TOWN OF WEST YELLOWSTONE

PUBLIC WATER SYSTEM

PWS ID No. MT0003136

SOURCE WATER DELINEATION & ASSESSMENT REPORT

PREPARED BY:

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
SOURCE WATER PROTECTION PROGRAM

PREPARED FOR:

The Town of West Yellowstone
Public Water Supply

PO Box 1570
West Yellowstone, Montana, 59758

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EXECUTIVE SUMMARY

This Source Water Delineation and Assessment Report (SWDAR) was prepared as required by the Federal Safe Drinking Water Act, according to a detailed Source Water Assessment Plan developed by a statewide Montana citizens' advisory committee, and approved by the US Environmental Protection Agency. The Department of Environmental Quality (DEQ) is completing assessment and delineation reports for all public water systems in Montana. These reports are intended to provide information so that the public water system staff/operator, consumers, and community citizens can develop strategies to protect drinking water sources. The information provided includes the delineation of the area most critical to maintaining safe drinking water (the inventory region), an inventory of significant potential sources of contamination within this area, and an assessment of the relative threat that these sources pose to the water system.

The Town of West Yellowstone's drinking water is supplied by a spring, and supplemented by three wells. Whiskey Spring is located approximately four miles southwest of town, in land managed by the Gallatin National Forest. The three wells are located within the town. According to the Source Water Protection Program (DEQ, 1999) the source water aquifer for the wells is considered to have **high sensitivity** to potential contamination, since the source aquifer is shallow unconsolidated alluvium. On the basis of the 1990 hydrogeologic investigation, the Whiskey Spring source aquifer is considered a deep fractured bedrock aquifer, which is considered to have **low sensitivity** to potential contamination.

As part of this assessment, three types of source water protection management areas were mapped for the Town of West Yellowstone public water system. They are: the control zone, the inventory region, and the recharge region. Potential sources of contamination were identified within each of these three regions and the results are as follows:

- No potential sources of contamination were identified within the control zones. 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 control zones are delineated as circles of 100-foot radius around the wellheads and spring box. The control zones should be isolated from traffic and passers-by, and all sources of potential contaminants should be excluded from the control zones.
- Two significant potential contaminant sources were identified within the inventory regions for the supply wells. The municipal sewer system is considered a potentially significant contaminant source. One underground storage tank (UST) was identified in the Well 3 inventory region. No significant potential contaminant sources were identified within the Whiskey Springs inventory region.
- While point sources of VOCs are not generally inventoried within the recharge region, it is appropriate to do so in West Yellowstone. There are many UST facilities present within the town. Several leaking UST sites are present within this region, and in an upgradient direction from the Well 2 inventory region. Municipal sanitary sewer lines are present within a minor portion of the recharge region. Septic density is low, and the majority of the land cover is evergreen forest.

Coliform bacteria have not been detected in the Town of West Yellowstone PWS water within the past five years. Nitrate has been detected at each of the four sources regularly (at an average concentration of 0.13 parts per million). This concentration is below the regulatory limit of 10 parts per million, and probably represents natural background levels.

Low risk potential sources and potential sources located outside the inventory region, but within the region that contributes recharge to the aquifer may still pose a threat over time, but are not considered in this assessment. This includes documented petroleum contamination of soil and groundwater present at

several locations within the town. The susceptibility analysis is intended to provide the operator with information on where the greatest risk occurs.

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

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1.0 INTRODUCTION

The primary purpose of this source water delineation and assessment report (SWDAR) is to provide information that helps the Town of West Yellowstone public water supply (PWS) protect its drinking water sources. The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies. The Town of West Yellowstone is a community PWS, as it serves more than 25 year-round residents.

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

Eric Sivers, a hydrogeologist with the Montana Department of Environmental Quality (DEQ) Source Water Protection Section, completed the Town of West Yellowstone (PWS ID No. MT0003136) Source Water Delineation and Assessment Report. Information on the West Yellowstone PWS was obtained from a Wellhead Protection Plan completed by the Town and the Hebgen Lake Ranger District of the US Forest Service (USFS) in 1997, and from DEQ's most recent sanitary survey (December 2003). Additional references are detailed at the end of this report.

2.0 BACKGROUND

The Town of West Yellowstone is located in Gallatin County in southwestern Montana, immediately west of Yellowstone National Park (Figure 1). According to the Census Bureau, the population of Gallatin County in 2000 was 67,831. The Town of West Yellowstone's population in 2000 was 1,177 residents. West Yellowstone's economy is dependent upon tourism, centering on the east-adjacent Yellowstone National Park and the surrounding Gallatin National Forest.

2.1 PHYSICAL SETTING

2.1.1 Geography and Geology

West Yellowstone sits in the Upper Madison River valley, at an elevation of approximately 6,660 feet above mean sea level. The town is located at the junction of US Highways 191/287 and 20, at the western margin of Yellowstone National Park.

The Upper Madison River valley extends over roughly 110 square miles of southwestern Montana. The drainage basin extends to the headwaters of the Madison River in Yellowstone National Park. The valley extends downriver through the Madison River Canyon to the debris dam created by the 1959 Hebgen Lake earthquake. The Upper Madison River valley is bordered by the Madison Range to the north, the continental divide to the south, the Madison River valley to the west, and for this report, the Montana-Wyoming border to the east (Kendy and Tresch, 1996). The major geographic features of the valley are the Madison River and Hebgen Lake.

The valley is underlain by unconsolidated glacial and alluvial deposits (Richmond, 1964). These deposits are approximately 200 feet thick, beneath which are a series of volcanic rocks (Hamilton, 1964). The mountains surrounding the basin are composed of metamorphic, sedimentary and igneous bedrock. South of West Yellowstone, the valley is bordered by rhyolitic volcanic rocks that originated in Yellowstone. The bedrock is generally less

permeable than the unconsolidated basin sediments, although fractures or carbonate dissolution features create significant local flow conduits.

2.1.2 Climate

Climate in the West Yellowstone area is wetter and colder than is typical of southwestern Montana. West Yellowstone is popularly known as one of the coldest places in Montana. Annual total precipitation is 21.56 inches, and occurs year round. West Yellowstone receives an annual average of 160 inches of snow, mainly from October to May. Climate data is provided by the Western Regional Climate Center, operated by the Desert Research Institute of Reno, Nevada. See Table 1 for additional climate information.

Table 1. Monthly Climate Summary: West Yellowstone Climate Station (248857)

Period of Record: 01/02/1924 to 02/26/2004

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Ave. Max. Temp (F)	24.2	30.8	38.0	47.6	59.3	68.5	79.2	77.2	66.4	52.5	34.5	25.3	50.3
Ave. Min. Temp. (F)	-0.2	2.5	8.7	19.7	28.7	35.3	39.6	37.2	29.4	22.1	10.3	1.8	19.6
Ave Tot. Precip. (in.)	2.14	1.72	1.72	1.53	2.05	2.37	1.50	1.37	1.48	1.54	1.95	2.20	21.56
Ave. Tot. Snowfall (in.)	32.9	26.6	23.3	10.7	3.3	0.6	0.0	0.1	1.1	7.3	22.9	31.8	160.4
Ave Snow Depth (in.)	30	38	38	21	1	0	0	0	0	1	7	18	13

2.1.3 Source Water

The Town of West Yellowstone PWS obtains water from two separate aquifer systems. The primary source is Whiskey Spring, which sits at the base of the Rhyolite Plateau volcanic flow, approximately four miles southwest of West Yellowstone. This unit represents the latest rhyolitic flow erupted from the Yellowstone thermal area (O'Neill and Christiansen, 2004). This is a conspicuous geologic and topographic feature, sharply rising above the valley some 400 feet. A 1990 hydrogeologic investigation by Braun Geotechnical Engineering (Appendix 4 of the 1997 Wellhead Protection Plan) included an annual water budget, from which a probable recharge area of 7.2 miles was calculated. The hydrogeologic investigation concluded that the spring water's thermal and chemical characteristics are indicative of a deep, regional groundwater source that is isolated from surface water.

Based on the depths of the three supply wells, they are assumed to derive water from alluvial and glacial deposits that line the basin floor to depths ranging up to 200 feet. A petroleum exploration well drilled 1.2 miles north of town in 1953 (Hamilton, 1964) encountered volcanic rocks at a depth of approximately 200 feet. The Yellowstone Airport PWS supply well reached volcanic rock at a depth of 190 feet. The deepest well within a five-mile radius of West Yellowstone is the town's Well 3 (222 feet), but no log was available from the MBMG database. Despite the possibility that this well may draw water from fractured volcanic bedrock present beneath the alluvial/glacial deposits, it will be considered to have the same source as Wells 1 and 2. To obtain detailed information on the groundwater hydrology beneath West Yellowstone, several groundwater monitoring reports submitted to the DEQ's Petroleum Release Section related to leaking underground storage tank (LUST) sites were reviewed. Groundwater flow beneath West Yellowstone appears to be generally consistent. The water table is generally in the area of 40 feet below the ground surface, and dips to the north-northwest at approximately 0.0028 ft/ft, or 15 feet per mile. Groundwater flow is uniformly 15º-20º west of north. In 2001, Atlatl, Inc. of Butte completed a

hydrogeologic investigation that included slug testing (a test of hydraulic conductivity performed by displacing a 'slug' of water and measuring the aquifer's response) of seven groundwater monitoring wells at a LUST site in town. The results of the slug tests yielded an average hydraulic conductivity of 3.4 feet per day. This rate is consistent with published values for the sediment types reported beneath West Yellowstone.

According to the Source Water Protection Program (DEQ, 1999) the source water aquifer for the wells is considered to have **high sensitivity** to potential contamination, since the source aquifer is shallow unconsolidated alluvium. In accordance with the 1990 hydrogeologic investigation, the Whiskey Spring source aquifer is considered a deep fractured bedrock aquifer, which is considered to have **low sensitivity** to potential contamination.

2.2 THE PUBLIC WATER SUPPLY

2.2.1 Water Supply System

Three wells and one spring provide groundwater to the system. The PWS distributes water through 461 service connections. The wells were not in production as late as the 2000 sanitary survey, but were connected to the system as a contingency. An underground reservoir located southwest of town provides 1,000,000 gallons of storage. According to the 2003 sanitary survey, a functional gas chlorination system is in place, but not in operation. The chlorination system was reportedly installed as a contingency for emergencies or changing PWS requirements. The Town of West Yellowstone PWS is classified as a community public water system since it serves more than 25 year-round residents.

2.2.2 Spring Source Information

Whiskey Spring is located approximately four miles southwest of town, in forest land managed by the USFS Gallatin National Forest. The spring is located at the base of a large rhyolite plateau, at the contact between fractured and weathered volcanic rock and an underlying clay unit, probably an older glacial moraine. According to the hydrogeologic investigation, the average discharge from the spring is 2,570 gallons per minute (gpm). The current spring collector box was installed in 1989.

2.2.3 Supply Well Information

Three wells provide additional water to the PWS. These wells are located in town, as illustrated on Figure 3. Wells 1 and 2 are located in the northern end of town; Well 3 is located at the southern end. Well 1 was completed to 121 feet in 1985; Well 2 was completed to 130 feet in 1984; Well 3 was completed to 222 feet at an unrecorded date. No construction details are available for Well 3. Both Well 1 and Well 2 are cased and grouted to 20 feet below grade, and are installed into sand; the screened interval was not recorded. According to the well logs, yields are 65 gpm (Well 1); 149 gpm (Well 2); and 100 gpm (Well 3). The well logs are attached as Appendix A.

2.3 WATER QUALITY

Each PWS performs regular sampling of its water supply to detect contamination. The analytical parameters for a community PWS include: coliform bacteria, nitrates, metals, petroleum hydrocarbons, and synthetic organic chemicals. The monitoring schedule depends on factors such as the type of PWS, type of source water, the number of supplies (e.g. wells or springs), and the population served. Monitoring programs are tailored to each system, following the general protocols defined by DEQ and the US EPA. Monitoring schedules are available online at:

<http://nris.state.mt.us/wis/swap/swapquery.asp>. The West Yellowstone PWS monitoring data from DEQ's database for the past five years was reviewed and is summarized in this section. Analytical results are reported in units of milligrams per liter (mg/L, equivalent to one part per million) or micrograms per liter (µg/L, equivalent to one part per billion). The results are compared to quality standards established by the US EPA. Maximum Contaminant Levels (MCLs) are enforceable standards limiting the amount of a contaminant in drinking water. National Secondary Drinking Water Standards (known as SMCLs) are non-enforceable guidelines regarding contaminants that may cause aesthetic (color, odor, taste) or cosmetic (staining, skin/tooth discoloration) issues.

2.3.1 Public Water Supply Monitoring Results

No violations are reported for the period from January 2000 to March 2005.

Bacteria have not been detected in the five-year period reviewed. Nitrate (NO_3) has been detected in each sampling event, and at each water source. The average nitrate concentration at Whiskey Spring is 0.10 mg/L. At Wells 1, 2 and 3, the average concentrations are 0.13 mg/L, 0.16 mg/L and 0.17 mg/L, respectively. The highest detected NO_3 level was from Well 3 in July 2004 (0.21 mg/L). These concentrations are below the MCL of 10 mg/L, and probably reflect background NO_3 levels in the aquifer. No other regulated analytes have been detected.

The only other detected parameter is fluoride, for which the EPA has established a SMCL of 2.0 mg/L. Each of the four water sources yields water with a fluoride concentration slightly over the SMCL. The average concentration at Whiskey Spring is 2.77 mg/L. At Wells 1, 2 and 3, the average concentrations are 2.83 mg/L, 2.85 mg/L and 3.10 mg/L, respectively. The water quality results are attached as Appendix B.

2.3.2 Background Water Quality Monitoring Results

Background water quality typically includes general water quality parameters: major dissolved ions (calcium, magnesium, sodium, potassium, iron, manganese, silica, bicarbonate, carbonate, chloride, sulfate, nitrate, fluoride and orthophosphate), trace elements, and metals. Background water quality data was identified for one water source: Well 3. The results are indicative of good-quality water. The water is "soft" (low calcium carbonate), and total dissolved solids are low. Although the Madison River commonly exhibits elevated arsenic due to natural sources in the Yellowstone caldera, the arsenic level is low (2.6 µg/L). The background water quality report for Well 3 is attached in Appendix B.

3.0 MANAGEMENT AREA DELINEATION

This report delineates three source water management areas. The goal of source water management is protection of the source water by 1) controlling activities in the control zone, 2) managing significant potential contaminant sources in the inventory region, and 3) ensuring that major land use activities or other significant activities in the recharge region pose minimal threat to the source water. Methods and criteria for delineating source water protection areas for public water supplies are specified in the Montana Source Water Protection Program (DEQ, 1999).

3.1 DELINEATION

Control Zone – A 100-foot radius control zone is delineated around each of the three wellheads and the spring box. Ideally, these regions would be isolated, and all sources of potential contaminants excluded.

Inventory Region – The inventory region is generally the area that is expected to contribute to the water supply over three years; this is sometimes referred to as a three-year capture zone. All potentially signification contaminant sources are inventoried in these regions. The inventory region for Whiskey Spring is based upon the 'recharge region' mapped in the 1990 hydrogeologic assessment (Figure 2). This was mapped on the basis of an annual water budget, and thus approximates a one-year capture zone. Given the remote location and protected setting of the spring and the area contributing to it, the DEQ Source Water Protection Section considers this area to be appropriate for the inventory region.

The inventory region for the three wells is delineated on the basis of a three-year time of travel. The groundwater velocity was calculated based upon measurements of hydraulic conductivity and effective porosity of aquifer materials. These values were assumed to be representative of the aquifer, and were input to the uniform flow equation, as specified in the Source Water Protection Program (DEQ, 1999). The delineated inventory regions for the wells are illustrated on Figure 3. The groundwater flow direction is extrapolated from site-specific groundwater flow measured at several detailed UST site investigations within the town of West Yellowstone. The groundwater time-of-travel calculations are attached as Appendix C.

Recharge Region – The recharge region is the area that contributes water to the source aquifers. This is essentially the Madison River watershed upgradient from the PWS sources. For the purposes of this report, the Yellowstone National Park border bounds the watershed (as shown on Figure 1).

4.0 INVENTORY

Significant potential contaminant sources in the source water management areas were inventoried to assess the susceptibility of West Yellowstone's source water to contamination, and to provide a foundation for source water protection planning. The inventory for the West Yellowstone PWS focuses on facilities or features that generate, use, store, or transport potential contaminants, as well as certain land uses in the inventory and recharge regions. It is important to remember that the sources identified in this section are only potential sources of contamination to the drinking water. Contamination of drinking water sources is less likely when potential contaminants are properly managed.

4.1 INVENTORY METHOD

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

- Step 1: The Montana State Library Natural Resources Information System (NRIS) GIS database was queried to identify septic land application sites, wastewater treatment plants, animal feeding operations, septic system density, sewer systems, and agricultural land uses.
- Step 2: The DEQ PWS files were reviewed to identify agricultural activities or wastewater treatment in the vicinity of the PWS.
- Step 3: The US Environmental Protection Agency's (EPA) Envirofacts System <http://www.epa.gov/enviro/> was queried to identify EPA-regulated facilities located in the management areas. This system accesses facilities listed in the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory System (TRIS), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) and the Permit Compliance System (PCS - for Concentrated Animal Feeding Operations with MPDES permits). The available reports

were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility should be classified as a significant potential contaminant source.

- Step 4: Montana DEQ databases were queried to identify any of the following in the management areas:

  Underground storage tanks (USTs) <http://www.deq.state.mt.us/UST/USTDownloads.asp>

  Hazardous waste contaminated sites, above ground storage tanks (ASTs), landfills, and abandoned and active mines, including gravel pits <http://nris.state.mt.us/gis/bundler/>

  Any information on past releases and present compliance status was noted.

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

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

4.2 INVENTORY RESULTS

4.2.1 Control Zone Inventory Results

No significant potential sources of contamination were identified within the 100-foot radius control zones. As a blanket statement, the control zones should be isolated from livestock, traffic, wildlife, and passers-by, and drainage away from the wellhead should be maintained.

4.2.2 Inventory Region Results

No significant potential point or nonpoint contaminant sources were identified within the Whiskey Spring inventory region. The entire inventory region is covered by evergreen forest.

One active UST facility was identified in the inventory region for Well 3. No active LUST facilities were identified within the inventory regions, although there are many present in town, upgradient of Wells 1 and 2. A sanitary sewer system is present in the inventory regions for the wells. Septic system density surrounding the town is low. No private agricultural uses were identified within the inventory regions. The majority of the land cover within the inventory regions is mapped as evergreen forest, although recent development is visible on aerial photos. Wells 1 and 2 are located in a residential neighborhood, and a portion of the inventory regions for these wells is mapped as mixed urban.

4.2.3 Recharge Region Results

The recharge region inventory is limited to certain land uses; PWS susceptibility to these uses is not assessed.

While point sources of VOCs are generally not inventoried within the recharge region, it is appropriate to do so in West Yellowstone. Numerous point sources of potential contaminants are present within the town, and close to the inventory region for Well 2. LUST sites with documented dissolved hydrocarbon plumes (gasoline/diesel and heating oil) are present in an upgradient direction from Well 2, as illustrated on Figure 3. These sites are actively monitored and the results are provided to the DEQ's Petroleum Release Section (PRS). Further information regarding these sites is available from PRS at http://www.deq.state.mt.us/rem/Index.asp. As a portion of the recharge region is within an urban setting, other potential contaminant sources associated with commercial activities that use, store, generate or transport potential contaminants may be present outside the inventory region.

No sources of long-term concern were identified in the Whiskey Springs recharge region. The recharge region is dominated by conifer forest, and septic system density is low. No point sources were identified within the Whiskey Springs recharge region.

5.0 SUSCEPTIBILITY ASSESSMENT

Susceptibility is the degree of likelihood for a public water supply to be impacted by inventoried contaminant sources. According to the DEQ Source Water Protection Program (DEQ, 1999), susceptibility is determined by considering the *hazard* rating for each significant potential contaminant source relative to any contaminant *barriers*. Proximity or density of significant potential contaminant sources and nature of contaminants determines hazard. Barriers to contamination are anything that decreases the likelihood of contaminants reaching a spring or well. No barriers were identified for the Town of West Yellowstone public water system.

The inventory results and management recommendations for the Town of West Yellowstone wells are provided in Table 2.

Table 2. Susceptibility Assessment of Significant Potential Contaminant Sources

Potential Contaminant Source	Potential Contaminants	Hazard	Hazard	Barriers	Susceptibility	Management Recommendations
Inventory Region						
Municipal Sewer Lines	Pathogens, nitrate (NO_3)	Ongoing or catastrophic leakage of sewage	Moderate	None	High	Ongoing inspection and maintenance with rehabilitation or replacement of existing sewer mains if necessary. Use sewer main liners. Develop rapid response plan for leaks or ruptures.
USTs and LUSTs	VOCs, petroleum hydrocarbons	Release of petroleum hydrocarbons to soil and groundwater	Moderate to low	Site cleanup, groundwater monitoring	Low	Review permit status; ensure proper operation and maintenance, emergency planning, training of local emergency response personnel, spill prevention, and BMPs. Properly abandon and remove tanks if out-of-service.
Commercial or industrial users, transporters, and generators of hazardous materials	Petroleum products: VOCs, SOCs and others	Spills or leaks of chemicals used	Low	Management actions	Low	Maintain sealed concrete floors. Ensure proper chemical and waste use, storage, and disposal/recycling. Ensure good housekeeping.
Class V Injection Wells	VOCs, SOCs, metals	Infiltration into groundwater	Unknown at this time	None	Unknown at this time	Work with EPA to identify locations and appropriate response.
Transportation Routes: Roads and Railroads	Pesticides, fertilizers, VOCs, SOCs, other	Spills, routine spraying, storm water runoff, infiltration into groundwater	Low	Emergency spill response	Low	Encourage and support emergency planning, training of local emergency response personnel, and cooperation with MDOT to reduce herbicide use.
Recharge Region						
USTs and LUSTs	VOCs, petroleum hydrocarbons	Release of petroleum hydrocarbons to soil and groundwater	Not assessed	Site cleanup, groundwater monitoring	Not assessed outside inventory region	Review permit status; ensure proper operation and maintenance, emergency planning, training of local emergency response personnel, spill prevention, and BMPs. Properly abandon and remove tanks if out-of-service.

6.0 LIMITATIONS

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

- Not every potential or existing source of groundwater or surface water contamination in the Town of West Yellowstone area has been identified. Consideration was limited to potential sources of contamination that are within the inventory regions and of a type determined by the DEQ to be significant.
- Delineation of the inventory regions was based upon previous field studies by other authors. The DEQ Source Water Protection Section accepts the results of these investigations and considers them an appropriate basis for preliminary source water delineation and assessment. Additional information specific to the PWS wells and their interactions with the aquifer would be recommended if a Source Water Protection Plan were to be pursued.
- Potential and documented point sources of petroleum hydrocarbons are present a short distance upgradient of the inventory region for Well 2. The PWS operators and stakeholders should be cognizant of potential contaminant sources that were not included in the assessed inventory for the West Yellowstone PWS.
- The potential contaminant sources described in the inventory are identified from readily available information, as described in Chapter 4. Consequently, unregulated activities or unreported contaminant releases may have been overlooked. Multiple data sources are used to increase the likelihood that major threats to the source water are identified. The inventory is not exhaustive. Absence of a potential contaminant in the inventory or susceptibility assessment of this report does not mean that the potential for contamination does not exist, or that there is no threat.

7.0 CONCLUSIONS

The Town of West Yellowstone's drinking water is supplied by a spring, and supplemented by three wells. Whiskey Spring is located approximately four miles southwest of town, in land managed by the Gallatin National Forest. The three wells are located within the town. According to the Source Water Protection Program (DEQ, 1999) the source water aquifer for the wells is considered to have **high sensitivity** to potential contamination, since the source aquifer is shallow unconsolidated alluvium. On the basis of the 1990 hydrogeologic investigation, the Whiskey Spring source aquifer is considered a deep fractured bedrock aquifer, which is considered to have **low sensitivity** to potential contamination.

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Coliform bacteria have not been detected in the Town of West Yellowstone PWS water within the past five years. Nitrate has been detected at each of the four sources regularly (at an average concentration of 0.13 parts per million). This concentration is below the regulatory limit of 10 parts per million, and probably represents natural background levels.

Low risk potential sources and potential sources located outside the inventory region, but within the region that contributes recharge to the aquifer may still pose a threat over time, but are not considered in this assessment. This includes documented petroleum contamination of soil and groundwater present at several locations within the town. The susceptibility analysis is intended to provide the operator with information on where the greatest risk occurs.

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

8.0 REFERENCES

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9.0 GLOSSARY

Aquifer. A water-bearing layer of rock or sediment that will yield water in usable quantity to a well or spring.

Barrier. A physical feature or management plan that reduces the likelihood of contamination of a water source from a potential contaminant source

Best Management Practices (BMPs). Methods for various activities that have been determined to be the most effective, practical means of preventing or reducing non-point source pollution.

Coliform Bacteria. A general type of bacteria found in the intestinal tracts of animals and humans, and also in soils, vegetation and water. Their presence in water is used as an indicator of pollution and possible contamination by pathogens.

Confined Animal Feeding Operation (CAFO). Any agricultural operation that feeds animals within specific areas, not on rangeland. Certain CAFOs require permits for operation.

Confined Aquifer. A fully saturated aquifer overlain by a confining unit such as a clay layer. The static water level in a well in a confined aquifer is at an elevation that is equal to or higher than the base of the overlying confining unit.

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

Delineation. The process of determining and mapping source water protection areas.

Geographic Information Systems (GIS). A computerized database management and mapping system that allows for analysis and presentation of geographic data.

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

Hazard. A relative measure of the potential of a contaminant from a facility or associated with a land use to reach the water source for a public water supply. The location, quantity and toxicity of significant potential contaminant sources determine hazard.

Hydraulic Conductivity. A constant number or coefficient of proportionality that describes the rate water can move through an aquifer material.

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

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

Maximum Contaminant Level (MCL). Maximum concentration of a substance in water that is permitted to be delivered to the users of a public water supply. Set by EPA under authority of the Safe Drinking Water Act to establish concentrations of contaminants in drinking water that are protective of human health.

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

Nitrate. An important plant nutrient and type of inorganic fertilizer that can be a potential contaminant in water at high concentrations. In water the major sources of nitrates are wastewater treatment effluent, septic tanks, feed lots and fertilizers.

Nonpoint Source Pollution. Pollution sources that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. Examples of nonpoint- source pollution include agriculture, forestry, and run-off from city streets. Nonpoint sources of pollution, such as the use of herbicides, can

concentrate low levels of these chemicals into surface and/or groundwaters at increased levels that may exceed MCLs.

Pathogens. A microorganism typically found in the intestinal tracts of mammals, capable of producing disease.

Point Source. A stationary location or a fixed facility from which pollutants are discharged. This includes any single identifiable source of pollution, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fracture, container, rolling stock (tanker truck), or vessel or other floating craft, from which pollutants are or may be discharged.

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

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

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

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

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

Source Water Delineation and Assessment Report (SWDAR). A report for a public water supply that delineates source water protection areas, provides an inventory of potential contaminant sources within the delineated areas, and evaluates the relative susceptibility of the source water to contamination from the potential contaminant sources under "worst-case" conditions.

Source Water Protection Areas. For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply. For groundwater sources, the area within a fixed radius or three-year travel time from a well, and the land area where the aquifer is recharged.

Static Water Level (SWL). Water level in a well when the pump is not operating.

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

Transmissivity. A number that describes the ability of an aquifer to transmit water. The transmissivity is determined by multiplying the hydraulic conductivity time the aquifer thickness.

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

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

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

FIGURES

APPENDIX A

WELL LOG AND PWS SANITARY SURVEY

Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
WEST YELLOWSTONE CITY OF * WELL #1

Plot this site on a topographic map

Location Information

GWIC Id:	106789	Source of Data:	LOG
Location (TRS):	13S 05E 27 CDAD	Latitude (dd):	44.6675
County (MT):	GALLATIN	Longitude (dd):	-111.1041
DNRC Water Right:	58320	Geomethod:	UNKNOWN
PWS Id:		Datum:	NAD27
Block:		Altitude (feet):	6660.00
Lot:		Certificate of Survey:	
Addition:	MADISON ADD	Type of Site:	WELL

Well Construction and Performance Data

Total Depth (ft):	121.00	How Drilled:	CABLE
Static Water Level (ft):	39.00	Driller's Name:	HAGGERTY
Pumping Water Level (ft):	95.00	Driller License:	WWC353
Yield (gpm):	65.00	Completion Date (m/d/y):	1/9/1985
Test Type:	PUMP	Special Conditions:	
Test Duration:	2.00	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 UNUSED

Well Notes: WELL IS NOT CURRENTLY USED. CAPABLE OF BEING TURNED ON IF SOMETHING HAPPENS TO CITY WATER AT WHISKY SPRINGS. WELL CASING HAS SOME KIND OF SEAL 20' DOWN.

Hole Diameter Information
No Hole Diameter Records currently in GWIC.

Annular Seal Information

From	To	Description
8.0	20.0	CEMENT

Lithology Information

From	To	Description
0.0	11.0	SAND
11.0	75.0	SAND AND CLAY MIX
75.0	85.0	CLEANER SAND
85.0	107.0	CLAY SAND MIX
107.0	110.0	HEAVING SAND
110.0	121.0	CEMENTED HARD

Casing Information[1]
No Casing Records currently in GWIC.

Completion Information[1]
No Completion Records currently in GWIC.

[1] - All diameters reported are **inside** diameter of the casing.

Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
WEST YELLOWSTONE CITY OF * WELL #2

Plot this site on a topographic map

Location Information

GWIC Id: 106788
Location (TRS): 13S 05E 27 CCCA
County (MT): GALLATIN
DNRC Water Right:
PWS Id:
Block:
Lot:
Addition: MADISON ADD.

Source of Data: LOG
Latitude (dd): 44.8166
Longitude (dd): -111.1108
Geomethod: UNKNOWN
Datum: NAD27
Altitude (feet): 6656.00
Certificate of Survey:
Type of Site: WELL

Well Construction and Performance Data

Total Depth (ft): 130.00
Static Water Level (ft): 44.00
Pumping Water Level (ft): 104.00
Yield (gpm): 149.00
Test Type: PUMP
Test Duration: 15.00
Drill Stem Setting (ft):
Recovery Water Level (ft):
Recovery Time (hrs):

How Drilled: CABLE
Driller's Name: HAGGERTY
Driller License: WWC353
Completion Date (m/d/y): 10/10/1984
Special Conditions:
Is Well Flowing?:
Shut-In Pressure:
Geology/Aquifer: Not Reported
Well/Water Use: DOMESTIC
UNUSED

Well Notes: WELL WAS INACCESSIBLE. HAS SOME KIND OF SEAL 20' DOWN. IS NOT CURRENTLY IN USE BUT CAN BE TURNED ON IF SOME- THING HAPPENS TO CITY WATER SUPPLY AT WHISKY SPRINGS.

Hole Diameter Information

No Hole Diameter Records currently in GWIC.

Casing Information[1]

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
-1.0	107.0	8.0				STEEL
107.0	117.0	8.0				STEEL

Annular Seal Information

From	To	Description
8.0	20.0	CEMENT

Completion Information[1]

From	To	Dia	# of Openings	Size of Openings	Description
107.0	117.0	8.0			40/1000 JOHNSON
117.0	120.0	8.0			TAILPIPE

Lithology Information

From	To	Description
0.0	12.0	SAND
12.0	75.0	SAND AND CLAY MIX
75.0	85.0	CLEANER SAND
85.0	107.0	SAND AND CLAY MIX
107.0	130.0	HEAVING SAND

[1] - All diameters reported are **inside** diameter of the casing.

Montana Bureau of Mines and Geology
Ground-Water Information Center Site Report
CITY OF WEST YELLOWSTONE

Plot this site on a topographic map
View Water Quality for this Site

Location Information

GWIC Id:	8959	Source of Data:	
Location (TRS):	13S 05E 34 CAAB	Latitude (dd):	44.6596
County (MT):	GALLATIN	Longitude (dd):	-111.1009
DNRC Water Right:		Geomethod:	TRS-TWN
PWS Id:		Datum:	NAD27
Block:		Altitude (feet):	6664.00
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

Well Construction and Performance Data

Total Depth (ft):	222.00	How Drilled:	
Static Water Level (ft):	43.00	Driller's Name:	
Pumping Water Level (ft):		Driller License:	
Yield (gpm):	100.00	Completion Date (m/d/y):	
Test Type:		Special Conditions:	
Test Duration:		Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	112ALVM
Recovery Time (hrs):		Well/Water Use:	UNUSED

Well Notes: NO ACCESS PORTS FOR MEASUREMENTS. PUMP COULD NOT BE TURNED ON. PUMP HAS BEEN OFF SINCE OCT. 1990. WELL IS IN PUMP HOUSE UNDER A LARGE RED PUMP.

Hole Diameter Information

No Hole Diameter Records currently in GWIC.

Casing Information[1]

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	0.0	8.0				STEEL

Annular Seal Information

No Seal Records currently in GWIC.

Completion Information[1]

No Completion Records currently in GWIC.

Lithology Information

No Lithology Records currently in GWIC.

[1] - All diameters reported are **inside** diameter of the casing.

APPENDIX B

WATER QUALITY ANALYTICAL REPORT

Ground-Water Information Center
Site Name: CITY OF WEST YELLOWSTONE

Water Quality Report
Report Date: 3/9/2005
Compare to Water Quality Standards

Location Information

Sample Id/Site Id: 1979Q3396 / 8959
Location (TRS): 13S 05E 34 CAAB
Latitude/Longitude: 44° 39' 34" N 111° 6' 3" W
Datum: NAD27
Altitude: 6664.00
County/State: GALLATIN / MT
Site Type: WELL
Geology: 112ALVM
USGS 7.5' Quad: WEST YELLOWSTONE 7 1/2
PWS Id:
Project: YNPW

Sample Date: 8/23/1979 9:50:00 AM
Agency/Sampler: MBMG / SMK
Field Number: WYO21
Lab Date: 3/21/1980
Lab/Analyst: MBMG / FNA
Sample Method/Handling: GRAB / 3120
Procedure Type: DISSOLVED
Total Depth (ft): 222.000
SWL-MP (ft): NR
Depth Water Enters (ft): NR

Major Ion Results

	mg/L	meq/L		mg/L	meq/L
Calcium (Ca)	5.200	0.259	Bicarbonate (HCO3)	44.800	0.734
Magnesium (Mg)	0.900	0.074	Carbonate (CO3)	0.000	0.000
Sodium (Na)	14.600	0.635	Chloride (Cl)	4.300	0.121
Potassium (K)	1.700	0.043	Sulfate (SO4)	2.400	0.050
Iron (Fe)	0.050	0.003	Nitrate (as N)	0.016	0.001
Manganese (Mn)	0.000	0.000	Fluoride (F)	3.800	0.200
Silica (SiO2)	41.400		Orthophosphate (OPO4)	NR	0.000
Total Cations		1.024	**Total Anions**		1.107

Trace Element Results (µg/L)

Aluminum (Al):	80.000	Cadmium (Cd):	NR	Mercury (Hg):	NR	Tin (Sn):	NR
Antimony (Sb):	NR	Chromium (Cr):	NR	Molybdenum (Mo):	NR	Titanium (Ti):	NR
Arsenic (As):	2.600	Cobalt (Co):	NR	Nickel (Ni):	NR	Thallium (Tl):	NR
Barium (Ba):	NR	Copper (Cu):	NR	Silver (Ag):	NR	Uranium (U):	NR
Beryllium (Be):	NR	Lead (Pb):	NR	Selenium (Se):	NR	Vanadium (V):	NR
Boron (B):	<20.	Lithium (Li):	0.055	Strontium (Sr):	NR	Zinc (Zn):	NR
Bromide (Br):	NR					Zirconium (Zr):	NR

Field Chemistry and Other Analytical Results

**Total Dissolved Solids:	96.510	Field Hardness as CaCO3:	NR	Ammonia (mg/L):	NR
**Sum of Diss. Constituents:	119.250	Hardness as CaCO3:	16.690	T.P. Hydrocarbons (µg/L):	NR
Field Conductivity (µmhos):	106.000	Field Alkalinity as CaCO3:	NR	PCP (µg/L):	NR
Lab Conductivity (µmhos):	128.700	Akalinity as CaCO3:	36.740	Phosphate, TD (mg/L as P):	NR
Field pH:	7.000	Ryznar Stability Index:	11.158	Field Nitrate (mg/L):	NR
Lab pH:	7.280	Sodium Adsorption Ratio:	1.570	Field Dissolved O2 (mg/L):	NR
Water Temp (°C):	NR	Langlier Saturation Index:	-1.939	Field Chloride (mg/L):	NR
Air Temp (°C):	NR	Nitrite (mg/L as N):	NR	Field Redox (mV):	NR

Notes

Sample Condition:
Field Remarks: WYG-97 * SUPPLIES CITY OFFICES ETC * WELL LOCATED ON SOUTH SIDE OF UNION PACIFIC R.R. NEAR BLACK (65000 GAL) H2O TOWER *
Lab Remarks:

Explanation: **mg/L** = milligrams per Liter; **µg/L** = micrograms per Liter; **ft** = feet; **NR** = No Reading in GWIC

Qualifiers: **A** = Hydride atomic absorption; **E** = Estimated due to interference; **H** = Exceeded holding time; **K** = Na+K combined; **N** = Spiked sample recovery not within control limits; **P** = Preserved sample; **S** = Method of standard additions; ***** = Duplicate analysis not within control limits; ****** = Sum of Dissolved Constituents is the sum of major cations (Na, Ca, K, Mg, Mn, Fe) and anions (HCO3, CO3, SO4, Cl, SiO2, NO3, F) in mg/L. Total Dissolved Solids is reported as equivalent weight of evaporation residue.

APPENDIX C

GROUNDWATER TIME-OF-TRAVEL CALCULATIONS

APPENDIX D

UST / LUST DATABASE SEARCH RESULTS

APPENDIX E

1997 WELLHEAD PROTECTION PLAN

APPENDIX F

CONCURRENCE LETTER

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