City of Shelby

Public Water Supply – PWS ID # MT0000328

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

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INTRODUCTION

This report is intended to meet the technical requirements for the completion of the Source Water Delineation and Assessment for the City of Shelby Public Water Supply (PWS), # MT0000328. This report is completed as required by the Montana Source Water Protection Program and the federal Safe Drinking Water Act. Jeffrey Frank Herrick, a hydrogeologist with the Source Water Protection Program, Montana Department of Environmental Quality (DEQ) completed this Delineation and Assessment Report (SWDAR).

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protecting public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is termed delineation and assessment. The emphasis of this delineation and assessment report is identifying significant potential contaminant threats to public drinking water sources and providing the information needed to develop source water protection planning.

Delineation is a process whereby areas that contribute water to aquifers or surface waters used for drinking water, called source water protection areas, are identified on a map. Geologic and hydrologic conditions are evaluated in order to delineate source water protection areas. Assessment involves identifying locations or regions in source water protection areas where contaminants may be generated, stored, or transported and then determining the potential for contamination of drinking water by these sources.

Delineation and assessment is the foundation of source water protection for the Shelby area sources. Although voluntary, source water protection plans are the ultimate focus of source water delineation and assessment. This delineation and assessment report is written to encourage and facilitate the City of Shelby PWS managers and operators and the community to be involved in source water protection planning and the possible development of a Source Water Protection Plan that is tailored to and meets their specific needs.

This report has been written based on readily available public information and is as complete and accurate as possible within time and resource constraints. Unfortunately, accurate and reliable information may not be available on the hydrogeology beneath certain areas or on the nature or location of some potential contaminant sources in the area. The author has asked for comments and/or corrections from the managers and operators of this PWS prior to finalization of this report.

CHAPTER 1
BACKGROUND

The Community

The City of Shelby is located in Toole County, of northwestern Montana, near the Canadian border (Figure 1). It is situated along Interstate Highway 15 at the intersection with Montana Highway 2. It is also situated along the High Line, the northern east-west route of the Burlington Northern Santa Fe Railroad (Figure 2). The public water supply (PWS) addressed in this SWDAR is the City of Shelby PWS (MT0000328), which is classified as a Community Non-Transient PWS serving most of the residents of the City of Shelby. It is listed as serving approximately 3,222 residents via 1,251 active service connections. The address and name of contact person for this PWS is listed on the cover of this document and in the next chapter. According to the 2000 US Census, the population of Shelby consists of approximately 3,216 people and Toole County has a population of approximately 5,262 people. The population served appears to be larger than the population of the city, which is probably a result of service being provided to businesses, residences, and the Crossroads Correctional Center, which are located just outside of city proper. Shelby is the Toole County seat. The economy for the area of Shelby reflects the fact that it is at a major crossroads on the northern Great Plains situated near the Canadian Border. The economy is based mostly on service industries, retail, the railroad, federal offices (US Port Authority and US INS offices are present), regional agriculture, service for the regional oil production industry, and the privately managed Crossroads Correctional Center (a state prison). The City of Shelby is serviced by a municipal water supply and a sewer system, but any residents or businesses located outside of the city limits must have their sewage discharged to onsite drain-fields. An exception to this are a major water and sewer extension that runs west and south to the state prison. The City of Shelby's municipal sewer coverage isn't precisely known, but is believed to be similar to the land encompassed by the limits of the incorporated city. The production wells that supply water to the Shelby PWS are all located approximately 5-6 miles south of town along the Marias River just east of where the river is crossed by Highway 15.

Geographic setting

The City of Shelby is located in northwest Montana near the Canadian border. It is situated in on the high prairie just east of the Rocky Mountain range front and Glacier National Park. No major rivers pass near town, but it is situated just north of the Marias River and the Marias Tiber Reservoir. The Physiography of the area is best described as northwestern Great Plains consisting of gently rolling grassy prairie that is dissected by numerous coulees. The perennial streams present in the area all drain toward the Marias River, which is a tributary to the Missouri River. The City of Shelby resides at an elevation of approximately 3,260 to 3,300 feet above mean sea level (MSL) and appears to be situated within a dry coulee that runs east-southeast toward the Marias River. The climate in this area is a modified continental climate that is typical of northern prairies found east of the Continental Divide. Generally, the area experiences cool dry summers and cold winters. The nearest weather station is in the City of Shelby. Historic climatic data for Shelby is presented in Table 1 below. Shelby has an average annual precipitation of approximately 11.6 inches and the total average snowfall is 22.3 inches. It appears that most of the precipitation occurs in the middle of winter each year.

Table 1. Climatic Data

Shelby, Montana (247500)

Period of Record Monthly Climate Summary – Period of Record : 4/ 1/1950 to 3/31/2003

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	29.5	37.8	41.9	55.7	66.6	73.2	83.2	82.6	73.1	59.2	43.1	34.2	56.7
Average Min. Temperature (F)	2.5	12.1	16.2	27.3	38.1	45.9	51.2	48.5	40.2	29.3	18.2	9.5	28.2
Average Total Precipitation (in.)	0.35	0.34	0.53	0.77	1.76	3.14	1.47	1.19	0.84	0.45	0.37	0.40	11.62
Average Total Snowfall (in.)	4.4	4.3	4.9	1.1	1.9	0.0	0.0	0.0	0.1	0.2	2.4	2.9	22.3
Average Snow Depth (in.)	1	1	0	0	0	0	0	0	0	0	0	1	0

Source: Western Regional Climate Center, wrcc@dri.edu

General description of the Source Water

In the development of this SWDAR only limited hydrogeologic information specific to the well field was found. The following assumptions are drawn for the geologic map, lithologic and well logs, some published reports and correspondence, and a general knowledge of geology/hydrogeology. In general terms, the primary aquifer in the Marias River valley (around the well field) is found within the following materials: sedimentary rocks of the Cretaceous age, which completely underlie the area and make up the bedrock; and younger Quaternary alluvium and possibly glacial outwash deposits. Figure 5 is a geologic map depicting the distribution of geologic units around Shelby. Unfortunately, this map does not depict the narrow alluvium filled stream channel along the Marias River. Wells in and around the Marias River valley almost exclusively draw water from the river valley-fill sediments, primarily alluvium, but other deeper bedrock wells are common. The shallow unconfined aquifer of the Marias River valley is the predominant source of domestic and municipal water in the area. This shallow aquifer is undoubtedly in communication with (it exchanges water with) the river and is subject to seasonal and yearly water level fluctuations. The shallow unconfined groundwater is forced by the shape of the river valley to move in a parallel to sub-parallel direction as depicted on Figure 6. Due to the complexities of groundwater flow through old buried river channels and abandoned oxbows, groundwater flow beneath specific locations is harder to predict. But in a general sense, groundwater flows through the shallow alluvial aquifer in the directions indicated on Figure 6. It isn't clear at what the depth of bedrock is encountered beneath the river, but it is estimated that the depth is less than around 80 feet below the river.

The City of Shelby PWS appears to operate 10 wells in a well field that are drilled and installed into the unconfined alluvial aquifer within the Marias River valley. Some of the information available suggests that there are 12 wells used by the PWS. Whatever the number, the wells are all located in close proximity to one another in a well field located about 5-6 miles south of Shelby on the Marias River (Figure 2, Figure 3, and Figure 4). At least 1 additional well exists, but has not been located by this author. This well is currently listed as inactive. It should be noted that the well field displayed on Figure 3 & Figure 4 does not plot the precise locations for each of the wells. The available information sources (the correspondence and reports found in Appendices A, B, and C) are not in agreement about the locations for individual wells of this PWS. The PWS wells and other facilities are listed on Table 2. The latitude and longitude for each well listed on the table comes from the DEQ PWS Database, but the author considers the accuracy of this information suspect. Some correspondence has suggested that the 3-

4 wells are operated constantly, but are supplemented during dry weather by turning on the remaining wells. The static water level for the

City of Shelby PWS production wells within the well field was recorded as generally less than 25 feet below ground surface (bgs). No data exist on groundwater flow directions beneath specific areas within the alluvium around the wells, but it is assumed that it basically flows parallel or sub-parallel to the direction of surface water flow in the river valley. Groundwater movement in the surrounding bedrock aquifer is probably similar to that of the shallow aquifer only in a broad sense, as it probably has a net groundwater flow that is to the east, with eventual discharge points along the Marias River or Missouri River. There's no way to estimate the cross communication between the deeper bedrock aquifer and the shallow water table aquifer. A summary of some well construction and lithologic logs for the Shelby PWS wells is contained in Appendices B and C of this SWDAR.

The City of Shelby PWS (MT0000328) is classified by DEQ as a Community Non-Transient PWS. Its source wells are identified in the DEQ PWS Database as Well #1 (source # WL002) through Well #10 (WL011). This database output is found in Appendix A. Past correspondence references other wells that could not be identified or located for this report. The wells appear to have been completed in the shallow unconfined aquifer in the Marias River valley that is probably composed of alluvium and possibly some glacial out-wash deposits. The general groundwater flow direction beneath the Shelby wells is probably parallel or sub-parallel to the Maria River and to the walls of the valley. The author's estimate of groundwater flow direction is depicted on Figure 6. According to past Sanitary Surveys and the Department of Environmental Quality, Public Water Supply Section, the PWS has 1,251 active service connections that serve approximately 3,222 people (all residents). Although there is probably a transient (tourist) population for the area, this was not estimated. The source wells are connected to a lift station, a pipeline into town, and 3 water tanks that float on the distribution system and provide storage and/or water pressure. One 1 million gallon capacity storage tank appears to be located just north of the well field and in close proximity with a booster station. The 1.5 million gallon storage tank appears to be located east of Shelby and the 100,000 gallon capacity tank is located west of Shelby. This smaller tank is probably associated with the Crossroads Correctional Center and the water line servicing that facility. The exact locations for the tanks were not discovered during the development of this report. There does not appear to be a water treatment plant associated with the production wells prior to distribution or storage, although correspondence in the PWS files suggests a UV Treatment system is in the works. Table 2 is a tabular summary of the City of Shelby PWS facilities as listed in the DEQ PWS Section database. An output of this database is found in Appendix A of this SWDAR. Correspondence relevant to the construction of the wells is found in Appendix C.

Table 2. PWS Facilities

City of Shelby PWS (MT0000328)

Operator / Contact Person & Address	**William F. Moritz** **Public Water Supply** **City of Shelby** **PO Box 743** **Shelby, MT 59474 Phone: 406/434-5564**									
Class	Community Non-Transient									
Intake Source Code	**WL002**	**WL003**	**WL004**	**WL005**	**WL006**	**WL007**	**WL008**	**WL009**	**WL010**	**WL011**
Well/Intake Name	**Well 1** Lot 7	Well 2 Lot 7	**Well 3** Lot 7	Well 4 Lot 7	**Well 5** Lot 7	Well 6 Lot 7	Well 7 Lot 5	Well 8 Lot 5	Well 9 Lot 7	Well 10 Lot 7
Status	**Active**	**Active**	**Active**	**Active**	**Active**	**Active**	**Active**	**Active**	**Active**	**Active**
Location (Lat. & Long.)	48.4234 -111.8747	48.4238 -111.8759	48.50526 - 111.85608	48.4247 -111.8749	48.4237 -1118739	4834239 -111.8750	48.4244 -111.8765	48.4248 -111.8756	48.4254 -111.8740	48.4246 -111.8738
Treatment Plants	No treatment plants are in-place at the time of writing this document.									
Treatment Plant ID	Not yet assigned									
Distribution System	**DS001** **/ SP001 Active**									
Storage Facility	**Storage Tank 1** capacity 1,000,000 gallons **/ SP002 Active**			**Storage Tank 2** capacity 1,500,000 gallons **Active**			**Storage Tank 3** capacity 100,000 gallons **Active**			
Storage ID	ST001 / EP502 Active			ST002			ST003			
Storage Location (Lat. & Long.)	47.2138 -114.8859									
Common Header for Wells	**CH001**									

Note:

- The above listed wells are the only ones that appear in the DEQ PWS Database. Others appear to exist, but it was unclear where they may be or what their activity status may be.
- Lot 7 and Lot 5 appear to be the description of the PWS well field located on the Marias River east of Hwy 15.
- Well 11 (WL012) is EP512. Well 11 does not appear to be in Lot 7 or Lot 5 within the well field and could not be located. It is recorded in the DEQ PWS Database as being Inactive and without coordinates.
- Various sources of information suggest different numbers of wells are present in the well field or elsewhere. It is hoped that the PWS Operator will help clarify this matter to ensure this SWDAR is current and accurate.

Water Quality and Regulatory History

The City of Shelby PWS system and the wells have been sampled as part of regular water quality monitoring for public water supplies. The up-to-date bacteriological and inorganic analytical results are displayed on tables within Appendix A of this report. The chemical analytical results in these tables for the storage facility's EP502 begin in 1990; and for the distribution system's SP001 analytical results begin in 1975. The bacteriological data found in these data tables begin in 1998. These data tables are presented along with output from the DEQ PWS Section database and relevant correspondence from DEQ files. Standards compliance with regulated contaminants occurs on a variety of sampling schedules. The chemical analytical data contain no exceedences of any of the regulated contaminants. A single elevated nitrate concentration showed up in a sample from September 2002 (4.06 mg/L), but this appears anomalous and not representative of the analytical history for the system. Correspondence contained in

Appendix C of this SWDAR and the bacteriological analytical results since 1998 (Appendix A) suggest a recurring problem with bacteriological contamination reaching the wells. Several boil orders have been in place over the past several years. It is documented that the wells are within the flood plane of the river and are periodically inundated with floodwater. To reduce the impact from the floodwaters on the wells, the casing have been extended well above the ground surface. The Shelby PWS has been studied to determine to what extent water the river influences quality in well field. In the letter dated 18 March 2002 from DEQ to Mr. Moritz, 8 wells were examined to determine the final classification for the water system as part of the Ground Water Under Direct Influence of Surface Water (GWUDISW) program. Of the 8 wells examined, 5 wells failed the preliminary assessment and 3 wells passed. Of the 5 wells that failed the preliminary assessment, 4 of them were identified as GWUDISW. According to the Administrative Rules of Montana (ARM) 17.38.229 the water supply must begin full time chlorination of all water withdrawn from the well field. The correspondence from DEQ to the Mayor of Shelby dated 09 April 2003 acknowledged receipt of a plan to shut down the well field during flood conditions. This DEQ letter also provided the justification for the requiring full-time chlorination of the water supply. The letter from DEQ to the Mayor of Shelby dated 30 July 2003 clarified DEQ's position of UV disinfection and other points. This letter suggests that Well #4 should be removed from service; the City should enter into a compliance schedule that details when plans and specifications for the UV disinfection system will be submitted to DEQ; it addresses the need for an alternate chlorination system if a 01 February 2004 approval date is not met; and the letter provided specifications for UV disinfection. The most recent correspondence and other records found during the development of this SWDAR did not indicate that any form of disinfection has to-date been installed on the City of Shelby PWS.

Businesses and residences within and in close proximity to the City of Shelby are serviced by a municipal sewer system and sewage is collected and transported by sewer mains to the community wastewater treatment facility for treatment. The City of Shelby wastewater treatment facility is located at the southeast end of town, which is downstream along the dry coulee. The area of Shelby that is serviced by municipal sewer approximates the municipal boundaries for the community, which is depicted on Figure 2. It should be noted that City of Shelby water and sewer also service the Crossroads Correctional Center located west of town.

CHAPTER 2
DELINEATION

Delineation Process

The source water protection regions, the delineated land areas that contribute water to wells in Shelby are identified in this chapter. There are 3 management or source water protection regions usually identified for any given water source. These 3 regions are the Control Zone, Inventory Region, and Recharge Region. The Control Zone, also known as the exclusion zone, is an area at least 100-foot radius around the wellhead, spring collection box, or surface water intake. Human activity in this area can have an immediate impact on water quality by introducing contaminants into the area around an intake. As such, careful management of this Control Zone is critical to protect a PWS. The Inventory Region usually represents the zone of contribution to the well, which can approximate a three-year groundwater time-of-travel or an approximate 1-mile radius around a wellhead. The Inventory Region comprising a 1-mile radius circle around a well is often a conservative value that is used either for convenience or when insufficient geologic or hydrogeologic information is available about an area or if details are lacking on the construction of a production well. In certain circumstances where a PWS well taps into an aquifer that has been characterized as being confined, the Inventory Region can be limited to a 1,000-foot radius around the wellheads, and the inventory of potential contaminant sources is only completed for those sources within 1,000 feet of the wells. Activities or contaminant releases in the Inventory Region have the potential to reach a PWS well in a period approximating less than 3 years. In circumstances where there appear to be interactions between surface water and the groundwater source or if a surface water body is present within the Inventory Region, a Surface Water Buffer is delineated. The Surface Water Buffer encompasses approximately 0.5 miles on either side of the river and about 10 miles upstream along the primary stream channels. The Recharge Region is the largest of the regions and represents the entire aquifer or an area that contributes water to the local aquifer and over time supplies water to a well. This extended region of groundwater recharge is often, but not always inclusive of the limits of a watershed. At times an entire watershed is too large to be realistically manageable by a PWS or community, so a subsection of that watershed can be delineated as the Recharge Region. Long-term water quality at a PWS is affected by large contaminant sources, accidental chemical releases, or extensive land use activities in the Recharge Region. Table 3 summarizes how these source water protection regions are determined.

Table 3. Methods and Criteria for Delineating Source Water Protection Regions

If Your Source of Water Is	Delineate These Water Protection Regions	Method For Each Region	Minimum Distance Values & Type of Inventory Required
Ground Water that is:			
• **Unconfined or Semi-confined***	Control Zone Inventory Region Recharge Region	Fixed radius Fixed radius Topography	Distance – 100 feet Distance – ~1 mile Limits of the watershed
• **Confined**	Control Zone Inventory Region Recharge Region	Fixed radius Fixed radius Topography	Distance – 100 feet Distance – 1000 feet Limits of the watershed
*Ground Water that is hydraulically Connected to Surface Water also needs the following ----------→>	Surface Water Buffer Zone	Fixed Distance	In addition to the Inventory Region, a one-half mile surface water buffer will extend upstream a distance corresponding to a 4-hour TOT but not to exceed ten miles or the nearest intake. The buffer will not exceed the extent of the watershed. Inventory is limited to pathogens and nitrate sources.
Surface water	Spill Response Region Watershed Region	Fixed Distance Topography	One-half mile buffer extending upstream a distance corresponding to a 4-hour TOT but not to exceed ten miles or the nearest intake. Buffer will not exceed the extent of the watershed. Limits of the watershed

Note: The highlighted choices above are probably applicable to the PWS production well field in Shelby.

Hydrogeologic Conditions

In the development of this SWDAR little hydrogeologic information was found that addresses the immediate vicinity of the City of Shelby PWS well field. The following assumptions are drawn for the geologic map, area lithologic and well logs, and a general knowledge of geology/hydrogeology. In general terms, the primary aquifers in/around the Marias River valley (around the Shelby well field) are within the following groups of materials: sedimentary rocks of Cretaceous age, which surround the area and make up the bedrock underlying the region: assorted Quaternary glacial till and Lake Cut Bank lakebed sediments; and younger Quaternary alluvium and glacial outwash deposits lining the stream valleys. No Tertiary age sediments have been mapped in the region. Figure 5 is a geologic map depicting the distribution of surficial geologic units around Shelby. Domestic wells in the area almost exclusively draw water from the Marias River valley sediments or that of other sediment-lined coulees and valleys. To the west of Shelby, many wells draw water from bedrock wells drilled into the more porous sections of the Virgelle Sandstone or lower portion of the Two Medicine Formation. A few wells in the area of Shelby are installed into the fractured bedrock of the Colorado Shale, but these tend to be several hundred feet deep and only produce water if they intersect open water-bearing fractures that are laterally extensive. The region was heavily glaciated during the Pleistocene and the tabular surface of the regional bedrock was scoured smooth by the repeated advances of the Laurentide Ice Sheet and it received a scattering of deposits of glacial till or was covered by Glacial Lake Cut Bank that formed around the front of the continent spanning ice sheet (whether it was advancing or retreating). Local streams received large volumes of melt water and sediments from both the Laurentide Ice sheet and from valley glaciers

flowing eastward out of the Rocky Mountain front. Sediments scattered across the region reflect the glacial advance in the area, with shallow soils forming on the surface of the scoured bedrock. Basal till and other pro-glacial till deposits are still scattered about the region in areas where they haven't been removed by erosion. These glacial till deposits are typically quite heterogeneous, but usually have a fine-grained matrix of silt and/or clay. As such, they usually have poor transmissivity and are not used as a water source. High terraces in the larger stream channels reflect some of the initial reworking of glacial tills during or just after the retreat of the continental and mountain valley glaciers. It is difficult to say what the depth of incision (the depth to bedrock) is within the Marias River valley, but it is probably less than 80 feet below the active river channel. Lithologic logs for wells in the Shelby PWS well field suggest that the shale bedrock may be from 30-45 feet bgs (below ground surface), but the logs are not actually clear. The shallow alluvial sediments that fill the Marias River valley represent the most recent post-glacial deposits of the active river. These deposits appear to consist of complexly stratified, laterally discontinuous, but vertically and horizontally interconnected water-bearing zones that are comprised of sand and gravel lenses. Assorted finer grained layers (probably lenses and other laterally discontinuous features) show up in the lithologic logs for the wells and these vary in thickness, composition, and depth. These materials are interpreted as possibly being overbank flood deposits, reworked glacial till and outwash, and maybe abandoned and silted-in oxbow lake features. The water-bearing zones interact together to form the shallow water table aquifer that runs beneath the City of Shelby PWS well field. This shallow unconfined aquifer is undoubtedly in communication with (it exchanges water with) the river and is subject to seasonal and yearly water level fluctuations. It is receives water from (it is recharged from) the river and from the surrounding bedrock. Flow direction in the alluvial aquifer is constrained by the lower permeability bedrock of the valley walls. This flow direction within the alluvial aquifer is depicted on Figure 6. The total depths for wells lining the Marias River valley range from less than 10 feet to around 50 feet bgs. Water levels in these wells vary from the ground surface to less than 25 feet bgs. A summary of well construction and lithologic logs for the City of Shelby PWS wells in the well field is contained in Appendices B, C, and D of this SWDAR.

The shallow unconfined alluvial aquifer is characterized as having High Source Water Sensitivity to contamination. This is based on criteria used by the DEQ Source Water Protection Program as outlined on Table 4. The interpretation of the author is that this sensitivity is based on the fact that the well field is located in an area where the aquifer is shallow, it is unconfined, it is present within sand and gravel alluvium, and many of the wells are actually in close proximity to the active stream.

Table 4. Source Water (Aquifer) Sensitivity

DEQ Source Water Protection Program Criteria

High Source Water Sensitivity	Moderate Source Water Sensitivity	Low Source Water Sensitivity
• Surface water and GWUDISW • Unconsolidated Alluvium (unconfined) • Fluvial-Glacial Gravel • Terrace and Pediment Gravel • Shallow Fractured or Carbonate Bedrock	• Semi-consolidated Valley Fill sediments (semi-confined) • Unconsolidated Alluvium (semi-confined)	• Consolidated Sandstone Bedrock • Deep Fractured or Carbonate Bedrock • Semi-consolidated • Confined Aquifers

Note: The sensitivity of the aquifer/source water beneath the City of Shelby PWS well field is based on the assumption that the aquifer is shallow, unconfined, present within alluvium, and in close proximity to the active stream.

PWS Source/Well Information

What is known about the wells used by the City of Shelby PWS is summarized in Table 5 below.

Table 5. Source/Well Information

City of Shelby PWS

Source Name	Well 1 Lot 7	Well 2 Lot 7	Well 3 Lot 7	Well 4 Lot 7	Well 5 Lot 7	Well 6 Lot 7	Well 7 Lot 5	Well 8 Lot 5	Well 9 Lot 7	Well 10 Lot 7	??	??
Source ID	**WL002**	**WL003**	**WL004**	**WL005**	**WL006**	**WL007**	**WL008**	**WL009**	**WL010**	**WL011**	??	??
Status	**Active**	**Active**	**Active**	**Active**	**Active**	**Active**	**Active**	**Active**	**Active**	**Active**	**??**	**??**
Lcn (Lat. & Long.)	**48.4234 - 111.8747**	**48.4238 - 111.8759**	**48.50526 - 111.8561**	**48.4247 - 111.8749**	**48.4237 -1118739**	**4834239 - 111.8750**	**48.4244 - 111.8765**	**48.4248 - 111.8756**	**48.4254 - 111.8740**	**48.4246 - 111.8738**	**??**	**??**
MBMG GWIC #	87581	87577	87576	87478	87579	87580	87572	87573	87574	87575	??	??
Water Right #	W192877	W192878	W192879	W192880	W192881	W192882	P004489	P004490	L071891	M071891	??	??
Date compl.	06 June 1940	01 Jan 1946	07 July 1939	12 Oct 1946	01 Jan 1962	04 Aug 1962	14 Jan 1975	12 Mar 1975	13 Mar 1985	13 Mar 1985	31 May 1993	31 May 1993
Total Depth (ft bgs)	49	48	48	50	44	41	39	31	40	41	38	38
Perforated Interval (ft bgs)	26-36	13-15 19-32	24-34	15-30	34-44	31-41	28-36 36-38	20-24 24-30	24-40	29-41	24-36	24-36
Static Water Level (ft bgs)	18	15	*	20	20	20	7	7	10	9	8	8
Pumping Water Level (ft bgs)	36	30	*	29	34	30	??	??	18	15	23	23
Draw Down (ft)	18	15	*	9	14	10	??	??	8	6	15	15
Yield (gpm)	300	300	*	300	350	250	90	??	235	320	440	440

Note:

- The coordinates for each well listed above comes from the DEQ PWS Database.
- The remainder of the information contained in this table comes form the MBMG GWIC database or from lithologic logs provided in the correspondence. These logs are provided in Appendices B and C.
- "??" indicates that no information was available or that it couldn't be determined at the time this report was written.
- Well locations listed above are taken from the DEQ PWS Database. The author believes that the accuracy of these are suspect. As a result, until better information is available, the locations of individual wells within the well field are not plotted in this SWDAR.
- Some records indicate that there are additional wells in the well field or elsewhere. It was not clear to the author what wells these are or where they were located.

Delineation Results

The delineations for the source water protection regions were done by assuming the PWS wells are withdrawing water from an unconfined aquifer and are in close proximity to one another. The Control Zone is delineated to provide a minimum 100-foot radius buffer around each of the wellheads. It should be noted that a large portion of Williamson Park is occupied by the Control Zones for the wells. The Inventory Region was delineated as an approximation of a 1-mile radius circle around the well field as depicted on Figure 7. Owing to the fact that this is a well field and not a single wellhead, the Inventory

Region was distorted to be narrow at the downgradient end (east) around the well field itself and is wide at the upgradient end (west). If any wells other than those in the well field are in active use by the City of Shelby PWS, they were not included in the delineation process. Note that the region incorporates Highway 15 and reaches the golf course and country club. It should be noted that this Inventory Region was delineated only on the convenient 1-mile fixed radius, rather than based upon the calculation of groundwater velocity and a 3-year time-of-travel distance. In aquifers with high transmissivity (like those in active river channels), the 3-year groundwater time-of-travel can extend for considerable distances, much greater than 1-2 miles and include a considerable greater amount of land surface. The Surface Water Buffer was delineated to cover the area within about 0.5 miles of the river and extends 10 miles upstream. The Surface Water Buffer is depicted on Figure 8. The Recharge Region is depicted on Figure 9. It is a large watershed that extends to the confluence of Cut Bank Creek and the Two Medicine River in the east, as far south as Valier and Highway 44, and as far east as Highway 15. Several noteworthy potential contaminant sources are present in Recharge Region, but these will be discussed in the next chapter.

Limiting Factors

Groundwater behavior has not been well studied in the Marias River valley in the vicinity of the City of Shelby well field. But some reasonable assumptions can be made about groundwater, based on what information is available for the area and utilizing geologic and hydrogeologic conditions in similar settings. It should be noted that groundwater behavior beneath specific locations is very difficult to predict with any confidence. Groundwater flow direction fluctuates seasonally and from year to year, which adds a complication to any models of groundwater behavior beneath specific areas. This author has made several conservative assumptions in the delineation of the source water protection areas and the development of this report. The author used his professional judgment and reliance on some basic hydrogeologic principals to define the aquifer boundaries and groundwater movement. However the Report can and should be revised if more data becomes available that alters the assumed groundwater flow direction(s) or the assumptions about other hydrogeologic conditions (such as confinement of the aquifer).

CHAPTER 3
INVENTORY

Inventory Method

An inventory of potential sources of contamination was conducted for the City of Shelby PWS within the Control Zone, Inventory Regions, Surface Water Buffer, and Recharge Region. Potential sources of all primary drinking water contaminants and Cryptosporidium were also identified and noted, however, only significant potential contaminant sources were selected for detailed inventory and the susceptibility evaluation that occurs in Chapter 4 of this SWDAR. It should be noted that the inventory emphasizes potential contaminant sources. Inclusion of a facility or business in the inventory does not indicate that it is an actual polluter. The exception to this would be known hazardous waste sites where past releases have occurred, areas with known onsite contamination, locations with leaking underground storage tanks (LUSTs), or wastewater dischargers.

The inventory for the City of Shelby PWS (specifically the area around the 3 wells) focuses on all activities in the Control Zones for the wells; certain types of municipal and private facilities or land uses in the Inventory Region and in the Surface Water Buffer; and general land uses and large facilities in the Recharge Region. The following databases have been searched in an effort to identify generators, storage facilities, and land uses that could be potential generators of contamination in the Inventory Region.

Step 1: Urban and agricultural land uses were identified from the U.S. Geological Survey's Geographic Information Retrieval and Analysis System (http://nris.state.mt.us/gis/datalist.html). Sewered and unsewered residential land uses were identified from boundaries of sewer coverage obtained from municipal wastewater utilities.

Step 2: As appropriate, EPA's Envirofacts System (http://www.epa.gov/enviro/) 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), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS). 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 3: The Permit Compliance System (PCS) was queried using Envirofacts (http://www.epa.gov/enviro/) to identify Concentrated Animal Feeding Operations with MPDES permits. The PWS system operator and/or system managers are familiar with the area included in the Inventory Region will have identified animal feeding operations that are not required to obtain a permit.

Step 4: Databases were queried to identify the following in the Inventory Region: Underground Storage Tanks (UST) (http://webdev.deq.state.mt.us/UST/), hazardous waste contaminated sites (DEQ hazardous waste site cleanup bureau), landfills (http://nris.state.mt.us/gis/datalist.html), abandoned mines (http://nris.state.mt.us/gis/datalist.html) and active mines including gravel pits. Any information on past releases and present compliance status was noted.

Step 5: A business phone directory was queried to identify businesses that generate, use, or store

chemicals in the Inventory Region. Equipment manufacturing and/or repair facilities, printing or photographic shops, dry cleaners, farm chemical suppliers, and wholesale fuel suppliers were targeted by SIC code.

Step 6: Major road and rail transportation routes were identified throughout the Inventory Region (http://nris.state.mt.us/gis/datalist.html).

Step 7. All land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the Recharge Region and identified on the base map.

Potential contaminant sources are designated as significant if they fall into one 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 UST leak sites).
5. Underground injection wells.
6. Major roads or rail transportation routes.
7. Cultivated cropland greater than 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.

Inventory Results/Control Zone

Of the documents examined for this SWDAR, there was very little discussion of the presence of activities or potential contaminant sources within 100 feet of the production wells. The well field along the Marias River is dispersed throughout a city park, identified on the topographic map as Williamson Park. The facilities at this park include bathrooms and possibly a shower facility that may have a septic system. Maintenance of the grounds at the park do not include vegetation management, lawns, ball fields, etc., so that maintenance would not involve the use of any significant volumes of fertilizers and or herbicides. And this activity would not be considered a potential contaminant source. Human activity and access to the wellheads may allow for tampering or accidents, but this wouldn't count as a potential contaminant source.

Inventory Results/Inventory Region

The area within and surrounding the Inventory Region for the City of Shelby PWS well field (as depicted on Figure 8) is rural land within the Marias River valley and on the surrounding upland plain. It is the authors estimate that groundwater follows the general flow direction of the Marias River and flows from west to east as depicted on Figure 6. Groundwater flow beneath precise locations within this area may be affected by the localized stratigraphy within the alluvium, and this flow may be quite different than this author's estimate. But in the larger picture, all groundwater will have to flow toward the east parallel or sub-parallel to the river. The Inventory region encloses a city-owned park, some pasture/grazing land,

part of a golf course, and some cropland. No community septic systems or wastewater treatment systems are present within or directly upgradient (west) of the Inventory Region. The well field at the downgradient (east) end of the Inventory Region is co-located with Williamson Park. This facility is a campground / boat ramp / recreation area with a shower and bathrooms. The presence of these facilities suggests that there may be some sort of septic system. This may be a large capacity septic system. Large capacity septic systems are those that service at least 20 people per day for more than 6 months of the year. These systems are not documented, so it is difficult to determine their actual usage or precise locations. There are a couple of residences in the area of the well field. One is thought to be associated with Williamson Park (possibly a caretaker), but the other is probably associated with a local farm/ranch. The density of private onsite septic systems is low within the Inventory Region. Septic density is an estimate that is based on the 2000 US Census data. Highway 15 (I-15) bisects the Inventory Region from south to north and crosses the Marias River valley with at least 3 parallel bridges (2 for the highway on 1 for the frontage road). Traffic accidents by trucks are an infrequent but potentially catastrophic occurrence. Such accidents can and do allow for the release of large volumes of hazardous materials that can quickly reach the river. Highway 15 is a heavily traveled truck route for the regional and even international transport of a wide range of materials used for industry and agriculture. The logic is that if a catastrophic spill occurs on or near the bridge, it can reach the river. If that material can reach the river, it can reach the shallow unconfined aquifer that supplies water to the well field. Thus the highway is a potential contaminant source. Just west of the Highway 15 bridge and at the west end of the Inventory Region is the Marias Valley Golf and Country Club, which is a country club associated with an 18 hold golf course. Golf course are known to use large amounts of fertilizer and herbicides in their grounds and greens maintenance program. In addition, abundant water is used for irrigation to keep these greens in suitable shape for use by golfers. The golf course is considered a potential contaminant source. Land use within the Inventory Region for the City of Shelby PWS well field is approximately: 68% grassland/herbaceous vegetation, 13.6% pasture/hay/small grains, 7.8% woody and herbaceous wetlands, 6% open water, and 5% fallow ground. The remaining the land uses total less than 1% of the area within the Inventory Regions (see Table 6 and Figure 10). None of these concentrations of land uses would typically pose a threat to this PWS. Figure 7 depicts the Inventory Region and the nearby potential contaminant sources and Figure 8, Figure 9, and Figure 10 depict land use in the area. Table 7 is a listing of the potential contaminant sources known to be present within the Inventory Region for the City of Shelby PWS well field.

Table 6. Land Use

Town Shelby PWS
Refer to Figure 10

Inventory Region	Land Use					
	Grassland / Herbaceous	Pature / Hay / Small Grains	Wetlands	Open water	Fallow	Other
	67.6%	13.6%	7.8%	5.6%	4.7%	~>0.7%

Inventory Results/Surface Water Buffer

The inventory conducted within the Surface Water Buffer is limited to potential contaminant sources of nitrate and pathogens. The Surface Water Buffer is depicted on Figure 8. Potential contaminant sources within the buffer are very similar to those described within the Inventory Region. The golf course and

country club is within the Surface Water Buffer and this business contains both greens and other landscape that requires maintenance, but the facilities are serviced by a large capacity septic system. The buffer runs right along the Marias River valley and generally doesn't include much of the land that is up on the high ground outside of the valley. Thus, little or no small grain acreage or other dry land farms are present. A lot of the valley floor is used for grazing and/or pasture, but no confined animal feeding operations (CAFOs) are known to be present. The land use percentages for the Surface Water Buffer are essentially the same as those for the Inventory Region. As such, none of those land uses would be considered to pose a threat to the water system as potential contaminant sources.

Inventory Results/Recharge Region

The Recharge Region as delineated for this SWDAR is depicted on Figure 9. It is a large watershed that is bounded on the east by a north-south line intersecting the confluence of the Two Medicine River and Cut Bank Creek and on the south by a line that runs just south of Highway 44 to Valier. Land use in the Recharge Region is predominantly agricultural in nature, consisting mostly of non-irrigated agricultural land and rangeland. None of these land uses appear to be significant potential contaminant sources for this PWS. Septic density in the Recharge Region as a whole is low. Highway 15 is present as the eastern border of the region and Highway 44 to Valier is enclosed by the southern boundary. Most of the time, these transportation corridors do not pose any threat to surface or groundwater, but any large scale release/spill on the highways has a high potential to reach the surface water and be carried/transported to the Marias River, then to the area of the Shelby PWS well field. If a contaminant gets that far, it may have an impact on groundwater quality. The size and magnitude of chemical releases that could occur from any one vehicular accident (e.g., a tanker truck rollover) and the large number of miles of these transportation routes in the Recharge Region make this contaminant source significant. All of the railroad lines in the area travel outside of the Recharge Region boundaries. The Recharge Region also contains a couple of regulated stormwater and wastewater dischargers. The wastewater discharger is the wastewater treatment plant for the town of Valier, which is on an unnamed coulee located at the extreme southwest corner of the Recharge Region. It isn't clear if this wastewater discharger is discharging throughout the year of if it is seasonal only. A stormwater discharger is present at the Northern Montana Joint Refuse facility located just west of the intersection between Highways 44 and 15. It is not the impression of the author that either of these wastewater or stormwater dischargers would be a significant threat to the well field for Shelby as they are located as far away as you can get within the Recharge Region. There is a confined animal feeding operation (CAFO) located just northeast of Valier, called the Still Feedlot. These types of operations has a great potential to release large amounts of nitrate and possibly pathogen into surface water and groundwater. This site is located relatively remote from the well field and isn't considered an significant threat to surface water or groundwater quality. A titanium-iron ore prospect turned up during the inventory. It is located approximately 10 miles west of the well field and does not pose an obvious threat to water quality. Also of significance are the 4 petroleum pipelines that run from the northwest corner of the Recharge Region south across Highway 44. Various types and volumes of crude oil or other petroleum fractions are shipped south through these pipelines. As with the highways, spills are infrequent, but they can be very large and quite catastrophic. All 4 of these pipelines cross the Marias River very close to the corner intersection of Glacier, Toole, and Pondera Counties. Please refer to Figure 9. It is beyond the scope of this document to do more than to bring these potential contaminant sources within the Recharge Region to the attention of the reader. Table 7 below is a listing of potential contaminant sources in the Inventory and Recharge Regions. An evaluation of the hazard of the more significant potential contaminant sources and the determination of the PWS's susceptibility to them is discussed in the next chapter.

Table 7. Noteworthy potential contaminant sources

City of Shelby PWS

Inventory Region (significant contaminant sources)		
Source	**Contaminants**	**Description**
Large Capacity Septic System at Williamson Park	Pathogens, Nitrates, other organic and inorganic chemicals	Waste water discharged to drain fields that may contain improperly disposed chemicals or may not completely eliminate nitrate and pathogens from the effluent
Highway 15 and the bridges that cross the Marias River just upstream of the well field	Hazardous Materials (VOCs, SOCs, metals, other)	Large scale spills of hazardous or other materials that can infiltrate into the ground and reach the groundwater
18 Hole Golf Course & Country Club	SOCs and fertilizers	Herbicide and fertilizer applied to greens and other landscape that is well irrigated
Surface Water Buffer (not significant potential contaminant sources evaluated in susceptibility assessment)		
Source	**Contaminants**	**Description**
18 hole Golf Course & Country Club	Fertilizers (nitrates)	Fertilizer applied to greens and other landscape that is well irrigated
Large Capacity Septic System (associated with Country Club facilities)	Pathogens, Nitrates, other organic and inorganic chemicals	Waste water discharged to drain fields that may contain improperly disposed chemicals or may not completely eliminate nitrate and pathogens from the effluent
Recharge Region (not significant potential contaminant sources evaluated in susceptibility assessment)		
Source	**Contaminants**	**Description**
Highways 15 and 44	Hazardous Materials (VOCs, SOCs, metals, other)	Large scale spills of hazardous or other materials that reach surface water and potentially reach groundwater near the well field
Valier Waste Water Treatment Plan	Pathogens, Nitrates, other organic and inorganic chemicals	Ongoing discharge of low concentrations of contaminants or system failure accompanied by discharges of significant concentrations of contaminants to surface water
Northern Montana Joint Refuse facility stormwater discharge	Pathogens, Nitrates, other organic and inorganic chemicals	Ongoing discharge of low concentrations of contaminants or system failure accompanied by discharges of significant concentrations of contaminants to surface water
Still Feedlot, a confined animal feeding operation (CAFO)	Pathogens and Nitrates	Ongoing discharge of low concentrations of contaminants or system failure or large runoff events that entrain and transport significant concentrations of contaminants to surface water
Petroleum Pipelines (4 total) Continental PL (2 pipelines) Conoco PL Cenex PL	VOCs, SOCs, petroleum hydrocarbons	Catastrophic / large scale spills of petroleum that can reach surface water and potentially reach groundwater near the well field
Dry Land Farming, mostly hay and small grains on land between the coulees	SOCs and Nitrates	Pesticides and fertilizer applied to crops in excess of need and potential spills that may reach surface water or groundwater.

Note:

- This table lists noteworthy potential contaminant sources. Those potential sources considered significant will be included in the susceptibility assessment that is performed in the next chapter of this SWDAR.
- Only sources within the Inventory Region will actually be evaluated for hazard and susceptibility in the next chapter.

Inventory Update

To make this SWDAR a useful document in the years to come, the owners or the certified water system operator(s) for the City of Shelby public water supply should update the inventory for their records every year. Changes in land uses or the presence of new potential contaminant sources should be noted and additions made as needed. This updated inventory should be submitted to DEQ at least every 5 years to ensure that this report/plan stays current in the public record.

Inventory Limitations

The extent of the potential contaminant source inventory is limited in several respects. The inventory is based on data that is readily available through state documents, published maps and reports, GIS data, and discussions with people that are familiar with the area. Also, documentation may not be readily available on some potential sources. An example of this is the large capacity septic systems that are present within or near the Inventory Region, which are difficult to identify for the inventory. As a result, all potential contaminant sources may not have been identified or recognized as being significant potential contaminant sources. The author of this SWDAR is depending on local PWS managers and/or operators for site-specific knowledge. Their initial review of this document has been sought and their comments incorporated.

CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

General Discussion

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 City of Shelby PWS managers and operators. 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 major land use activities or other significant 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 PWS managers and operators to reduce susceptibility are recommended in this chapter.

Hazard Determination

The Susceptibility of the City of Shelby PWS production well field to various types of contamination is assessed in the following paragraphs. The proximity of a potential contaminant source to a spring or well intake, potential contaminant migration pathways, or the density of potential non-point contaminant sources determines the threat of contamination, referred to here as hazard (Table 8). Hazard and the existence of barriers to contamination determine susceptibility, which is described in Table 9. Table 8 below describes the criteria to determine hazard within the Inventory Region as it was delineated in this SWDAR. Note that this table is specific to PWSs that draw their water from unconfined aquifers. The determination of hazard is somewhat different for other types of water sources (i.e., surface water sources or from confined aquifers). For the situation involving the City of Shelby PWS well field, its production wells are about 40-50 feet deep and are drawing from the shallow unconfined alluvial aquifer. Some finer sedimentary materials are recorded in the lithologic log for the wells, but these aren't interpreted to be confining units. On the whole, the wells appear to be constructed properly, but a few don't appear to have a good casing seal, where it is grouted for several feet below the ground surface. The grouted casing is to avoid any direct conduits for water to travel from the surface into the well. It should be noted that when groundwater flow velocities are determined, a 1-year groundwater time-of-travel and a 3-year groundwater time-of-travel (TOT) distances could be established. When these distances haven't been established, for example where a simple Inventory Region is established based on distance, then any potential contaminant sources within the boundary of the Inventory Region are considered to have a high hazard. And sources that are outside the region are considered to have a low or undetermined hazard. Refer to Table 8 below.

Table 8. Hazard of potential contaminant sources.

For wells drawing water from unconfined aquifers.

Potential Contaminant Source	High Hazard	Moderate Hazard	Low Hazard
Point Sources	Within 1 year TOT	Between 1 to 3 years TOT	Over 3 years TOT
Density of Private Septic Systems (# per square mile)	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
Municipal Sanitary Sewer (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region
Cropped Agricultural Land (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

Notes:

- Highlighted areas are those relevant to the City of Shelby PWS Inventory Region.
- There is no municipal sewer system present within and around the Inventory Region described in this SWDAR.
- The density of private septic systems is low for the Inventory Region, and is so low as to not be counted in the susceptibility evaluation.

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 reach the City of Shelby PWS well intakes. First, hazard is rated by the proximity of a potential contaminant source to the well(s) (if it is within the Inventory Region) or the concentration of that potential contaminant source within the Inventory Region (from Table 8). Susceptibility ratings are then determined individually for each significant potential contaminant source and/or contaminant based on Table 9. These susceptibility ratings are the evaluation of the vulnerability of wells to the more significant potential contaminant sources and are presented on Table 10.

Table 9. Susceptibility, 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

Discussion of Susceptibility

A summary of the susceptibility assessment for City of Shelby PWS production wells is located in Table 10. Following that is a brief discussion of the susceptibility assessment for the significant potential contaminant sources listed. Because a contaminant source has not been identified in the inventory or susceptibility assessment of this report, it doesn't mean that the potential for contamination does not exist or is not a threat. So, if potential contaminant sources are present near or upgradient of any PWS intake,

it would be prudent to understand the threat from these sources.

Table 10. Susceptibility Assessment

City of Shelby PWS – Inventory Region (only)

Source	Contaminants	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Large Capacity Septic System – associated with Williamson Park	Nitrate, pathogens, other contaminants	Leakage of poorly installed or maintained systems	**High Hazard**	None known	**Very High Susceptibility**	Design and installation of an advanced septic system, public education with posters and placards at the park, possible engineering of leach field for septic system that is remote from the well field (uphill by the residence)
18 hole golf course	Nitrates, SOCs	Leaks and spills that can reach groundwater	**High Hazard**	Dilution of contaminants by river and groundwater channels during transport	**High Susceptibility**	Coordination between operator and management of golf course to reduce chemical use
Highway 15 and bridge across the Marias River	VOCs, petroleum hydrocarbons, SOCs, other	Wrecks and large spills near the river or on the bridge, which can reach the rivers and maybe impact groundwater	**High Hazard**	Emergency responders are trained and equipped to deal with a spill, spills will generally occur on the far bank of the river and dilution will occur during contaminant transport	**Moderate Susceptibility**	Emergency planning, training of local emergency response personnel, allocation resources for spill cleanup equipment
4 petroleum pipelines	VOCs, petroleum hydrocarbons	Large scale leaks directly into the river upstream of the Inventory Region	**Not evaluated**	None	**Not evaluated**	Coordination with the managers of the pipeline

Notes on Susceptibility Assessment table:

- The key to the evaluation for these significant potential contaminant sources is that the City of Shelby PWS wells are drawing water from an unconfined aquifer and are located in proximity to the river.
- It is significant that the determination of Hazard and Susceptibility is only done for contaminant sources that are within the Inventory Region. Sources located outside the IR, but within the Recharge Region may still pose a threat over time. As such the most significant potential contaminant sources in the Recharge Region are still included in this table.
- Potential contaminant sources in/around the Recharge Region, especially within upstream communities such as Cut Bank or Valier will be addressed in different SWDARs that focus on those areas.

Large Capacity Septic System

The presence of this large capacity septic system is an assumption. If the shower and restrooms are serviced by a vault that gets periodically pumped, this potential contaminant source ceases to exist. A large capacity septic system that is located within the well field (in very close proximity to the wells) poses a high hazard of contamination. It doesn't appear that there are any real barriers in place between this contaminant source and the wells, so the City of Shelby PWS well field has a very high susceptibility to this contaminant source. There are engineering strategies to eliminate or reduce the hazard posed by a septic system in or near the well field. These include the engineering of an advanced septic system or the

removal of the leach field to a more remote location. Installing a sump that is periodically pumped simply removes the potential contaminant source. These steps each will go a long way toward protecting the water supply.

18 Hole Golf Course

Routine maintenance and watering of the golf course can introduce a wide range of contaminants (SOCs and nitrate) to groundwater and surface water. The only known barrier between this contaminant source and the well field is the dilution within groundwater and in the river en-route to the well field. This dilution has not been quantified in this situation, but it is believed to be an actual process to reduce what contaminants actually reach the well intakes. This assumption is supported by the sampling history of the PWS that demonstrates an absence of SOCs and only trace amounts of nitrates that show up in water samples. The PWS well field has a high susceptibility to contaminants associated with the maintenance at the golf course. Communication and coordination between the operator and the golf course/country club managers and groundskeeper(s) will go a long way toward protecting the PWS water quality.

Highway 15 and the bridges across the river

Both the interstate highway and the frontage road cross the Marias River with bridges (3 in all) and bisect the Inventory Region north to south. These transportation corridors have the potential to have infrequent but high volume spills associated with vehicular wrecks. As such, the corridors pose a high hazard to the PWS well field. A couple of barriers are believed to be in-place between the highway bridges and the PWS well field. One of these would be that the bridges are located mostly on the far side of the river. Additionally and in a similar way, there appear to be at least a couple of old river channels that run southwest toward the river and may act to divert any contaminated surface water or groundwater toward the river. It is believed that any spill might be diverted and carried away before they had a chance to impact the groundwater directly beneath the well field. Both of these are simple assumptions and have not been quantified or evaluated for applicability, but may provide some measure of protection between a major spill and the well field. An additional barrier is thought to be any training or resources that local emergency responders have to deal with spills along the highway. With these multiple barriers in place, it appears that the PWS well field has a moderate susceptibility to contaminants associated with spills along the highway on or near the bridges.

Other Significant Contaminant Sources

A number of other contaminant sources are present in and around the City of Shelby Recharge Region, but these are outside of the Inventory Region. It should be noted that the Surface Water Buffer did not pick up any additional potential nitrate or pathogen sources along the river, other than the large capacity septic system that has to be associated with the Marias Valley Golf & Country Club facilities. The most notable contaminant sources in the Recharge Region were the 4 petroleum pipelines that cut across the region from north to south and crossed the Marias River near the corners of Glacier, Toole, and Pondera Counties. Although remote from the well field, any spill from a pipeline will be large and catastrophic, and if it happens near or on the river, the petroleum products will be transported directly to the well field. The actual impact of such a release can't be measured, but it would be great. Most of the remaining contaminant sources in the Recharge Region pose less of a hazard to the well field, but a few are of note. A large CAFO / feedlot is located just northeast of Valier and upgradient of the Marias River. If lagoons or large waste stockpiles are maintained at this site, these do have the potential to catastrophically break loose and move down the coulee toward the Marias River. Fortunately, this feedlot is remote from the Marias River and probably not a great threat. The same can be said about the Valier wastewater treatment plant and the Northern Montana Joint Refuse transfer station (both along Highway 44). Both are

dischargers, but the volumes of discharge and their potential impacts to the Marias River water quality are probably very small. Part of this is that the author didn't have many specifics on volumes of the discharges and that the sites are located on the perimeter of the watershed / Recharge Region and remote from the river and the City of Shelby PWS well field. The Recharge Region contains a large percentage of agricultural land. The land is mostly in small grains that do not receive artificial irrigation. As such, there is little chance for erosion and transport or leaching of any applied chemicals (such as fertilizer or herbicide). Additionally, rainfall is low, which reduces the potential for ongoing erosion and transport of soil (and the chemicals) into surface water that will reach the Marias River. It should be noted that the susceptibility of the PWS well field is not determined for the potential contaminant sources that are outside of the Inventory Region. These are only noted and discussed to provide the PWS owners and operators with information that may aid them in understanding the factors that will affect water quality in their well field.

Summary of Susceptibility

The City of Shelby public water supply uses wells that are all located within a well field along the Marias River. These wells are installed into shallow alluvium and withdraw water from an unconfined aquifer. The recharge area for this aquifer is along the margins of the valley and from the surrounding bedrock. For the purposes of this SWDAR, the Recharge Region is composed of Marias River watershed west to the confluence of Cut Bank Creek and the Two Medicine River, south to the area north of Valier, and south to enclose Highway 44. This Recharge Region is mostly an acknowledgement that there are potential contaminant sources in the drainage that should be kept in the awareness of the PWS managers and operators. The groundwater beneath the area of the Shelby PWS well field is believed to flow approximately west-to-east and sub-parallel to the Marias River. For the purposes of this delineation and assessment, this SWDAR's Inventory Region boundaries were established as seen on Figure 7 and Figure 10. This Inventory Region contains several significant potential contaminant sources. They include a large capacity septic system at Williamson Park, Highway 15 and the 3 bridges that cross the river just upstream of the well field, and the 18-hole golf course (Marias Valley Golf and Country Club). The Shelby PWS well field has a very high susceptibility to he large capacity septic system in Williamson Park. The PWS well field has a high susceptibility to spills along the highway or on the bridges. It has a moderate susceptibility to contaminants originating at the 18 hole golf course located upstream and within the Inventory Region. Overall, there appear to be very few unmanageable potential contaminant threats to the City of Shelby production wells. The Inventory Region and nearby contaminant sources are depicted on Figure 7 and discussed on Table 10.

Waiver Recommendation

This section addresses the City of Shelby PWSs that DEQ has classified as Community Non-Transient public water supply. The authors' recommendation is based upon the determination of susceptibility as described above.

Monitoring Waiver Requirements

The 1986 Amendments to the Safe Drinking Water Act require that community and non-community PWSs sample drinking water sources for the presence of volatile organic chemicals (VOCs) and synthetic organic chemicals (SOCs). The US EPA has authorized states to issue monitoring waivers for the organic chemicals to systems that have completed an approved waiver application and review process. All PWSs in the State of Montana are eligible for consideration of monitoring waivers for several organic chemicals. The chemicals diquat, endothall, glyphosate, dioxins, ethylene dibromide (EDB),

dibromochloropropane (DBCP), and polychlorinated biphenyls are currently excluded from monitoring requirements by statewide waivers.

Use Waivers

A Use Waiver can be allowed if through a vulnerability assessment, it is determined that specific organic chemicals were not used, manufactured, or stored in the area of a water source (or source area). 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.

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. Susceptibility is based on prior analytical or vulnerability assessment results, environmental persistence, and transport of the contaminants, natural protection of the source, wellhead protection program efforts, and the level of susceptibility indicators (such as nitrate and coliform bacteria). 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 1.0 miles as an area of investigation for the use of organic chemicals. Vulnerability assessment of spring water sources should use a minimum fixed radius of 1.0 miles as an area of investigation for the use of organic chemicals. Shallow groundwater sources under the direct influence of surface water (GWUDISW) should use the same area of investigation as surface water systems; that is, the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the point of diversion. 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.

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, or 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 DEQ's 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 time-of-travel 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.

Waiver Recommendation of this SWDAR

Based on past monitoring results and the susceptibility assessment of the City of Shelby PWS (as it is now configured, using a shallow well field located in river alluvium along the Marias River), the PWS might be eligible for some limited monitoring waivers. DEQ records suggest that the PWS currently has waivers for Phase II and Phase V inorganics. Based on the monitoring history for the wells, the results of the inventory, and the susceptibility assessment of this SWDAR, the inferred geology of the area, the nature of the aquifer from which the wells draw water, the City of Shelby PWS production wells probably are not eligible for volatile organics (VOCs) or synthetic organics (SOCs) waivers. This is less a factor of the contaminant sources within or near the Inventory Region, and more a factor of the location and construction of the production wells. For monitoring waiver consideration, the City of Shelby PWS should submit a letter to DEQ requesting the specific monitoring waivers. If requested by DEQ, the PWS may also need to provide additional information regarding chemical use in the area within the Inventory Region or within town limits.

REFERENCES

Alt, David, and Hyndman, Donald W., **1990**, **Roadside Geology of Montana**, Mountain Press Publishing Company, Flathead.

Alt, David, and Hyndman, Donald W., **1998, Northwest Exposures, A Geologic Story of the Northwest,** Mountain Press Publishing Company, Flathead.

Alden, W.C., **1953, Physiography and glacial geology of western Montana and adjacent areas**, U.S. Geologic Survey Professional Paper 231, 200 p.

Board of Water Well Contractors, **Administrative Rules of Montana**, 01/30/**2001**. **36.21.656-.660**

Campbell, Arthur B., 1960. Geology and Mineral Deposits of the St. Regis-Shelby Area, Mineral County, Montana. Contributions To Economic Geology, USGS bulletin 1082-I.

DEQ Permitting and Compliance Division: **1984, 1988, 1991, 1994, & . Sanitary Survey,** and **1997 Report on Health Advisory Follow-up** for City of Shelby PWS - PWS # MT0000328, and other correspondence.

Department of Environmental Quality, 1999. **Montana Source Water Protection Program**, Approved by EPA in November 1999, inclusive of **personal communications in 2003** with Joe Meek & others.

Fetter, C.W., **Applied Hydrogeology**, **1994**, 3rd Edition, Prentice Hall, Upper Saddle River, New Jersey.

Freeze, R. Allan and Cherry, John A., **1979. Groundwater,** Prentice-Hall, Inc.

Kendy, E., and R.E. Tresch, **1996**, **Geographic, Geologic, and Hydrologic Summaries of Intermontane Basins of the Northern Rocky Mountains**, Montana: U.S. Geological Survey Water Resources Investigations Report 96-4025, 233 p.

Heath, Ralph C., **1984. Ground-water Regions of the United States**, U.S. Geological Survey, Water Supply Paper 2242, Washington D.C., 78p.

Montana Bureau of Mines and Geology, **tabular well information, 2000**:
http://mbmgsun.mtech.edu/ & http://mbmggwic.mtech.edu/

Montana Department of Environmental Quality, Permitting & Compliance Division and the Drinking Water Assistance Program - Montana Water Center: **Ground Water Manual for Small Water Systems, January 1999**.

Montana State Library - Natural Resource Information Service, **2000. Graphical and tabular information**:
http://nris.state.mt.us/mapper/

Montana State Library - Natural Resources Information System (NRIS) **2000 map base of the USGS Topographical coverage** at 1:24,000 scale in MrSID format.

Raines, G.L. and B.R. Johnson, **1996**. **Digital Representation of the Montana State Geologic Map**: U.S. Geological Survey Open File Report 95-691, 19 p.

U.S. Department of Commerce, **2003, Climatic Summary of the United States Supplement for 1914 Through 2002**, Montana: Washington. D.C. Department of Commerce, Weather Bureau, Climatology of the United States no. 86-20, p11 and 60. Specific data came from the website: wrcc@dri.edu

U. S. Environmental Protection Agency (US EPA), **1991**. **Manual of Small Public Water Supply Systems**, US EPA Office of Water (WH-550), EPA 570/9-91-003.

U.S. Geological Survey, **2000**. **National Landcover Dataset, Montana**. 30-meter electronic digital landcover / land use data set interpreted from satellite imagery.

GLOSSARY

Acute Health Effect. An adverse health effect in which symptoms develop rapidly.

Alkalinity. The capacity of water to neutralize acids.

Bgs. Below Ground Surface. This is the measure of a borehole or depth to features in the borehole or well (i.e., The static water level is 25 feet bgs.)

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

Coliform Bacteria. Bacteria found in the intestinal tracts of animals. Their presence in water is an indicator of pollution and possible contamination by pathogens.

CAFO. Confined animal feeding operation, which is typically registered by the State of Montana.

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 that inhibits the flow of water.

Delineation. A process of mapping source water management areas.

Effective Porosity. The percent of soil, sediment, or rock through which fluids, such as air or water, can pass. Effective porosity is always less than total porosity because fluids can not pass through all openings.

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

Hazard. A measure of the potential of a contaminant leaked from a facility to reach a public water supply source. Proximity or density of significant potential contaminant sources determines hazard.

Hydraulic Conductivity. A coefficient of proportionality describing the rate at which water can move through an aquifer.

IOCs. Inorganic Chemicals

Inventory Region. A source water management area that encompasses an area expected to contribute water to a public water supply well within a fixed distance or a specified groundwater time-of-travel distance.

Large Capacity Septic Systems. As defined by the US EPA Underground Injection Control (UIC) Program, these are septic systems that serve more than 20 persons per day for a period greater than 6 months of the year.

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.

Nitrate. An important plant nutrient and type of inorganic fertilizer. In water the major sources of nitrates are 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.

Pathogens. A bacterial organism or virus typically found in the intestinal tracts of mammals, capable of producing disease.

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

Porosity. The percent of soil, sediment, or rock filled by air, water, or other fluid.

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

POTW. Publicly Owned Treated Wastewater facility, typically a municipal sewer treatment plant with a wastewater discharge.

SIC Code. The U.S. Standard Industrial Classification (SIC) Codes classify categories of businesses. SIC Codes cover the entire range of business categories that exist within the economy.

Source Water Protection Area. For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply.

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

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

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

Total Maximum Daily Load (TMDL). The total pollutant load to a surface water body from point, non-point, and natural sources. The TMDL program was established by section 303(d) of the Clean Water Act to help states implement water quality standards.

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

Transmissivity. The ability of an aquifer to transmit water.

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

Volatile Organic Compounds (VOC). Any organic compound which evaporates readily to the atmosphere (e.g. fuels and solvents).

Recharge Region / Watershed. The land area that drains into a stream; the watershed for a major river may

encompass a number of smaller watersheds that ultimately combine at a common delivery point.

Note: Definitions are taken from EPA's Glossary of Selected Terms and Abbreviations and other sources.

APPENDICES

APPENDIX A

DEQ PWS's Database Output
PWS Water Quality Data

APPENDIX B

Sanitary Surveys
PWS Well Logs

APPENDIX C

Relevant Correspondence

APPENDIX D

Other Background Information

APPENDIX E

Concurrence Letter