned in this report along with what is known about the status of cleanup and remediation activities. Contamination of drinking water sources is less likely when potential contaminants are properly managed.

4.1 INVENTORY METHOD

Information on facilities and land uses that are potential sources of regulated contaminants was obtained from a number of databases. The process for completing the inventory includes the following:

- Step 1: The Montana State Library Natural Resources Information System (NRIS) GIS database was queried to identify septic land application sites, wastewater treatment plants, animal feeding operations, septic system density, sewer systems, and agricultural land uses. It should be noted that septic density is based upon population density in non-sewered areas and comes from US Census data for the 2000 census.
- Step 2: The DEQ PWS files were reviewed to identify agricultural activities or wastewater treatment in the vicinity of the PWS.
- Step 3: As appropriate, the US Environmental Protection Agency's (EPA) Envirofacts System <http://www.epa.gov/enviro/> was queried to identify EPA-regulated facilities located in the management areas. This system accesses facilities listed in the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory System (TRIS), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) and the Permit Compliance System (PCS - for Concentrated Animal Feeding Operations with MPDES permits). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility should be classified as a significant potential contaminant source.
- Step 4: Montana DEQ databases were queried to identify any of the following in the management areas:
 - Step 5: Underground fuel storage tanks (USTs) and leaking underground fuel storage tanks (LUSTs) <http://www.deq.state.mt.us/UST/USTDownloads.asp>
 - Step 6: Hazardous waste contaminated sites, above ground fuel storage tanks (ASTs), landfills, and abandoned and active mines, including gravel pits <http://nr.is.state.mt.us/gis/bundler/>
 - Any information on past releases and present compliance status was noted.

Potential contaminant sources are considered significant if they fall into one or more of the following categories:

1. Large quantity hazardous waste generators.
2. Landfills.
3. Underground storage tanks.
4. Known groundwater contamination (including open or closed hazardous waste sites, state or federal Superfund sites, and leaking UST sites).
5. Underground injection well.
6. Major roads or rail transportation routes.
7. Cultivated cropland exceeding 20% of the Inventory Region.
8. Animal feeding operations.
9. Wastewater treatment facilities, sludge handling sites, or land application areas.
10. Septic systems.
11. Sewer mains.
12. Storm sewer outflows.
13. Abandoned or active mines

4.2 INVENTORY RESULTS

The following are the results of the inventory process.

4.2.1 Control Zone Results

No potential contaminant sources were identified within the Control Zones during the most recent Sanitary Survey. It is difficult, however, for the author to complete a detailed inventory at a scale of 100 feet without a site inspection. The Control Zone for Well 1 appears to be surrounded by residential yards. The Control Zone for Wells 2 and 3 may include some residential land, but they actually appear to be located within or adjacent to forest.

4.2.2 Inventory Region Results

A small area of increased density of private onsite septic systems is found south and outside of the Inventory Region. If any of the septic systems present either fail or are poorly maintained, they have the potential to discharge untreated or poorly treated septic effluent to the subsurface and can impact groundwater. Since this area is outside of the Inventory Region, it isn't considered to be a significant potential contaminant source for this evaluation.

The housing development (the subdivision) is sewerred. The sewer mains conduct untreated sewage toward the sewage lift station(s) below the lagoons and from there to the lagoons. It isn't clear if there are any septic tanks distributed among the homes that might receive sewage prior to the effluent being conducted toward the lagoons for treatment. Sewer mains have the potential to chronically leak effluent into the subsurface fractured bedrock. If this happens, groundwater can be impacted.

There are 2 sewage treatment lagoons that are located north of PWS Well 3. Lagoons have the potential to chronically or catastrophically leak under certain circumstances. If a failure of one of the lagoons occurs, septic effluent might be able to reach the subsurface fractured bedrock and impact the local groundwater.

There are 3 areas where the spray irrigation of treated septic effluent occurs. Although the author doesn't know the specifics of the treated effluent, it appears to have gone through treatment within one or both of the sewage lagoons and has received chlorination prior to its discharge to the ground surface. Each of the areas of sewage effluent application (by spray irrigation) can be considered a potential contaminant source. This is because the discharged effluent may be able to reach the near surface fractured bedrock and the shallow groundwater.

It appears that an underground fuel storage tank (UST) was located along the southeastern border of the Inventory Region. DEQ records for this UST indicate that it was removed and do not indicate that contamination was found at the time of removal. So, the tank has been removed; no contamination was observed; the site is not currently active; it is on the periphery of the region; and it is not upgradient from the well. As such, this site will not be considered a significant potential contaminant source for this PWS and it is not going to be included in the susceptibility assessment that occurs in the next section.

The PWS' susceptibility to inventoried potential contaminant sources is assessed in Section 5, and presented in Table 4.

4.2.3 Recharge Region Results

The Recharge Region was not delineated in this report because the Inventory Region encompassed the entire local watershed. As a result, the Recharge Region was not inventoried.

5.0 SUSCEPTIBILITY ASSESSMENT

Susceptibility is the degree of likelihood for a public water supply to be impacted by inventoried contaminant sources. Susceptibility is determined in accordance with the DEQ Source Water Protection Program (DEQ, 1999). This guidance document is available on the DEQ Source Water Protection website (see the Reference section) or by request.

5.1 DETERMINATION OF HAZARD AND SUSCEPTIBILITY

Susceptibility is determined by considering the hazard that a significant potential contaminant source presents to the PWS's source water, relative to any barriers to the contaminant. Hazard is determined by the proximity or density of significant potential contaminant sources, or in the case of confined aquifers by the presence or absence of an adequate seal around the outside of the well casing. This evaluation is done according to a formula described in the Source Water Protection Program (DEQ, 1999). Barriers to contamination are anything that decreases the likelihood of contaminants reaching a water source. Credit is given to these clay rich sediments as they probably will act as a local barrier to contamination.

Inventory results and management recommendations are provided in Table 4. In some cases the management recommendations are fairly site-specific and can be implemented by the public water supply. However, other management options can only be implemented by federal, state, county or local governmental entities. When the latter options are mentioned, it is assumed that representatives from this PWS would participate in the public process sponsored by various governmental entities to develop and implement any of these management options.

Table 4. Susceptibility Assessment

Potential Contaminant Source	Potential Contaminants	Hazard	Hazard Rating	Barriers	Susceptibility Rating	Management Recommendations
Sewer Mains that run the length of the subdivision	Pathogens, nitrate	If the sewer mains leak, they can discharge a significant volume of untreated septic effluent to the upper fractured bedrock, which in turn can reach groundwater	High Hazard	<ul style="list-style-type: none"> ○ Most of these mains are located somewhat lateral to the groundwater gradient (they're mostly not upgradient from the well). ○ Local topography and the sewer mains at the east end of the subdivision appear to drain away from the area of the well (to the west-southwest). ○ The operator of the wastewater system is trained and certified. ○ The static water level is >50 below the ground surface. ○ The depth to the top of the well intake is ~88 feet below the static water table. 	Moderate Susceptibility	<ul style="list-style-type: none"> ○ Promote growth management in the area (within and outside of the subdivision) to ensure residential density does not increase beyond capacity of the sewage treatment system. ○ Promote an educational program (including posters and/or training) to reduce improper disposal of chemicals. This usually provided by the county or MT DEQ SWP Program. ○ For new homes in the Inventory Region, but outside of the subdivision . . .Promote the design and installation of advanced septic systems (aka Level II Systems) in the area for new and/or replacement septic systems.
2 sewage treatment lagoons	Pathogens, nitrate	If the sewer lagoons fail and leak, they can discharge a significant volume of untreated septic effluent to the upper fractured bedrock, which in turn can reach groundwater	High Hazard	<ul style="list-style-type: none"> ○ The lagoons are located uphill, but somewhat lateral to the groundwater gradient (they're not upgradient from the well). ○ The lagoons appear to be designed to operate in series, to allow for storm flow and the failure of one of the lagoons. This is an added protection against the release of sewage to the surface or subsurface. ○ The operator of the wastewater system is trained and certified. ○ The static water level is >50 below the ground surface. ○ The depth to the top of the well intake is ~88 feet below the static water table. 	Moderate Susceptibility	<ul style="list-style-type: none"> ○ Promote growth management in the area (within and outside of the subdivision) to ensure residential density does not increase beyond capacity of the sewage treatment system. ○ Promote an educational program (including posters and/or training) to reduce improper disposal of chemicals. This usually provided by the county or MT DEQ SWP Program. ○ For new homes in the Inventory Region, but outside of the subdivision . . .Promote the design and installation of advanced septic systems (aka Level II Systems) in the area for new and/or replacement septic systems.
3 areas where treated sewage effluent are applied to the ground surface by spray irrigation	Pathogens, nitrate	If the effluent discharged at these locations was not adequately treated, then untreated or poorly treated septic effluent might be able to reach the upper fractured bedrock, which in turn can reach groundwater	High Hazard	<ul style="list-style-type: none"> ○ 2 of the 3 spray irrigation areas are located somewhat lateral to the groundwater gradient, they're not upgradient from the well. The easternmost spray irrigation area is not directly uphill, but is a bit lateral along the slope at a similar elevation as the well. ○ The operator of the wastewater system is trained and certified. ○ The static water level is >50 below the ground surface. ○ The depth to the top of the well intake is ~88 feet below the static water table. 	Moderate Susceptibility	<ul style="list-style-type: none"> ○ Promote growth management in the area (within and outside of the subdivision) to ensure residential density does not increase beyond capacity of the sewage treatment system. ○ Promote an educational program (including posters and/or training) to reduce improper disposal of chemicals. This usually provided by the county or MT DEQ SWP Program. ○ For new homes in the Inventory Region, but outside of the subdivision . . .Promote the design and installation of advanced septic systems (aka Level II Systems) in the area for new and/or replacement septic systems.

Note: This evaluation focuses on the relationship of the inventoried potential contaminant sources and the PWS Well 3 Lot 12. The other 2 PWS wells are inactive.

These ratings are derived from the procedures established by the DEQ Source Water Protection Program (DEQ, 1999). In general, the aquifer/the PWS source water is moderately susceptible to contamination that originates with the centralized sewer system (specifically to nitrate and pathogens). This moderate susceptibility is backed up by the data found in the groundwater monitoring for this PWS. No elevated nitrates, pathogens, or other contaminants were present in any samples collected from the system. This suggests that septic effluent from any of the above sources is not reaching groundwater that is entering the PWS well.

5.2 CONCLUSIONS OF SUSCEPTIBILITY ASSESSMENT

Shelter Bay Estates PWS's drinking water is supplied by groundwater from 1 well (Well 3). A total of three (3) wells are associated with the system, but the 2 of the wells (Wells 1 & 2) are inactive and used only for backup/emergency. Refer to [Figure 4](#). The water source is an unconfined deep bedrock aquifer. Confining materials don't seem to be present above the water-bearing fractures. This aquifer may or may not behave as if it were confined, but a case for confinement of the aquifer can't really be made because of a lack of pump test or other data that better characterize the aquifer. According to the Source Water Protection Program (DEQ, 1999) the source aquifer for the wells is considered to have moderate sensitivity to potential contamination. The PWS provides water to the Shelter Bay Estates subdivision. This subdivision is serviced by a centralized sewage collection and treatment system that consists of a pair of sewage treatment lagoons (in series), a disinfection unit (chlorination), and surface discharge of the treated effluent in the form of spray irrigation. Refer to [Figure 7](#).

As part of this assessment, three types of source water protection management areas were mapped for this public water supply. They are: the Control Zone, the Inventory Region, and the Recharge Region. The Control Zone (sometimes called the exclusion zone) is a 100-foot radius circle around the wellhead. The Inventory Region is the area that is expected to contribute groundwater to the well over several years (DEQ, 1999); in this case it is the entire small watershed above the wells as seen on [Figure 7](#). The Recharge Region represents the area that is expected to contribute water to the well over longer periods. The Recharge Region would enclose the same area as the Inventory Region, so a figure was not prepared for the region in this report. Potential sources of contamination were inventoried within the Control Zone and Inventory Region and the results are as follows:

- Based upon the 2001 Sanitary Survey, no potential sources of contamination were identified within the Control Zone.
- The sewage collection and treatment system for the subdivision contains 3 main parts that are considered potential contaminant sources of nitrate and pathogens. They are the sewer mains, the treatment lagoons, and the surface spray irrigation areas. Each of these was assigned a high hazard due to their proximity to the PWS well. Multiple barriers are thought to be in place between these potential contaminant sources and the PWS well, so the source water is believed to be moderately susceptible to contamination from these potential contaminant sources. At first look, the PWS well(s) appeared like they would have a greater susceptibility to contamination from the sewage treatment system. But the susceptibility assessment process suggested otherwise and the excellent water quality monitoring history confirmed this. Management suggestions are provided on Table 4 above to help reduce any current or future impacts from the subdivision's sewage treatment system.

The susceptibility analysis is intended to provide the operator with information on where the greatest risk occurs. To this end, the assessment is focused on potential contaminant sources nearest the PWS that the Source Water Protection Section has determined to be significant.

6.0 MONITORING WAIVERS

6.1 RECOMMENDATION OF THIS SWDAR

It appears that the PWS does not currently have any water quality monitoring waivers except for the statewide waivers that are credited to all PWSs. Diquat, endothall, glyphosate, dioxins, ethylene dibromide (EDB), dibromochloropropane (DBCP), polychlorinated biphenyls (PCBs), cyanide, and asbestos (at the source) are excluded from monitoring requirements by statewide waivers. The PWS may be eligible for additional monitoring waivers. The water quality and the PWS susceptibility suggest that the system may be eligible for waivers for inorganic chemicals (IOCs), volatile organic chemicals (VOCs), and synthetic organic chemicals (SOCs). Under these waivers, the monitoring schedule for these parameters could be reduced to every nine years, rather than every one or three years.

6.2 GENERAL DISCUSSION OF WAIVERS

To be sure that eligibility for all available waivers is considered, the PWS Operators are encouraged to carefully review the following section on Monitoring Waiver Requirements. The PWS should demonstrate sufficient barriers such that the susceptibility would not change over the term of a compliance cycle, even with continued development in the area. The PWS must be in compliance with monitoring requirements to be considered. Written waiver requests must be sent to DEQ at the address below:

Greg Butts
Montana DEQ, PWS Section
109 Cooperative Way
Suite 105
Kalispell, MT 59901

Upon receipt of a waiver request, DEQ will review the system's compliance history, historical monitoring results and source water setting. If waivers are considered appropriate, DEQ will provide the operator with application forms, guidance and technical assistance. If requested by DEQ, the PWS may also need to provide additional information regarding chemical use in the area within the Inventory Region. A site visit may be required to further investigate VOC and SOC use within the Inventory Region.

6.3 MONITORING WAIVER REQUIREMENTS

6.3.1 Use Waivers

A Use Waiver may be granted if it is determined that target organic chemicals were/are not used, manufactured, or stored in the area of a water source. If certain organic chemicals have been used, or if the use is unknown, the system would be determined to be vulnerable to organic chemical contamination and ineligible for a Use Waiver for those particular contaminants.

6.3.2 Susceptibility Waivers

If a Use Waiver is not granted, a system may still be eligible for a Susceptibility Waiver, if through a vulnerability assessment it is demonstrated that the water source would not be susceptible to contamination. The purpose of the vulnerability assessment procedures outlined in this section is to determine which of the organic chemical contaminants are in the area of investigation. The vulnerability assessment of a surface water source must consider the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the surface water intake. PWSs developed in unconfined aquifers should use a minimum fixed radius of one mile as an area of investigation for the use of organic chemicals. Vulnerability assessment of spring water sources should use a minimum fixed radius of one mile as an area of investigation for the use of organic chemicals. Surface water and shallow groundwater sources under the direct influence of surface water (GWUDISW) should assess the watershed area above the source, or a minimum fixed radius of one and one-half miles upgradient.

Given the wide range of landforms, land uses, and the diversity of groundwater and surface water sources across the state, additional information is often required during the review of a waiver application. Additional information may include well logs, pump test data, water quality monitoring data from surrounding public water systems, delineation of zones of influence and contribution to a well; time-of-travel or attenuation studies; vulnerability mapping; and the use of computerized groundwater flow and transport models. DEQ's PWS Section and Source Water Protection Program will conduct review of an organic chemical monitoring waiver application. Other state agencies may be asked for assistance.

Susceptibility Waiver for Unconfined Aquifers

Unconfined aquifers are the most common source of usable groundwater. Unconfined aquifers differ from confined aquifers in that the groundwater is not regionally overlain by relatively impervious geologic strata. As a result, the upper groundwater surface or water table in an unconfined aquifer is not under pressure that produces hydrostatic head common to confined aquifers.

Unconfined aquifers are often locally recharged from surface water or precipitation. In general, groundwater flow gradients in unconfined aquifers may reflect surface topography, and the residence time of water in the aquifer is typically comparatively shorter than for water in confined aquifers. Similar water chemistry may often exist between unconfined groundwater and area surface water, and physical parameters and dissolved constituents can be indicators of the hydraulic connection between groundwater and surface water. Consequently, unconfined aquifers can be susceptible to contamination by organic chemicals migrating from the ground surface or surface water to groundwater.

The objective of the Susceptibility Waiver application is to assess the potential of organic chemical migration from the surface to the unconfined aquifer. The general procedures make use of a combination of site specific information pertaining to the location and construction of the source, monitoring history of the source, geologic characteristics of

the vadose zones, and mobility and persistence characteristics of the organic chemicals. The zone of contribution of the unconfined groundwater source must be defined and plotted. Groundwater flow directions, gradients, and a 3-year groundwater time-of-travel distance should be described. All surface bodies within 1,000 feet of the PWS well(s) must be plotted. Analytical monitoring history of the PWS well and nearby wells should also be provided.

Susceptibility Waiver for Confined Aquifers

Confined groundwater is isolated from overlying material by relatively impermeable geologic formations. A confined aquifer is subject to pressures higher than atmospheric pressure that would exist at the top of the aquifer if the aquifer were not geologically confined. A well that is drilled through the impervious layer into a confined aquifer will enable the water to rise in the borehole to a level that is proportional to the water pressure (hydrostatic head) that exists at the top of a confined aquifer.

The susceptibility of a confined aquifer relates to the probability of an introduced contaminant to travel from the source of contamination to the aquifer. Susceptibility of an aquifer to contamination will be influenced by the hydrogeologic characteristics of the soil, vadose zone (the unsaturated geologic materials between the ground surface and the aquifer), and confining layers. Important hydrogeologic controls include the thickness of the soil, the depth of the aquifer, the permeability of the soil and vadose zones, the thickness and uniformity of low permeability and confining layers between the surface and the aquifer, and hydrostatic head of the aquifer. These factors will control how readily a contaminant will infiltrate and percolate toward the groundwater.

The Susceptibility Waiver has the objective of assessing the potential of contaminants reaching the groundwater used by the PWS. Contaminants could enter the confined aquifer through improper well construction or abandonment creating a hydraulic connection from the surface to the confined aquifer. Regional conditions that define the confinement of a groundwater source must be demonstrated by the PWS in order to be considered for a confined aquifer Susceptibility Waiver. Confinement of an aquifer can be demonstrated by pump test data (storage coefficient), geologic mapping, and well logs. Site-specific information is required to sufficiently represent the recharge area of the aquifer and the zone of contribution to the PWS well.

7.0 LIMITATIONS OF THIS SWDAR

This Source Water Delineation and Assessment Report is intended to meet the technical requirements for delineation and assessment of this PWS as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 [U. S. Code Title 42, Chapter 6A, Subchapter XII, Part E, § 300j-13-(a) Source Water Assessment]. The following limitations should be noted:

- Not every potential or existing source contamination in the vicinity of the PWS has been identified. Consideration was limited to potential sources of contamination that are within the Inventory Region and of a type determined by the DEQ to be significant.

- Potential sources of contamination were identified using online databases and available aerial (overhead) and map imagery. Field surveys and inspections of the Inventory Region were not conducted. It is highly recommended that the operator or other persons knowledgeable about the community review the inventory, and revise it as necessary. The potential contaminant sources described in the inventory are identified from readily available information. Consequently, unregulated activities or unreported contaminant releases may have been overlooked. Multiple data sources are used to increase the likelihood that major threats to the source water are identified. The inventory is not exhaustive and some potential contaminant sources may not have been included for the reasons just stated. Absence of a potential contaminant in the inventory or susceptibility assessment of this report does not mean that the potential for contamination does not exist, or that there is no threat.
- The Inventory Region is delineated on the basis of hydrogeologic mapping, groundwater Time-Of-Travel (TOT) estimates, or a combination of the two. In cases where Time-Of-Travel (TOT) calculations are used to estimate groundwater travel times and distances, it is important to understand that uncertainties exist in estimating the aquifer characteristics that are used for the TOT input parameters. The TOT calculation is considered to be an estimate or an approximation of the distance that groundwater will travel within a 1- or 3-year time period. While results of the TOT calculation are considered to be sufficiently accurate to support source water delineation and assessment, they do not represent the results of a detailed field investigation or detailed groundwater flow modeling. This report and the delineated source water protection areas are intended to provide a starting point for the purposes of long-term source water protection efforts, and detailed field investigations is beyond the scope of this report.
- Delineation of the Recharge Region is considered a first-order approximation, and may not be accurate. In order to accurately delineate a truly representative Recharge Region, a detailed groundwater field study would be required. Such a study is beyond the scope of this report.
- This report is not, and should not be construed as, a guarantee, warranty or certification that the PWS will not be impacted by potential contaminant sources for which it appeared to have a low susceptibility. It should be understood that even small releases of some chemicals in close proximity to a well can have significant negative impact on water quality, and is therefore a significant threat to the public water supply.

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9.0 GLOSSARY

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 non-point source pollution.

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.

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 inhibits the flow of water and maintains the pressure of the groundwater in the aquifer. The physical properties of a confining unit may range from a five-foot thick clay layer to shale that is hundreds of feet thick.

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.

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

Large Capacity Septic System. Defined by Underground Injection Control regulations as an on-site septic system serving 20 or more persons.

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

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. Examples of nonpoint- source pollution include agriculture, forestry, and run-off from city streets. Nonpoint sources of pollution, such as the use of herbicides, can concentrate low levels of these chemicals into surface and/or groundwater 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 a fixed facility from which pollutants are discharged. This includes any single identifiable source of pollution, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fracture, container, rolling stock (tanker truck), or vessel or other floating craft, from which pollutants are or may be discharged.

Pollutant. Generally, any substance introduced into the environment that adversely affects the usefulness of a resource (e. g. groundwater used for drinking water).

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

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

Sensitivity. The relative ease with which contaminants can migrate to source water through the natural materials

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

Source Water Delineation and Assessment Report (SWDAR). A report for a public water supply that delineates source water protection areas, provides 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 groundwater sources, the area within a fixed radius or three-year travel time from a well, and the land area where the aquifer is recharged.

Static Water Level (SWL). Water level 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.

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.

Turbidity. The cloudy appearance of water caused by the presence of suspended matter.

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

Watershed. The region drained by, or contributing water to, a stream, lake, or other water body of water.

10.0 FIGURES

Figure 1.	Regional Map
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