

PWS-6 Report
Proposed Well Location Near Existing Water Storage Tank
Silver Gate Water User's Association - PWS ID: MT0000331
August 3, 2004

INTRODUCTION AND PURPOSE

The purpose of this PWS-6 report is to assess threats to a new supply well for the Silver Gate Water User's Association. The primary contact for this water supply is Mr. Steve Leibl, P.O. Box 1011, Cooke City, Mt. 59020, Phone: 406-838-2301. Jim Stimson, Hydrogeologist with the Montana Department of Environmental Quality (DEQ), prepared this PWS-6 report. Details on this water supply were obtained from a review of the Public Water Supply files and other public sources of information.

LIMITATIONS

The terms "drinking water supply" or "drinking water source" refer specifically to the source of the Silver Gate public water supply and not any other public or private water supply. Only significant potential sources of contamination in areas that contribute water to the drinking water source are considered in this report. A source is considered significant if substances that are used, generated or stored are hazardous to human health or if the volume on-site is relatively large. Some potential or existing sources of contamination may be unintentionally missed in the inventory. The inventory and report can be periodically updated when new information becomes available. 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.

PWS INFORMATION

Silver Gate is one mile from the Northeast entrance to Yellowstone Nation Park. The town of Silver Gate is located on land homesteaded by Horace S. Double, for which he was granted a patent on May 2, 1897. In 1932, John L Taylor and J. J. White founded the town of Silver Gate on part of the homestead. Covenants written for the original town site covered setbacks, signs, and building standards requiring log construction and rustic architecture. The year-round population includes only a few, but the summer population is well over a hundred. Today, the primary industry for the town is recreational related.

The unincorporated town is home to about 35 summer cabins, a café, five motels, a general store and Post Office, all served by the public water supply system. Wastewater disposal in Silver Gate occurs through individual on-site septic systems.

The most recent sanitary survey for Silver Gate is dated August 8, 2001 and was completed by Matt Usuriello of the DEQ Billings Office. The survey states that Silver Gate uses three spring sources for their water supply and these sources have been designated as ground water under the direct influence of surface water. Water from the springs is gravity fed to the 10,000-gallon above ground steel storage tank and then is distributed to individual homes and businesses through 34 service connections. The storage tank was inspected and cleaned in 1997. Based on documents from the DEQ files from a Mid-West Assistance report, a chlorinator was put into service for disinfection of the source water around August 2002. It is assumed that the proposed well will either 1) supplement the spring sources, 2) provide a backup source to the springs, or 3) replace the springs as the primary source of water if adequate water supply can be obtained. Based on the geology and logs from wells in the area, the water from the proposed well would be ground water and would not be under the direct influence of surface water.

DELINEATION

In accordance with DEQ Circular 6, two water protection zones are delineated for the Silver Gate's proposed well. They include a 100-foot fixed radius control zone, and a one mile fixed radius circle inventory region. The inventory region is modified to terminate at Soda Butte Creek (Figure 1). All regulated potential contaminant sources are inventoried within the control zone and inventory region. Table 1 lists the types of significant potential contaminant sources that included in the inventory effort.

The goal of management in the control zone is to avoid introducing contaminants directly into the water supply's well or immediate surrounding areas. The inventory region should be managed to prevent contaminants from reaching the well before natural processes reduce their concentrations.

Control Zone - 100-foot radius control zones are delineated for the proposed well; all sources of potential contaminants should be excluded in this region. All potential contaminant sources are identified within the control zone.

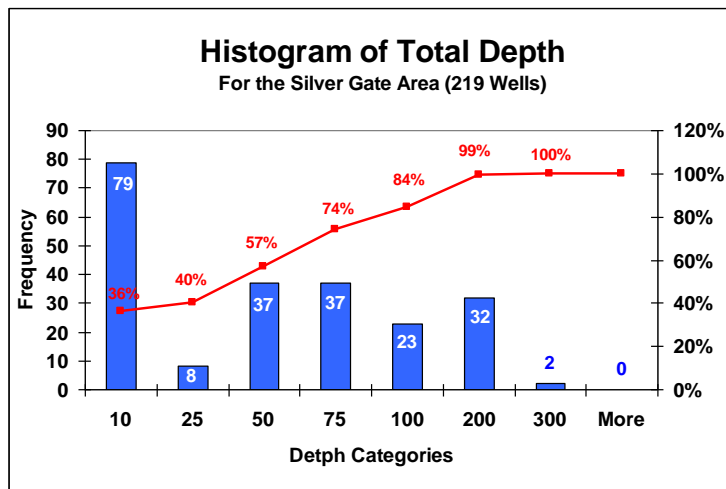
Inventory Region – A one-mile fixed radius inventory regions is delineated for the proposed well. The inventory region is modified to terminate at Soda Butte Creek, which is interpreted as a hydrologic boundary because ground water on the south side of the creek is interpreted to discharge to the creek and not flow beneath the creek to the other (Figure 1).

Hydrologic Conditions

Silver Gate is located in the Beartooth Mountains near the Montana – Wyoming Border (Figure 1). The geologic maps published by the Montana Bureau of Mines and Geology (MBMG) shows that the area is underlain by a variety of sediments and rocks including: Quaternary glacial deposits, Quaternary alluvium associated with Soda Butte Creek, and older bedrock that includes Tertiary volcanics, Paleozoic sandstone and limestone formations, and Precambrian metamorphic rocks (Figure 1 – Geology Map). Ground water is present in the younger alluvial and glacial deposits and in the older bedrock. Based on well logs from the area it is apparent that wells completed in the alluvium and some of the glacial deposits tend to have better production than those wells completed in the bedrock.

Alluvial deposits associated with Soda Butte Creek are composed of sorted gravel, sand, silt, and clay (Lopez, 2001). Glacial deposits around Silver Gate are composed of a complex mixture of unsorted sediments ranging in size from clay to boulders. The glacial deposits can include water-bearing beds of sorted sand and gravel that were likely deposited by glacial melt waters. Older bedrock in the area includes volcanic rocks, sedimentary sandstone and limestone, and metamorphic rocks. Ground water within the older bedrock is thought to flow through a complex network of fractures. In general, recharge for all of the aquifers is interpreted to come from infiltration of precipitation, snowmelt runoff, and leakage through stream channels in upland areas. General ground-water flow is from the north-northeast from upland areas toward lowland areas and the creek's floodplain (Figure 1).

Well data for the Silver Gate area was retrieved from the Montana Bureau of Mines (MGMG) Ground Water Information Center (GWIC) on August 3, 2004. A rough analysis of the 218 wells in this retrieval indicates that the average completed depth is 50 feet below land surface (bls) and the maximum depth recorded is 300 feet. Average water yield is 17 gallons per minute (gpm) and the maximum is 100 gpm. The average static water level for these wells is 17 feet bls and the maximum is 95 feet. Pumping water level averaged 33 feet bls and the maximum is recorded as 240 feet bls. The histogram of well depth shows the number of wells completed within certain depth categories. From the histogram it is apparent that 36% of the wells in the area are less than 10 feet deep. About 75% are less than 75 feet deep, and the remaining 26% are between 75 and 300 feet deep. Information from well logs indicates that wells are completed in all of the geologic formations mentioned above.



The proposed well location near the water storage tank places the well on glacial deposits that flank the north side of Soda Butte Creek (Figure 1 – Geology Map). Based on lithologic logs from wells that appear to be

located and completed in these glacial deposits, the aquifer appears to be composed of coarse sand and gravel (Appendix A). Multiple clay or “clay-bound” sand and gravel layers are present above the aquifer and range between 10 and 40 feet thick. These clay-rich layers will likely function as confining beds that will protect the aquifer from the migration of potential contaminants from the land surface. Based on the well log information, the aquifers within the glacial deposits are interpreted to be confined. A confined aquifer is considered to have a low sensitivity to potential sources of contamination at the land surface (Table 2 of the PWS-6 template for Community or Non-Community Non-Transient Public Water Supplies (DEQ Source Water Protection Program, 2000).

It will be important to verify the presence of the clay layers when the proposed well is completed. Due to the internal complexity of the glacial deposits and the geology in the area around Silver Gate, it is conceivable that the composition of the glacial deposits varies, perhaps significantly, from place to place. The clay layers may be thin or absent in some locations, which would make the aquifer more vulnerable to potential sources of contamination and the susceptibility ratings presented in this report would need to be adjusted accordingly.

Conceptual Model and Assumptions

The aquifer within the glacial deposits in the vicinity of the water storage tank is interpreted to be generally confined, although there may be areas where clay beds are thin or absent and would provide less effective confining conditions. The aquifer is composed of sand and gravel deposits within glacially derived and poorly stratified accumulations of clay, sand, gravel, and boulders. Aquifers in the Soda Butte Creek alluvium is interpreted to be unconfined and consist of relatively coarse sand, gravel and boulders. Ground water is interpreted to move generally from the north-northeast to the south-northwest. Potential contaminant sources south and west of the proposed well location, which includes septic systems within the town of Silver Gate, are interpreted to be in down-gradient locations from the proposed well site.

Limitations

The control zone and inventory region are delineated as simple fixed radius circles and are not established based on aquifer properties or time of travel calculations. Ground-water flow direction is estimated based on basic interpretations of land surface topography and the distribution of the glacial deposits. Aquifer properties and descriptions are based on well driller logs.

INVENTORY

Silver Gate is located in a relatively remote area that is rural and largely undeveloped. Landcover in the area is dominated by forest, exposed rock in alpine areas, and a small areas of grassland. As a result, potential contaminant sources are not abundant in the vicinity of the town. Table 4 lists the significant potential contaminant sources that are identified in the inventory region for the proposed well. Potential contaminant sources identified include 1 area of high septic density associated with the town, 2 areas of moderate septic density south and southeast of town, 1 inactive underground fuel storage tank with a leak history, and State Highway 212 (Figure 1). All of these potential contaminant sources are located down-gradient from the proposed well location. Basically that means that ground water beneath these potential contaminant sources will flow away from the proposed well location and not towards it. While it is possible to reverse the ground water flow direction in some areas by pumping a well site at very large rates, it does not appear that the proposed well will be used in that manner or have the capacity to do so. As a consequence, all of the potential contaminant sources in Table 4 are assigned a low susceptibility rating.

Roads and highways are considered to be significant potential contaminant sources. The concern is that accidents and spills involving large trucks can result in significant volumes of hazardous material being released in the proximity of a public water supply well or surface water intake. However, State Highway 212 is not a major traffic route and does not have a significant volume of large vehicle traffic. The road does not pose a significant threat to the source water or the proposed well.

Mining and mineral exploration have occurred in the area but the available data sources do not indicate that any major mines or mine waste deposits are located in the proximity of the proposed well. Mining is not considered to pose a threat to the source water or the proposed well.

SUSCEPTIBILITY

The susceptibility of the proposed well to contamination is assessed in this section. The proximity of a potential contaminant source to the well site or the density of non-point potential contaminant sources determines hazard rating or the threat of contamination. Hazard and the existence of barriers to contamination are used to determine susceptibility. Table 1 lists the hazard ratings for different types of potential contaminant sources. Table 2 indicates how barriers are used to determine the susceptibility rating for individual potential contaminant sources once a hazard rating has been assigned. Barriers can be anything that decreases the likelihood that contaminants will reach a well. Barriers can be engineered structures, management actions or natural conditions. Examples of engineered barriers are spill catchment structures for industrial facilities and leak detection for underground storage tanks. Emergency planning and best management practices can be considered management barriers. Thick clay-rich soils, a deep water table or a thick saturated zone above the well intake can be natural barriers. Down- and cross-gradient locations of the potential contaminant source are also counted as barriers and in some cases are given more weight than a single barrier because they essentially preclude the possibility of a contaminant source impacting a well or spring source.

Table 4 lists results from the susceptibility analysis for significant potential contaminant sources identified in the inventory region. Based on the available information, no other significant potential contaminant sources are identified within the inventory region for the proposed well.

Table 4 also lists some management options that could help reduce the threat from potential contaminant sources in the area. In addition to the management options listed in Table 4, it would also be advisable to monitor activities or proposals for landuse changes that would affect the land areas north of the proposed well location. This area is up-gradient from the well and contributes recharge to the aquifer that will be tapped by the new well. Potential contaminant sources in this land area could pose a threat to the source water and the public water supply.

Table 1. Identification of Significant Potential Contaminant Sources.

Septic Systems Animal Feeding Operations Underground Storage Tanks Underground Storage Tanks Leaks State and Federal Superfund Sites RCRA Large Quantity Generators Underground Injection Wells Wastewater Treatment	Landfills Abandoned Mines MPDES Wastewater Dischargers Municipal Sanitary Sewer Municipal Storm Sewers Highways, Railways, Pipelines Cultivated Croplands Other: Activities or substances that can compromise source water quality.
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Table 2. Hazard of potential contaminant sources.

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
Septic Systems	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

Table 3. Relative susceptibility to specific contaminant sources as determined by hazard and the presence of 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

Table 4. Susceptibility Assessment Significant Potential Contaminant Sources in the Inventory Region

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Individual Septic Systems	Microbial contaminants and nitrate	Infiltration into shallow ground water and possible discharge to surface water.	Low	- Located down-gradient from proposed well location* - High and Moderate areas represent small percentage of the inventory region.	Low*	-Support local and county efforts to provide educational materials for proper disposal of home hazardous wastes and voluntary community-wide hazardous material collection days.
Underground Storage Tanks (USTs) One Inactive Tank Site with a leak history	Fuels, hydrocarbons, VOCs	Spills, leaks impacting groundwater and/or reaching surface water	High	- Located down-gradient from proposed well location* - Modern construction, spill detection, spill containment and monitoring, - Remediation for historic leaks	Low*	Continue monitoring and encourage state and local officials to proceed to have leaking sites mitigated.
State Highway 212	Variety of hazardous materials including microbial contaminants, nitrate, pesticides, fertilizers, and VOCs	Accidents and spills, storm water runoff, infiltration into ground water	Low	-Located down-gradient from proposed well location* -Low traffic volume, especially low truck traffic volume.	Low*	-Be vigilant for accidents involving large vehicles -Support county efforts to develop an emergency response plan and support training and preparation of local and county response personnel

* Down- and cross-gradient locations are given more weight because they prevent contaminant sources from impacting a well or spring source.

REFERENCES

Berg, R.B., Lonn, J.D., Locke, W.W., 1999, Geologic map of the Gardiner 30' x 60' quadrangle, south-central Montana, Montana Bureau of Mines and Geology Open File Report 387, 9 page(s), scale 1:100,000.

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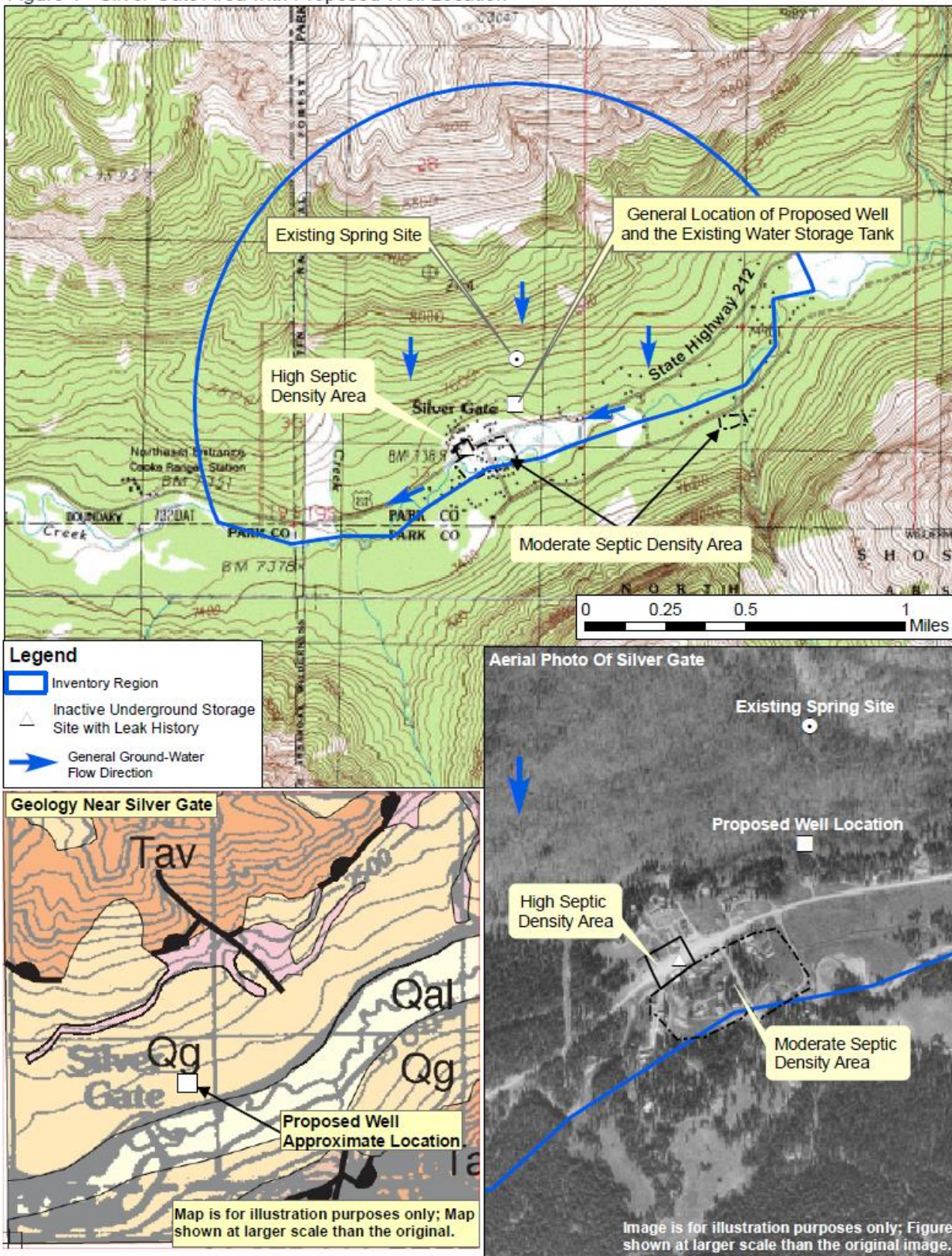
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Reheis, M. C., 1987, Soils in Granitic Alluvium in Humid and Semiarid Climates along Rock Creek, Carbon County Montana, USGS Bulletin 1590-D.

Ritter, Dale F., 1967, Terrace Development along the Front of the Beartooth Mountains, Southern, Montana. Geological Society of America Bulletin, V. 78, p. 467-484.

U.S. Geological Survey, 2000. National Landcover Dataset, Montana. 30-meter electronic digital landcover dataset interpreted from satellite imagery.

Figure 1 - Silver Gate Area with Proposed Well Location



Appendices A – Select logs for wells completed in glacial deposits

Montana Bureau of Mines and Geology
 Ground-Water Information Center Site Report
MENZEL MIKE

[Plot this site on a topographic map](#)

Location Information

GWIC Id: 148102	Source of Data: LOG
Location (TRS): 09S 14E 33 DBA	Latitude (dd): 45.0085
County (MT): PARK	Longitude (dd): -109.9888
DNRC Water Right: 91388	Geomethod: TRS-TWN
PWS Id:	Datum: NAD27
Block:	Altitude (feet):
Lot: 1	Certificate of Survey:
Addition: SILVERGATE	Type of Site: WELL

Well Construction and Performance Data

Total Depth (ft): 71.00	How Drilled: ROTARY
Static Water Level (ft): 14.00	Driller's Name: HAYES
Pumping Water Level (ft): 65.00	Driller License: WWC361
Yield (gpm): 50.00	Completion Date (m/d/y): 10/25/1994
Test Type: AIR	Special Conditions:
Test Duration: 1.00	Is Well Flowing?:
Drill Stem Setting (ft):	Shut-In Pressure:
Recovery Water Level (ft):	Geology/Aquifer: Not Reported
Recovery Time (hrs):	Well/Water Use: DOMESTIC
Well Notes: YELLOWSTONE CLOSURE AREA WATER TEMP = 40 DEGREES F	

Hole Diameter Information

No Hole Diameter Records currently in GWIC.

Casing Information¹

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
-1.5	68.0	6.0				STEEL

Annular Seal Information

From	To	Description
0.0	20.0	BENTONITE

Completion Information¹

No Completion Records currently in GWIC.

Lithology Information

From	To	Description
0.0	24.0	SANDY CLAYBOUND GRAVELS
24.0	65.0	SANDY CLAY MOIST STICKY GRAY
65.0	71.0	COARSE GRAVELS AND SAND SOME CLAY BROWN TINT

**Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
HERMAN GEORGE M & A**

[Plot this site on a topographic map](#)
[View Hydrograph for this Site](#)
[View Water Quality for this Site](#)

Location Information

GWIC Id: 106024
Location (TRS): 09S 14E 33 ACDA
County (MT): PARK
DNRC Water Right:
PWS Id:
Block:
Lot:
Addition:

Source of Data:
Latitude (dd): 45.0067
Longitude (dd): -109.9878
Geomethod: MAP
Datum: NAD27
Altitude (feet): 7385.00
Certificate of Survey:
Type of Site: WELL

Well Construction and Performance Data

Total Depth (ft): 141.00
Static Water Level (ft): 2.00
Pumping Water Level (ft): 9.00
Yield (gpm): 20.00
Test Type: BAIELR/ PUMP
Test Duration: 5.00
Drill Stem Setting (ft):
Recovery Water Level (ft):
Recovery Time (hrs):
Well Notes:

How Drilled: CABLE
Driller's Name: HULBERT
Driller License: WWC047
Completion Date (m/d/y): 10/11/1989
Special Conditions:
Is Well Flowing?:
Shut-In Pressure:
Geology/Aquifer: 112DRFT
Well/Water Use: DOMESTIC

Hole Diameter Information

No Hole Diameter Records currently in GWIC.

Casing Information¹

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
-2.0	139.0	6.0				STEEL

Annular Seal Information

No Seal Records currently in GWIC.

Completion Information¹

No Completion Records currently in GWIC.

Lithology Information

From	To	Description
0.0	4.0	SOIL
4.0	8.0	SOIL AND GRAVEL
8.0	15.0	SAND AND GRAVEL
15.0	30.0	BLUE CLAY AND SAND AND GRAVEL
43.0	45.0	VERY LITTLE WATER
45.0	50.0	BLUE CLAY AND GRAVEL
50.0	66.0	MUD SAND GRAVEL AND SMALL ROCK
66.0	75.0	BLUE CLAY SAND AND GRAVEL
75.0	110.0	SAND WATER CLAY AND VOLCANIC DUST
110.0	125.0	SAND WATER AND CLAY
125.0	130.0	SAND AND WTER
130.0	125.0	SAND CLAY AND WTER
135.0	141.0	SAND GRAVEL AND WATER (CLEAR WATER)

**Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
PINE EDGE CABINS**

[Plot this site on a topographic map](#)
[View Hydrograph for this Site](#)

Location Information

GWIC Id: 106031
Location (TRS): 09S 14E 33 ACBC
County (MT): PARK
DNRC Water Right: C104629-00
PWS Id: 03737002
Block:
Lot:
Addition:

Source of Data:
Latitude (dd): 45.0075
Longitude (dd): -109.9919
Geomethod: MAP
Datum: NAD27
Altitude (feet): 7420.00
Certificate of Survey:
Type of Site: WELL

Well Construction and Performance Data

Total Depth (ft): 120.00
Static Water Level (ft): 42.00
Pumping Water Level (ft):
Yield (gpm): 30.00
Test Type: AIR
Test Duration: 0.25
Drill Stem Setting (ft):
Recovery Water Level (ft):
Recovery Time (hrs):
Well Notes: WELL SERVES 10 CABIN UNITS AND OFFICE.

How Drilled:
Driller's Name: HILLMAN
Driller License: WWC258
Completion Date (m/d/y): 10/11/1988
Special Conditions:
Is Well Flowing?:
Shut-In Pressure:
Geology/Aquifer: 112DRFT
Well/Water Use: PUBLIC WATER SUPPLY

Hole Diameter Information

From	To	Diameter
0.0	120.0	6.0

Casing Information¹

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
-2.0	116.0	6.0				17 LB STEEL

Annular Seal Information

From	To	Description
0.0	0.0	BENTONITE

Completion Information¹

From	To	Dia	# of Openings	Size of Openings	Description
116.0	116.0	6.0			OPEN BOTTOM

Lithology Information

From	To	Description
0.0	10.0	GRAVEL AND SAND
10.0	20.0	CLAY
20.0	35.0	GRAVEL
35.0	40.0	CLAY
40.0	80.0	FRACTURED ANDERITE
60.0	95.0	QUICKSAND
95.0	110.0	GRAVEL AND SAND
110.0	112.0	CLAY
112.0	120.0	CLAY GRAVELS