

**Woods Bay Sheaver Creek
Water & Sewer District
Public Water Supply**

PWS ID #MT0004698

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

Date of Report: 16 February 2011

Revised Date: 06 April 2011

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INTRODUCTION

This Source Water Delineation and Assessment Report (SWDAR) was completed by Jeffrey Frank Herrick, a hydrogeologist with the Montana Department of Environmental Quality (DEQ) Source Water Protection Program (DEQ SWPP).

Purpose

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

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is “delineation and assessment.” Delineation is a process of mapping source water protection areas, which contribute water used for drinking. Assessment involves identifying locations or regions in source water protection areas where contaminants may be generated, stored, or transported, and then determining the relative potential for contamination of drinking water by these sources. The primary purpose of this source water delineation and assessment report is twofold, to provide information that helps the Woods Bay Sheaver Creek W&S District PWS protect its drinking water source and to lay the groundwork for the development of source water protection planning.

Limitations

This report was prepared to assess threats to the Woods Bay Sheaver Creek Water and Sewer District (WBSC W&S District) public water supply (PWS), and is based on published information and information obtained from persons familiar with the community. The terms “drinking water supply” or “drinking water source” refer specifically to the source of the Woods Bay Sheaver Creek Water and Sewer District public water supply and not any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the area of the airport are identified. Only potential sources of contamination in areas estimated to contribute water to its drinking water source are considered.

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

Chapter 1 BACKGROUND

The Community

The Woods Bay Sheaver Creek Water and Sewer District public water supply (PWS) will for the purpose of this report be referred to primarily as the WBSC PWS or the WBSC W&S District PWS. The WBSC PWS serves much of the small unincorporated community of Woods Bay, in northern Lake County, Montana. The community of Woods Bay surrounds the Woods Bay embayment that is located along the east shore of Flathead Lake in western Montana, approximately 6 miles south of the town of Bigfork (refer to [Figure 1](#), [Figure 2a](#), and [Figure 2b](#) attached). The WBSC W&S District public water supply is newly formed by the union of the Woods Bay Water Users Association PWS and the Sheaver Creek Water & Sewer District PWS. At the time of writing this SWDAR, the Boards for the Woods Bay Water Users Association PWS and the Sheaver Creek Water & Sewer District PWS still operate as separate entities, but manage the WBSC W&S District PWS as a single public water supply. I understand that there are ongoing discussions on how to combine the 2 boards. A sanitary survey of this new water system has not yet been completed by DEQ. The WBSC W&S District PWS serves much of the unincorporated community in and around Woods Bay excluding:

- the Edmiston Point HOA, which is served by the Point Service Corporation,
- some of the other PWSs that line the south and east shore of Woods Bay, and
- some of the PWSs located north of Woods Bay along Highway 35.

According to the 2000 United States Census, the unincorporated town of Woods Bay has ~748 residents, and Lake County has ~26,507 residents. Neighboring Bigfork, in Flathead County, is home to ~1,421 people. The economic base in Lake County is quite diverse, though private business accounts for the most substantial share of revenue. Other major contributors include manufacturing, retail, service-related, and government-related industries. Tourism is quite important to the area, as Glacier National Park, Big Mountain Resort, and, of course, Flathead Lake, are nearby. Retirement income is also a significant and growing component of the local economy.

Geographic Setting

Woods Bay is approximately 6 miles south of Bigfork, Montana, along the east shore of Flathead Lake. Flathead Lake is found within the basin that is enclosed by the Salish Mountains to the west, and the Swan and Mission Ranges to the east. Flathead Lake in Montana and Lake Tahoe in California & Nevada are approximately the same size and considered the largest freshwater lakes west of the Mississippi River. The major transportation corridor in the area are Montana Highway 35, which roughly follows the eastern shoreline of Flathead Lake and Highway 93 that follows the west shoreline. Highways 35 and 93 eventually merge at the south end of the Flathead Lake near Polson, and U.S. 93 continues southward from there.

The area surrounding Woods Bay is primarily forested with evergreen trees, as is common in western Montana. Areas of grassland, shrubland, and some small acreage agricultural plots are also found. The climate in the area is consistent with that of other lower elevation intermontane basins in the northern Rocky Mountains west of the Continental Divide. According to data collected at the nearby Bigfork weather station, average maximum temperature in July is ~81°F and in January is ~33.1°F. The area receives approximately 22 inches of precipitation yearly, along with approximately 55 inches of snow.

Table 1. Table of Climatic Data

BIGFORK 13 S, MONTANA (240755), Period of Record: 11/1/1938 to 3/31/2004

Table 1. Table of Climatic Data

BIGFORK 13 S, MONTANA (240755), Period of Record: 11/1/1938 to 3/31/2004

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	33.1	37.5	44.6	55.1	64.5	71.2	81.0	79.6	68.9	55.7	41.6	35.4	55.7
Average Min. Temperature (F)	21.7	23.9	27.6	34.3	41.2	47.7	52.8	52.1	44.7	37.2	29.4	24.7	36.4
Average Total Precipitation (in.)	1.81	1.22	1.34	1.62	2.69	3.12	1.50	1.50	1.81	1.60	1.83	1.92	21.97
Average Total Snow Fall (in.)	17.5	9.1	5.8	0.8	0.2	0.0	0.0	0.0	0.0	0.4	6.7	14.7	55.3
Average Snow Depth (in.)	5	5	3	0	0	0	0	0	0	0	1	3	1

Percent of possible observations for period of record:

Max. Temp.: 93.9% Min. Temp.: 93.7% Precipitation: 96.7% Snowfall: 66.6% Snow Depth: 67.1%

Check [Station Metadata](#) or [Metadata graphics](#) for more detail about data completeness.

The Mission Valley (south of Flathead Lake), Flathead Lake, and the Kalispell Valley (located directly north of Flathead Lake) are found within a north-northwest trending intermontane basin in northwestern Montana. The Kalispell Valley is bounded by Flathead Lake to the south, the Salish Mountains on the west, Stryker Ridge on the northwest, and the Swan Range on the east. The Mission Valley is bounded by Flathead Lake to the north, the Mission Range to the east, the Salish and Cabinet Mountains to the west, and the Coeur D’Alene Mountains to the southwest.

The southwestward-flowing Flathead River is the principal stream in the Kalispell Valley. The Stillwater and Whitefish Rivers, and Ashley Creek flow southward across the basin, joining the Flathead River near Kalispell. The flood plains and terraces of these rivers are the principal topographic features within the Kalispell Valley. Glacially sculpted terraces flank the flood plains and exhibit a variety of topographies. The Flathead River drains into and out of Flathead Lake and exits the Mission Valley near its southwest corner.

The Public Water Supply

According to information provided by the DEQ PWS files in Kalispell & Helena, and by Stephen Chenard (the PWS operator) this public water system supplies water to ~680 persons through 258 residential service connections. It is estimated that there are ~485 residents and ~195 transients served daily. There are 4 wells (water sources) that are part of this system. There is an old spring that was originally associated with the old Sheaver Creek W&S District PWS, but the spring was never incorporated into the new WBSC W&S District PWS. The spring is located near the water storage tank (ST002) northeast of town (refer to [Figure 2a](#)).

It does not appear that there is any community sewer system servicing Woods Bay or any of the residences or businesses associated with the WBSC W&S District PWS. As such, all of the residences and businesses in the community are likely serviced by individual or large capacity onsite septic systems. The density of these private onsite systems is addressed in the inventory section of this SWDAR.

The water storage tank (ST002) is located at least a mile north northeast of the main part of town. It appears that the relative elevation of the water tank provides pressure for the entire distribution system. The water storage facility appears to be a ~256,000-gallon above ground steel water tank. The inactive Well 1 Redgate (WL004) is located between the water tank (ST002) and the community of Woods Bay. Well 3 East (WL002), Well 2 West (WL003), and Well 4 (WL005) are clustered on a lot in the center of town (see [Figure 2a](#) and [Figure 2b](#)). The system does have a pump house located near

the 3 active wells and that building contains a common header (CH001) for WL002, WL003, and WL005. The pump house is actually located directly adjacent to Well 3 East (WL002). There are no pressure control tanks or booster pumps in the pump house or otherwise associated with the WBSC W&S District PWS. At this time there is no treatment of water prior to sending it to the distribution lines and the points of use. The water system as it is now configured hasn't been clearly diagrammed in a sanitary survey, so no diagram is provided in this SWDAR. The active wells pump water to the common header. The water line from the common header in the pump house then runs north through the center of the Woods Bay homes, then east along Driftwood Lane and Rocky Top to the top of Redgate Drive (at Highway 35), then up the hill to the water storage tank (ST002). Water then flows out of the tank in a water main that runs downhill to the distribution and points of use in and around the community.

The storage tank's water level is monitored using pressure measured within the water main by a pressure sensor/controller situated near the intersection of Redgate Drive and Highway 35. This sensor/controller communicates via radio telemetry to a Main Controller located in a structure called the Main Control House near the inactive Well 1 Redgate (WL004). The Main Controller in the Main Control House communicates with the tank house (near the active wells) via radio telemetry and directs which well pumps to turn on or off. The submersible pumps in the wells are controlled by the radio telemetry receiver in the pump house. The wells are utilized as the lead and lag wells based on water pressures measured by the sensor/controller in the distribution main, which reflects the water levels in the water storage tank. The acting lead and lag wells are rotated as needed. Table 2 is a summary of the facilities at the WBSC W&SD PWS as it is configured at this time.

Table 2. PWS Facilities

WBSC W&SD Public Water Supply (#MT0004698)

Contact Information	Anita Miller Admin./Financial Contact Woods Bay Sheaver Creek W&S District P.O. Box 1015 Bigfork, MT 59911 (406) 420-2072	Stephen M. Chenard Operator Woods Bay Sheaver Creek W&S District 1200 Middle Pierce Lane Bigfork, MT 59911 (406) 837-1271	Lyle Whiteman President of Woods Bay W&S District PO Box 685 Bigfork, MT 59911 (406) 837-6247	Cody Herring President Sheaver Creek W&S District PO Box 1015 Bigfork, MT 59911 (406) 249-5960
PWS Class	Community. 258 Residential Service Connections, serving ~458 residents & ~195 transients.			
Well / Source Code & Sample Point	WL003 w/ RW003	WL002 w/ RW002	WL004 w/ EP503	WL005 w/ RW005
Well/Intake Name	Well 2 West	Well 3 East	Well 1 Redgate	Well 4
Status	Active	Active	<i>Inactive</i>	Active
Latitude and Longitude	48.00154 -114.05583	48.00162 -114.05568	48.00628 -114.05057	48.00167 -114.05593
Common Header	CH001 w/ EP504 is located in the pump house/building near Well 3 East (WL002). Well 1 Redgate (WL004) is not connected to this common header (CH001).			
Pressure Control Assembly	None present			
Treatment Facility	None present			
Distribution System	DS001 Distribution System Active w/ SP001			
Storage Tank	ST002 Water Storage Tank, above ground ~256,000-gallons Active - located at Longitude -114.04775, Latitude 48.01724			

Note: Well logs for the PWS wells are included in the Appendix.

Chapter 2 DELINEATION

Delineation Process

The source water protection regions are identified in this chapter. They are the delineated land areas that contribute water to the sources at the Woods Bay Sheaver Creek W&S District PWS. Three management or source water protection regions are usually identified. These three 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 PWS 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 directly above a well screen or other intake structure. As such, management of this control zone is critical to protect a PWS. For groundwater sources the inventory region usually represents the zone of contribution of the well, which can approximate a three-year groundwater time-of-travel or a 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 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 an approximate 1,000-foot radius circle around the wellhead, and the inventory of potential contaminant sources is only completed for those sources within 1,000-feet of the well. Activities or contaminant releases within the inventory region have the potential to reach a PWS well in a period that is probably less than 3 years. The recharge region represents the entire portion of the 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 is delineated as the recharge region. Long-term water quality at a PWS can be affected by contaminant releases or certain land use activities in the recharge region. Table 3 summarizes how these source water protection regions are generally 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
<p>Ground Water that is:</p> <ul style="list-style-type: none"> • Unconfined or Semi-confined* • Confined • GWUDISW Ground Water that is hydraulically Connected to Surface Water also needs the following ----->> 	<p>Control Zone Inventory Region Recharge Region</p> <p>Control Zone Inventory Region Recharge Region</p> <p>Surface Water Buffer Zone</p>	<p>Fixed radius Fixed radius Topography</p> <p>Fixed radius Fixed radius Topography</p> <p>Fixed Distance</p>	<p>Distance - 100 feet Distance - 1 mile or 3-year groundwater TOT Limits of the watershed</p> <p>Distance - 100 feet Distance - 1000 feet Limits of the watershed</p> <p>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.</p>
<p>Surface water</p>	<p>Spill Response Region</p> <p>Watershed Region</p>	<p>Fixed Distance</p> <p>Topography</p>	<p>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. Inventory is for all regulated contaminants for that PWS. Limits of the watershed</p>

Note: In the case of this PWS, the watershed divide is only 2-3 miles uphill from Woods Bay. As such the Inventory Region (IR) and the Recharge Region encompass the same area. This IR is the watershed above the wells that reaches the watershed divide at the top of the Mission Range.

Hydrogeologic Conditions

The geology of the Kalispell Valley and the region surrounding Flathead Lake is a description of the sediments and bedrock of the region. This information is relevant because these rock units and sediments host the groundwater that supplies the production wells of the WBSC water system. The hydrogeology is a description of the presence and movement of groundwater in this area around Woods Bay and within the Kalispell Valley. The goal of this discussion is to help the reader to understand where the PWS wells are obtaining their water and the vulnerability of that source water to contamination. Most of the following information was drawn from Alt and Hyndman (1990), Kendy and Tresch (1996), and LaFave, Smith, and Patton (2004).

Geology

The Kalispell Valley (and Flathead Lake) are part of a large intermontane basin that occupies the southern-most extension of the thousand-mile-long Rocky Mountain Trench formed in the late Paleocene to Eocene. The Kalispell Valley and Flathead Lake are bounded by normal faults on the east and west sides, and crosscut by numerous other faults, resulting in an irregularly shaped basin floor. Gravity data indicate that Bigfork is near the northern end of a north-northwest-trending horst (which is an uplifted crustal block) that separates the grabens (downdropped crustal blocks) on which

Flathead Lake and Echo Lake are each centered. These grabens form deep basins, each containing about 2,000 – 4,800 feet of Cenozoic deposits.

Metasedimentary rocks of the Middle Proterozoic Belt Supergroup surround and underlie the basin. These bedrock units also underlie the Woods Bay area. These rocks include limestone, dolomite, siltite, quartzite, and argillite. Although no Tertiary aged sediments (Ts) crop out in the Kalispell Valley, this basin, like others in the Rocky Mountain Trench, contains hundreds to thousands of feet of Tertiary sediments beneath its glacial and alluvial sediment veneer. Overlying the bedrock near the middle of the valley are Tertiary sediments described as lignite, clay, and argillaceous sandy siltstone from 1,695 to 1,120 feet deep, overlain by peat, clay, and some sand from 1,120 feet to 600 feet deep. No Tertiary sediments are seen resting on the shallow bedrock in the area of Woods Bay. The upper 600 feet of material beneath the surface of the valley are reported to be assorted Pleistocene glacial deposits. This is the material draped thinly across the bedrock in the area of Woods Bay. Quaternary glacial deposits and alluvium overlie the Tertiary deposits or lie directly on top of bedrock on the flanks of all of the local mountains. Glacial Lake Missoula and other glacial lakes that occupied this basin deposited well-bedded, sometimes varved, sand and silt layers which interfinger with, are dissected, and are locally overlain by as much as 75 feet of late Pleistocene to Holocene dune sands and assorted fluvial sand and gravel deposits, as well as by glacial till. Glacial Lake Missoula deposits (varved silt and fine sand) are present along the east shore of the lake and are seen both north and south of Woods Bay. There are also extensive gravel deposits stretched longitudinally along the east shore of Flathead Lake. In places these deposits represent lateral moraines (because they are poorly sorted and contain abundant fine matrix) and sometimes appear to be fluvial in nature (where they are somewhat sorted into sand and gravel units). Woods Bay point (Edmiston Point?) appears to consist of gravel and sand units of varying consistencies that are interspersed among deposits that appear to be glacial till and glacial lakebed sediments. These sediments are collectively at least 300-400 feet deep near the Point Service PWS wells. The depth of bedrock beneath the Point is unknown, but some wells in the central part of Woods Bay suggest bedrock at 50-100 feet below the ground surface. Bedrock is predominantly not covered by glacial till in areas directly east of Highway 35 near Woods Bay and higher on the flanks of the Mission Range.

Well logs for representative wells in Woods Bay are attached to this report. They are arranged from west to east across the main portion of the community. These well logs do not tell a consistent story as some suggest abundant sand and gravel suspended in a dense silt or clay matrix to the full depth of the well, with occasional seeps of water. Others suggest thick beds of gravel and sand. In addition, none of the depths of the strata recorded correlate satisfactorily with other nearby wells. Typical of heavily glaciated terrain, the subsurface appears extremely heterogeneous and chaotic. The depositional origin of Woods Bay is probably best described as a lateral moraine feature that was continually reworked by active moving ice, as well as sediment rich streams and/or rivers. Large glaciers erode and carry enormous volumes of rock debris and other poorly mixed sediment mixed in their ice, on their surfaces, and along their edges. We see evidence of the material that was drug along the glacier's edges as lateral moraines (deposited on the margins of all valleys through which ice flowed). Glaciers predominantly also have flowing water that moves beneath, through the center of, or over the top of the glacial ice. These glacial streams are often super saturated with suspended or entrained sediment (from clay to boulder sized particles). During glacial advances numerous large streams enter the main valley from most tributary valleys. Often these large streams are displaced to the margin of the glacier and can flow across the coarse clasts and glacial till deposited there, and across the exposed bedrock on the margins of the valley. These rivers/streams are extremely common and are called ice-marginal streams. In the case of Woods Bay, the Swan River, Flathead River, and numerous local streams enter

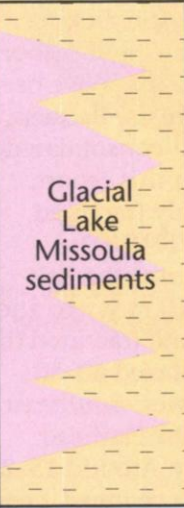
the Flathead Valley from the east in locations north of Woods Bay. The ice of the giant glaciers flowing through this area moved from north to south across Woods Bay. At times the rivers and streams entering the Flathead Valley from the east had to flow directly along the east side of the glaciers and along the bedrock face of the Mission Mountains. These streams would cut into and rework some portion of the enormous volume of glacial ice-deposited debris (till) present along the margin of the glacier. As such, deposits of this ice-marginal area will display features of:

- glacial lakebed deposits (fine sand, silt, and clay in varved (thin) layers);
- glacial till (chaotic deposits of coarse sand, gravel, and cobbles often with a silty to clay matrix);
- glacial outwash deposits (slightly sorted, but still pretty chaotic with smaller amounts of silt and little or no clay); and
- fluvial/stream deposits (sand and gravel or gravel, cobbles, and boulders).

All of these deposits probably cut through and truncate all of the other deposits. The topography of the area contains a number of pothole lakes. This unique terrain is generally the result of enormous ice blocks that are abandoned at the terminus (nose) of a glacier during a time of rapid glacial retreat. Recall that glaciers are essentially operating like a one-way conveyor belt of ice and water. The terminus of a glacier is the point where melting rates match the rate of ice supply from up-valley. A glacial retreat is when the melting rate exceeds the supply of ice from up-valley. Rapid glacial retreat will often see the abandonment of major volumes of ice (think in terms of mountain to hill sized blocks) sitting high in the valleys previously occupied by moving ice. The pothole lakes seen in glacial terrain represent an inverted topography where the ice blocks left behind by the glacier for a time stood tall above the rest of the landscape. Prior to the ice melting, sediments brought in by lakes and active streams were deposited around the large ice blocks. Ultimately when the ice block has completely melted away, a pothole (now a low spot in the topography) was left behind within the now elevated ground surface. Several of these potholes (some forming small lakes) are seen directly north of Woods Bay. Some glacial geologists suggest that Flathead Lake was formed by a giant block of ice (or a major section of the continental glacier) that calved off or was abandoned by the quickly retreating glacier. In this scenario, the lake itself represents the now absent block of ice. By the same token, Woods Bay (the embayment along the east shore of Flathead Lake) may also represent the void left by a very large block of abandoned ice (or another large segment of the glacier) abandoned by the retreating glacier. The sediments deposited along the west side of Woods Bay (Edmiston Point) may represent fluvial deposits that filled in the gap between the blocks of ice occupying Flathead Lake and Woods Bay. Note that [Figure 3](#) is so generalized that it does not differentiate the assorted sediment types present at the surface around Woods Bay. This is likely due to a lack of detailed geologic mapping for the area. What this map does tell us is that the area was covered by glacial till, outwash, or other glaciofluvial deposits and that in some places these materials have been removed (eroded?) and exposed the underlying bedrock. This is seen on the area north and uphill from the bay.

Table 4. Table of Sedimentary Units Forming Aquifers

Copied from the Ground-Water Resources of the Flathead Lake Area, Part A Descriptive Overview, 2004.

Period	Epoch	Kalispell, North Fork, Coram, Smith, Swan, and Flathead Lake Perimeter Subareas	Mission, Little Bitterroot, Jocko, Irvine Flats, and Camas Prairie Subareas	
Quaternary	Holocene	Shallow alluvium	Sand and gravel with minor silt and clay within modern stream valleys and in broad alluvial and eolian sheets.	
		Ancestral Flathead Lake deposits <i>transitional</i>	Brown and gray, laminated, calcareous fine sandy silt, clayey silt, and minor clay; upper surfaces are mostly broad and even; deposited from suspension in a lake that was initially pro-glacial; exposed as the lake sill was downcut and postglacial erosion occurred.	
	Pleistocene	Glacial-lake deposits	Gravel and boulders in a matrix of gray and brown dense sand mud (diamicton); some stratified sand and gravel deposited by, or near, glacial ice; clasts are typically rounded and subrounded metacarbonate, quartzite, argillite, and diorite; more resistant clasts are commonly striated; forms cores of many glacial landforms such as drumlins and moraines.	 <p>Glacial Lake Missoula sediments</p>
		Till	Brown and gray beds of silty and clayey gravel (diamicton), laminated silt and clay, and minor amounts of sand and gravel. Bedding along canyon walls of the Flathead River from Kerr Dam downstream to near Moiese is laterally continuous. Deposition is interpreted to have been in Glacial Lake Missoula (Levish, 1997); some diamictons (till) in Polson moraine and Valley View Hills were deposited by glacial ice; some till may also occur in subsurface in the Mission valley.	
		Deep alluvium	Brown, yellowish brown, and gray stratified coarse-grained sand and gravel conglomerate; rare calcium carbonate cement; clasts of quartzite, argillite, and metacarbonate.	
<i>local or basin-wide unconformities</i>				
Tertiary	Eocene-Miocene(?)	<p>Sedimentary rocks: Brown and orange medium and coarse-grained pebbly sandstone; pebble and cobble conglomerate; carbonaceous shale with carbonized wood; gray, yellow, and orange mudstone; and orange clayey gravel (diamicton). Gravel clasts of argillite, quartzite, and siltstone are mostly well rounded. Sandstone and conglomerate beds have channelized, erosional bases. Diamicton unit locally infills fractures in Belt Supergroup bedrock.</p> <p>Volcaniclastic rocks: sandstones, conglomerates, breccias, diamictons, and tuff (compacted deposit of volcanic particles) that contain small to large percentages of Belt Supergroup gravel- and sand-sized particles (Lange and Zehner, 1992).</p>		
<i>unconformity</i>				
Proterozoic		Belt Supergroup	Numerous stratigraphic units composed mostly of metamorphosed siltstones, carbonates, and quartz sandstones (Johns, 1970; Winston, 1986; Harrison and others, 1986, 1992) and minor amount of igneous rocks (McGimsey, 1985). Most bedding thicknesses range from less than 1 inch in metasiltsstones to a few feet to tens of feet in metacarbonates and quartzites.	

Hydrogeology

The Kalispell Valley contains more than 40 lakes. Flathead Lake, at 126,000 acres, is one of the largest natural freshwater lakes in the western United States. Kerr Dam, which was constructed in 1938, increases and helps to maintain its natural storage capacity. Echo Lake is the largest of more than thirty, primarily spring-fed, pothole lakes in the kame-and-kettle area on the east side of the basin.

Increased residential development has raised concerns about surface-water contamination. Under natural conditions, Flathead Lake is oligotrophic, or nutrient-poor, and produces small amounts of algae. However, the lake is becoming eutrophic due to increased nutrient loads. The leading source of phosphorus in Flathead Lake is atmospheric decomposition of dust and smoke. Another leading source of nutrients into the lake is the Flathead River. In urban areas north and around Kalispell, nitrate and phosphorus discharge to the river from the unconfined alluvial aquifer. Recent monitoring indicates that the amounts of nutrients and algae are increasing in Flathead Lake. Apparently, a phosphorus detergent ban and improvements to all of the municipal wastewater-treatment plants in the Flathead Lake drainage basin have been unable to offset increased phosphorus loading from private septic tanks and other sources.

Groundwater is an important resource in the Kalispell Valley, as thousands of residents rely on it for domestic water supplies. There are four principal types of aquifers in the basin: Holocene (modern) floodplain aquifers, Pleistocene perched aquifers, Pleistocene confined aquifers, and the Precambrian bedrock aquifer. The WBSW W&SD wells most likely use one of the Pleistocene perched aquifers and the Precambrian bedrock aquifer contained in the sediment and rock units around Woods Bay.

The Precambrian bedrock aquifer is an important source of water where overlying basin fill is either thin or not productive. The bedrock aquifer can be or can appear to be confined where it underlies glacial deposits of low permeability; elsewhere it is clearly unconfined. Wells completed in the bedrock generally yield about 0.5 to 30 gallons per minute, but yield is strictly dependant on the well intersecting open water-bearing fractures. In the vicinity of Woods Bay, low permeability glacial deposits do appear to overlie the bedrock and the aquifer within the rock can behave as if it were locally confined. At least it can be treated much like a confined aquifer. Recharge into the bedrock aquifer around this well is probably from:

- 1) the fractured bedrock aquifer upgradient (uphill);
- 2) infiltration of precipitation in nearby areas where the bedrock crops out; and
- 3) east northeast from the well where local streams flowing down the west face of the Mission Range can and do lose water into and recharge the fractured bedrock aquifer.

There is no surface water in the vicinity of this well, so surface water impacts on the local aquifer is not an issue.

The author collected well logs for the Woods Bay Sheaver Creek W& S District productions wells and several other domestic wells located across town and extending uphill to the northeast. These well logs are provided in Appendix B of this report. Please see Tables 5a and 5b below.

Wells throughout the community of Woods Bay (including the shallow in-town PWS wells) draw water from what appears to be an unconfined aquifer present in the alluvial and/or glacial deposits beneath town. The aquifer beneath the area is probably localized to this area and bordered by bedrock to the north and east of town, by glacial gravels and Flathead Lake to the west, and by the Woods Bay embayment to the south. The thickness of the saturated portion of this semi-confined to unconfined aquifer is not known, but may be more than a couple of hundred feet thick. Local wells are drilled

from 30-200 feet deep with static water levels recorded in just as great a variety of depths. This suggests that the drillers are encountering productive water-bearing zones of the aquifer in a wide assortment of depths. I was not able to see any pattern that suggested these numerous water-bearing zones were completely isolated and not interconnected with the rest of the aquifer. This complexity of water-bearing zones interfingering with lower permeability zones is consistent with the complex depositional history of this area. Because the aquifer appears to be unconfined, a direct interaction with the lake cannot be ruled out. Recharge for the alluvial aquifer beneath the community of Woods Bay can potentially be:

- 1) water moving north from the embayment or from the lake (generally under high well pumping rates),
- 2) water moving vertically upward from the underlying bedrock, or
- 3) water moving from the north along the interface between the bedrock and the fluvio-glacial sediments north of town (between the lake shore and the mountain front). This 3rd potential source of recharge to the alluvial aquifer can probably receive water from the infiltration of precipitation and from the bedrock over which the fluvio-glacial deposits lay.

PWS Well Information

Included in Appendix B are the well logs for many of the wells found in proximity to the PWS wells. Information regarding the wells for Woods Bay Sheaver Creek W&S District PWS is summarized in Tables 5a and 5b below.

Table 5a. PWS Source/Well Locations				
Woods Bay Sheaver Creek Water and Sewer District PWS (#MT004698)				
WBSC W&S Distr. Source Name	Well 3 East	Well 2 West	Well 4	Well 1 Redgate
Source Code	WL002	WL003	WL005	WL004
Status	Active	Active	Active	<i>Inactive</i>
Latitude & Longitude	48.00162 -114.05568	48.00154 -114.05583	48.00167 -114.05593	48.00628 -114.05057

Table 5b. PWS Source/Well Information				
Woods Bay Sheaver Creek Water and Sewer District PWS (#MT004698)				
	Well 3 East (WL002)	Well 2 West (WL003)	Well 4 (WL005)	This is Well 1 Redgate (WL004)
Notes	All information of well construction was derived from video log inspection of the well conducted on 13 October 2009.	Measurements have been adjusted to account for the extension of the casing and backfilling of the original vault to bring the floor up to grade.	This is the newest well.	This well is inactive.
MBMG GWIC Well #	??	79692	249349	215595
Water Right #	Unknown	P009181-00	Unknown	Unknown
Date completed	Unknown	31 October 1975	28 January 2009	25 March 2003
Casing Diameter	8 inches, steel	6 inches, steel	8.5 inches, steel	8.6 inches, 0-124.6 ft bgs 6.6 inches, 110-424 ft bgs
Total Depth (feet bgs)	43 ft btoc (below top of casing)	61 ft	243	424
Perforated Interval = the intake (ft bgs)	40-43 ft btoc	55-61 ft Screened	139-141 perforations 142-152 perforations ¹	324-364 perforations 384-404 perforations
Depth of Seal around casing (ft bgs)	unknown	19 ft cuttings	40 ft cement grout	124.6 ft cement grout
Static Water Level (ft bgs)	23.14 ft. btoc	25 ft	52	175
Pumping Water Level (ft bgs)	25.67 ft btoc after 1.5 hours	35 ft	Unknown	Unknown
Draw Down (ft)	2.53 ft btoc after 1.5 hours	10 ft	Unknown	Unknown
Test Pumping Rate (gpm)	80 gpm	120 gpm for 5 hours	200	70
Specific Capacity	31.6 gal./ft.	12 gal./ft.		
Yield (gpm)		70 gpm	~200	~70

Measurements below top of casing are noted as “btoc”. All available well logs are attached in Appendix B. The information above represents input by the PWS operator, data found on the MBMG GWIC well logs, information derived from the 2009 video inspection of Well 3 East, and information found on the 2011 DEQ Sanitary Survey Inspection.

Source Water Sensitivity

Based upon the hydrogeologic setting, the source water for this system’s 3 active wells is classified as having *high source water sensitivity* to contamination. The semi-confined to confined bedrock aquifer that provides water to Well 4 (WL005) probably has a *low source water sensitivity*. But since water from all 3 PWS wells enters a single common header (and is mixed) the high sensitivity is applied to the 3 wells collectively. This methodology for determining sensitivity is outline in Table 6 below.

Table 6. Source Water (Aquifer) Sensitivity

High Source Water Sensitivity	Moderate Source Water Sensitivity	Low Source Water Sensitivity
<ul style="list-style-type: none"> • Surface water and GWUDISW • Unconsolidated Alluvium (unconfined) • Fluvial-Glacial Gravel* • Terrace and Pediment Gravel • Shallow Fractured or Carbonate Bedrock 	<ul style="list-style-type: none"> • Semi-consolidated Valley Fill sediments (semi-confined) • Unconsolidated Alluvium (semi-confined) 	<ul style="list-style-type: none"> • Consolidated Sandstone Bedrock • Deep Fractured or Carbonate Bedrock** • Semi-consolidated • Confined Aquifers

* Woods Bay Sheaver Creek 3 production wells in town (WL002, WL003, and W1005)

**Well 1 Redgate (WL004)

Delineation Results

In all instances, a 100-foot radius control zone is delineated around the wellhead. This is done in order to ensure that the area immediately surrounding the wells remains free of contamination. Thus 100-foot radius control zones have been delineated and inventoried around the wells.

Although there is considerable elevation difference between Woods Bay and the watershed divide of the Mission Range the actual distance is less than 2-3 miles. As such the Inventory Region and Recharge Region have been combined and extend up to the watershed boundary east of town. This Inventory Region is depicted on [Figure 4](#). The delineation for this PWS is based on several factors, taking into consideration the local hydrogeology, the potential contamination sources, the amount of available information, and the interaction with surface water. Groundwater flow directions for the shallow unconfined and confined bedrock aquifers in the area of Woods Bay have been estimated by the author and are depicted on [Figure 4](#). Based on very limited information, the author believes that the shallow unconfined and the deeper bedrock aquifers should exhibit similar flow directions. These groundwater flow directions are collectively depicted by the dark blue arrows within the Inventory Region on [Figure 4](#).

Limiting Factors

Groundwater behavior in general terms is reasonably well understood in the Kalispell Valley, but is not easily predictable beneath specific locations and especially around a certain well that is drawing water from a specific depth. In addition to that, groundwater flow direction fluctuates seasonally and from year to year. Groundwater and its flow directions in the area of Woods Bay have not been characterized sufficiently for more than a rough estimate in this WBSC W&S District PWS SWDAR. Here, several conservative assumptions were made in the delineation of the source water protection areas and the development of this report. Also, reliance on some basic hydrogeologic principals to define the aquifer boundaries, areas of discharge, and groundwater movement was employed. The SWDAR, however, can and should be revised if more data becomes available that alters the assumed groundwater flow direction(s).

Chapter 3 INVENTORY

Inventory Method

An inventory of potential sources of contamination was conducted for the Woods Bay Sheaver Creek Water and Sewer District PWS within the control zone and inventory region. Note that the recharge region was incorporated into the inventory region and was not inventoried separately. 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, with the exceptions of 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 Woods Bay Sheaver Creek W&S District PWS focuses on all activities in the control zones of the wells, certain types of municipal and private facilities in the inventory 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. Septic density (the density of private onsite septic systems) was determined based on the 2000 US Census and obtained from the Montana State Library's Natural Resource Information System (NRIS) Thematic Mapper (<http://nris.state.mt.us/mapper/>) and (<http://nris.state.mt.us/wis/swap/swapquery.asp>)

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

Step 6: 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 (inclusive of large capacity septic systems).
6. Major roads or rail transportation routes.
7. Cultivated and irrigated cropland greater than 20% of the Inventory Region.
8. Animal feeding operations.
9. Wastewater treatment facilities, sludge handling sites, or land application areas.
10. Areas of increased septic density.
11. Sewer mains.
12. Storm sewer outflows.
13. Abandoned or active mines.

Inventory Results

Inventory Results/Control Zone

In documents examined during writing of this SWDAR, there was no mention of potential contaminant sources within the 100-foot radius control zones. Specifically, the previous sanitary surveys and related correspondence (prior to the unification and construction of the new combined water system) do not highlight any causes for concern within the control zones. Locations of septic tanks and drainfields within Woods Bay are unknown, so it is possible (though very unlikely) that some of these drain fields may encroach upon one of the control zones for the in-town wells.

Inventory Results/Inventory Region

The inventory region for WBSC W&SD PWS is shown in [Figure 4](#). The potential contaminant sources recognized as part of the inventory are described below and summarized in Table 7.

The entire inventory region is unsewered. As such, localized areas of high and extensive moderate septic density are found throughout the inventory region (except higher on the Mission Range front). These areas, shown in red on the map in [Figure 5](#), are considered a hazard to the public water supply sources. This is because they may generate wastewater discharged to drain fields containing improperly disposed chemicals or nitrate and pathogens levels in the effluent which may not have been adequately reduced prior to reaching groundwater.

Similarly, large capacity septic systems pose potential contamination threats (they are a hazard) to the PWS water sources. Large capacity septic systems are defined as those that serve over 20 people daily. Almost any business in the community will operate a large capacity septic system. Unfortunately, no public files are available regarding the exact locations of these facilities; it is assumed however, that they are present at all or most of the businesses, shops, subdivisions, parks, and a number of other locations within the inventory region. Large capacity septic systems threaten the public water supply sources in ways similar to localized areas of increased septic density.

Accidental spills or releases of petroleum to groundwater and surface water are possible. Above ground fuel storage tank sites (AST sites) or underground fuel storage tank sites (UST sites) in the inventory region, especially those that are known to be leaking (LUST sites), are serious threats to the public water supply sources. As such, UST and LUST sites are noted on the inventory and map.

Analysis of the predominant land covers in the inventory region reveal that the area is mostly comprised of forest ([Figure 6](#)). There are also small areas of grassland, agricultural land, and even some open water (lakes). Typically, agriculture is considered to be the only major land use that may pose a contamination threat to public water supplies. In and around Woods Bay the agricultural land is primarily classified as “hay and pasture”. An examination of aerial photographs leads to the assumption that some areas appear to be small residential-sized fruit orchards. These cropped areas may be somewhat hazardous to the groundwater, if chemical over-application occurs or spills of pesticides and/or fertilizers happen. The percentage of agricultural land in the inventory region is actually quite low (below 20% of the region).

Montana Highway 35 bisects the inventory region. This transportation route represents a potential contamination source as large scale spills of hazardous or other materials could occur. These types of accidents can be catastrophic to a public water supply. It is fortunate that, although these events happen on all roadways, they are very infrequent at any particular location (unless a particular stretch of roadway promotes vehicle accidents).

The Woods Bay Landfill is thought to be near, but not within the inventory region. This is a historic landfill and is currently closed. Past improper disposal of solid or liquid wastes have the potential to impact local groundwater.

Table 7. Noteworthy Potential Contaminant Sources

WBSC W&SD PWS—Control Zone and Inventory Region

Source	Contaminants	Description
Septic systems that may be failing to adequately treat septic effluent (localized areas high and moderate density of private systems)	Pathogens, nitrates, other organic and inorganic chemicals	Wastewater discharged to drain fields may contain improperly disposed chemicals or these systems may fail to adequately reduce nitrate and pathogens in the effluent. The highest density of these systems is in the immediate vicinity of the active in-town PWS wells.
Large Capacity Septic Systems (for businesses, offices, & shops) that may be failing to adequately treat septic effluent	Pathogens, nitrates, other organic and inorganic chemicals	Wastewater discharged to drain fields may contain improperly disposed chemicals or these systems may fail to adequately reduce nitrate and pathogens in the effluent. Most of these large capacity septic systems are probably in the immediate vicinity of the active in-town PWS wells, or potentially along the highway.
USTs/LUSTs , releases of petroleum products to the groundwater	VOCs, petroleum hydrocarbons	Accidental spills or releases of petroleum to the surface or subsurface groundwater are possible.
Agricultural Land (Particularly if Irrigated) that allows fertilizer or pesticides/herbicides to reach groundwater	SOCs, nitrates	Over-application and spills of pesticides and/or fertilizers are possible. These chemicals are persistent in groundwater and can migrate to local wells.
MT Highway 35, spills and releases due to vehicular accidents	Hazardous materials (VOCs, SOCs, metals, other)	Large scale spills and very high concentrations of hazardous materials could occur. This is most significant if the spills occur in upgradient locations from the wells.
Landfill, past practices may have left contamination that can migrate in groundwater	VOCs, SOCs, metals	Current or past improper disposal of solid or liquid wastes may impact groundwater and migrate to the area of the well.

Inventory Update

To make this SWDAR a useful document in the years to come, the owners, manager, or the certified water system operators for the WBSC W&S District 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 contaminant sources. This is the case with large capacity septic systems that are present in the inventory and recharge regions. 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 owners and/or operators for site-specific knowledge. Their initial review of this document was 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 Woods Bay Sheaver Creek Water & Sewer District PWS owners and operator. The goal of source water management is to protect the source water by 1) controlling activities in the control zone and 2) managing significant potential contaminant sources and ensuring that major land use activities in the inventory 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 owners and the operator to reduce susceptibility are recommended in this chapter.

Hazard Determination

The susceptibility of the WBSC W&SD PWS water sources 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 water sources in unconfined aquifers. WBSC W&SD PWS uses wells that are installed into the unconfined aquifer located in the center of the community. Even though one of the wells (probably Well 2 West (WL003)) is a bedrock well drawing water from a probable semi-confined to confined aquifer, water from all 3 wells in town is mixed as it enters a common header in the nearby pump house. The hazards discussed below were determined based upon the water system drawing from the unconfined aquifer beneath town. This choice is intended to be conservative and more protective of public health, though it is important to note that the deep bedrock well is probably less at risk from contamination than the other wells. For this water system, any potential contaminant sources within 1 mile of the 3 active production wells is considered to be within the 1-year groundwater time-of-travel (TOT) distance listed in Table 8. Essentially all of the potential contaminant sources depicted on [Figures 5](#) and [Figure 6](#) are located within 1 mile of the 3 active wells.

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)	High Density More than 300 per sq. mi.	Moderate Density 50 – 300 per sq. mi.	Low Density 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

Table 8. Hazard of potential contaminant sources

For wells drawing water from unconfined aquifers

Potential Contaminant Source	High Hazard	Moderate Hazard	Low Hazard
Cropped Agricultural Land (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

Susceptibility Determination

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to the PWS source intakes. First, hazard is rated by the proximity of a potential contaminant source to the water sources (the well intakes) or based on the percentage of the inventory region occupied by a certain type of contaminant source (from Table 8). Then the presence of barriers is used to determine susceptibility. Susceptibility ratings are 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 the Woods Bay Sheaver Creek W&S District PWS water sources is located in Table 10. Below the table is a brief discussion of the susceptibility assessment for the significant potential contaminant sources. Other sources of contamination may also exist and may pose threats to the public water supply at Woods Bay Sheaver Creek. It is prudent to make further attempts to identify these sources, especially if they are up-gradient from the PWS, and to understand the treats they may pose.

Table 10. Susceptibility Assessment

Assessment Of Susceptibility within the Inventory Region—Woods Bay Sheaver Creek W&S District PWS (#MT0004698)

Source	Contaminants	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Localized Areas of Moderate and High Septic Density	Pathogens, nitrates, other organic and inorganic chemicals	Wastewater discharged to drain fields that may be untreated or inadequately treated	Moderate to High Hazard	<ul style="list-style-type: none"> • Some low permeability strata were noted above the well intakes in domestic wells. These may be present in town and around the PWS wells. • Lake County is requiring pressure dosed septic system and other protective design features on all new systems. 	Moderate Susceptibility	<ul style="list-style-type: none"> • Promote the design and installation of advanced septic systems in the area. • Education (including posters and placards) to reduce improper disposal of chemicals. • Funding, design, and installation of a central sewer system and wastewater treatment plant for Woods Bay. • Consider the discontinued use of the shallowest (54 fee deep) PWS well.
Large Capacity Septic Systems (for businesses, offices, & shops)	Pathogens, nitrates, other organic and inorganic chemicals	Wastewater discharged to drain fields that may be untreated or inadequately treated	High Hazard	<ul style="list-style-type: none"> • Some low permeability strata were noted above the well intakes in domestic wells. These may be present in town and around the PWS wells. • Lake County is requiring pressure dosed septic system and other protective design features on all new systems. 	Moderate Susceptibility	<ul style="list-style-type: none"> • Promote the design and installation of advanced septic systems in the area. • Education (including posters and placards) to reduce improper disposal of chemicals. • The funding, design, and installation of a central sewer system and wastewater treatment plant for Woods Bay. • Consider the discontinued use of the shallowest (54 fee deep) PWS well.
MT Highway 35	Hazardous materials (VOCs, SOCs, metals, other)	Large scale spills of hazardous or other materials	High Hazard	<ul style="list-style-type: none"> • Some low permeability strata were noted above the well intakes in domestic wells. These may be present in town and around the PWS wells. • Local and regional emergency response measures including training of responders and resources for spill cleanup in the area 	Moderate Susceptibility	<ul style="list-style-type: none"> • Emergency planning. • Training of local emergency response personnel. • Allocation of resources/funding for emergency response. • Modify drainage along highway to conduct spilled liquids to lined retention ponds (for liquid recovery).

Table 10. Susceptibility Assessment

Assessment Of Susceptibility within the Inventory Region—Woods Bay Sheaver Creek W&S District PWS (#MT0004698)

Source	Contaminants	Hazard	Hazard Rating	Barriers	Susceptibility	Management
USTs/LUSTs	VOCs, petroleum hydrocarbons	Accidental spills or releases of petroleum to ground-water	High Hazard	<ul style="list-style-type: none"> • Some low permeability strata were noted above the well intakes in domestic wells. These may be present in town and around the PWS wells. • Secondary containment measures • Spill response planning requirements • Spill monitoring requirements • Inventory control • Regulatory oversight 	Moderate Susceptibility	<ul style="list-style-type: none"> • Careful monitoring of LUSTs and USTs. • Promotion of good management practices and quick response to problems.
Agricultural Land	SOCs, nitrates	Over-application and spills of pesticides and/or fertilizers	Low Hazard (low % of the region)	<ul style="list-style-type: none"> • Some low permeability strata were noted above the well intakes in domestic wells. These may be present in town and around the PWS wells. • Locals are utilizing integrated pest management and handling agricultural chemicals according to the label and product guidelines. Although economically driven, this is an active barrier for the well intakes. 	Very Low Susceptibility	<ul style="list-style-type: none"> • Promotion of Best Management Practices and good cropping practices. • Coordination with owners of agricultural land to ensure awareness and cooperation with PWS operators to protect groundwater.

Localized Areas of High and Moderate Septic Density

Localized areas of high and moderate septic density within the inventory region are located around and upgradient from the production wells. The areas of high septic density are actually more easily treated as quasi-point sources. As such, these high density areas within a mile of the wells represent a high hazard to the public water supply. It is probable that no drainfields are located within the well control zones. Few barriers to prevent contamination from reaching the well intakes could be identified at this time, so the public water supply wells' intakes have moderate susceptibility to contamination from areas of high and moderate septic density (see Table 10).

Large Capacity Septic Systems

Large capacity septic systems at businesses, shops, offices, and subdivisions within the area are also a high hazard (due mostly to their proximity to the wells). Again, few barriers were identified that stood between the potential contaminant sources and the well intakes. The wells' intakes for this the public water supply have moderate susceptibility to contamination from these large capacity septic systems.

Montana Highway 35

Montana Highway 35 bisects the inventory region and is rated as a high hazard. The presence of emergency response measures, including training of responders and resources for spill cleanup in the area represent barriers that stand between a contamination event and the well intakes. It is recognized that spills of this nature happen along all highways, but they are high probability and very low frequency event. The frequency (the odds of an event happening in the near future) at a certain stretch of road are considerably greater if road conditions promote such accidents (e.g., a bad intersection, blind curves, private driveways entering the highway, etc.). It is estimated that the PWS source wells' intakes have a moderate susceptibility to contamination from these spill events.

Underground Storage Tanks

Underground fuel storage tank sites (UST) and leaking underground fuel storage tank sites can and do have leaks and spills that occur and they do affect the subsurface around them. These releases are rated as a high hazard to the public water supply wells' intakes primarily due to their proximity to the wells. Spill response measures, management plans, inventory monitoring, and secondary containment all act as barriers to stand between a contamination event and the well intakes. With these barriers, the PWS wells' intakes have moderate susceptibility to contamination events associated with the UST and LUST sites.

Agricultural Land

Agricultural land in the inventory region represents a low hazard to the PWS well intakes as it makes up only a small percentage of the region. It appears that these are mostly small semi-rural or residential pastures and orchards. A couple of management barriers were identified as standing between the contaminant events and the wells' intakes. The public water supply source wells' intakes have very low susceptibility to contamination derived from activities on this agricultural land.

Summary of Susceptibility Assessment

The Woods Bay Sheaver Creek Water and Sewer District Public Water Supply uses 3 active production wells and 1 inactive well. These wells are located as seen on [Figure 2a](#) and [Figure 2b](#). The Inventory Region for this system was delineated as shown on [Figure 4](#). This region represents a combining of the inventory region and the recharge regions because both will encompass essentially the same area. The inventory region extends upgradient from the PWS wells to the watershed divide in the mountains east of Woods Bay. It is important to note that in the interests of conservatively protecting public health, hazard and susceptibility ratings have been based on analyses conducted for wells tapping an unconfined aquifer.

In summary, the PWS wells' intakes have the following susceptibilities to potential contaminant sources in the inventory region, as summarized in the above paragraphs and Table 10.

The WBSC W&S District PWS wells' intakes have a **moderate susceptibility** to contamination from the following potential contaminant sources in the inventory region:

- Localized areas of high & moderate septic density.
- Large capacity septic systems.
- Spills of chemicals along MT Highway 35.
- UST and LUST sites.

The WBSC W&S District PWS wells' intakes have a **very low susceptibility** to contamination from the following potential contaminant sources in the inventory region:

- Agricultural land (orchards or pasture land)

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GLOSSARY

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

Alkalinity. The capacity of water to neutralize acids.

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.

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 cannot 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.

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.

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.

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 that 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.

**Definitions taken from EPA's Glossary of Selected Terms and Abbreviations and other sources.

FIGURES

[Figure 1. Location Map](#)

[Figure 2a. Site Map](#)

[Figure 2b. Site Map \(Closer View\)](#)

[Figure 3. Geologic Map](#)

[Figure 4. Inventory Region WBSC W&S District PWS](#)

[Figure 5. Potential Contaminant Sources](#)

[Figure 6. Land Use Map](#)

APPENDICES

Appendix A

DEQ PWS's Database Output

System Facilities Summary
Water Quality Data
Sampling Schedule
Analytical Data (to date)
Regulatory History (to date)

Appendix B

Well Log Information

Other Supporting Information

Appendix C

Concurrence Letter

