Helena Water Utilities
Public Water System

PWSID # MT0000241

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Report Date: 05/21/03
Revision Date 03/26/2012

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HELENA WATER UTILITIES EXECUTIVE SUMMARY

The Helena Water Utilities Source Water Delineation and Assessment Report was prepared under the requirements and guidance of the Federal Safe Drinking Water Act and the US Environmental Protection Agency, as well as a detailed Source Water Assessment Plan developed by a statewide citizen's advisory committee here in Montana. The Department of Environmental Quality (DEQ) is conducting these assessments for all public water systems in Montana. The purpose is to provide information so that the public water system staff/operator, consumers, and community citizens can begin developing strategies to protect your source of drinking water. The information that is provided includes the identification of the area most critical to maintaining safe drinking water, i.e., the Inventory Region, an inventory of potential sources of contamination within this area, and an assessment of the relative threat that these potential sources pose to the water system.

To meet the City of Helena's daily water needs, the Helena Water Treatment Division operates two surface water treatment plants, the Missouri River Treatment Plant and the Tenmile Water Treatment Plant. The Missouri River Water Treatment Plant whose source is the Missouri River east of Helena is operated during summer months for peak demands and for the primary water supply during drought conditions throughout the year. A siphon pipe is located in the Missouri River on the down-stream side of Canyon Ferry Dam. Water is pumped into the siphon pipe and then flows by gravity through the Helena Valley Canal Tunnel and into the Helena Regulating Reservoir where the actual intake for the Missouri River is located. In 1997, the Helena Water Utilities Public Water System (PWS) was evaluated and it was determined that rehabilitation of the existing Missouri River Treatment Plant (MRTP) would be completed in phases over the next ten years. In 2003 and 2004, the Missouri River Treatment Facility underwent a complete renovation of its eight multi-media water filters. In 2011, the MRTP well was taken off line and the piping to the plant removed. This well will be properly abandoned in the future. On the upper east side of Helena, the new four million-gallon Nob Hill Reservoir, pumping station, and additional supply pipelines for the reservoir have been completed and are currently in service. The Tenmile Water Treatment Plant, located west of Helena and whose source is the Tenmile Creek drainage, is operated year round. Additional water is obtained from the Hale system, which consists of the Eureka well collector located at Cruse and Park Streets.

The Helena water distribution system consists of six finished water storage reservoirs (Malben, Winnie, Hale, Upper Hale, Nob Hill, and Woolston) and six pumping stations (Forrest Estates, Hale, Eureka, Dahlhausen, Nob Hill, and Reeders Village) linked together with 185 miles of water transmission and distribution pipelines. The Chessman and Scott Reservoirs in the Tenmile watershed also provide additional water for the Tenmile Water Treatment Plant (WTP) during low stream flows. These reservoirs are filled with spring runoff water. Water for the Helena PWS is treated via a series of steps that are described in further detail in the report.

Since Helena obtains its drinking water from both surface water sources, and from groundwater wells that are completed in either shallow fractured bedrock or alluvium, in accordance with the Montana Source Water Protection Program criteria (1999), the source water is considered to have a high sensitivity to potential contaminant sources. Sensitivity is defined as the relative ease that contaminants can migrate to source water through the natural materials.

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. 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 public water supply well or intake. The susceptibility analysis provides the community and the public water system with information on where the greatest risk occurs and where to

focus resources for protection of this valuable drinking water resource.

Depending on the water source, source water protection management regions including control zones, inventory regions, spill response regions, recharge regions, and watershed regions were identified for the Helena Water Utilities PWS water sources.

- 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 zone is delineated as a 100-foot radius around the well and all sources of potential contaminants should be excluded in this region.

- The goal of management in the inventory region is to prevent contaminants from reaching the well before natural processes reduce their concentrations. If the source water is unconfined, the inventory region includes the area of land overlying the aquifer that is expected to supply groundwater recharge to the well over the next three years.

- The goal of management in the spill response region is to prevent releases of contaminants where they can be drawn directly into a water intake within a short time.

- The goal of management in the recharge region is to maintain and improve water quality over long periods of time or increased usage. The recharge region includes all land overlying the aquifer but outside of the inventory region.

- The goal of management in the watershed region, which is much larger area to manage, will be to protect the long-term quality of drinking water sources from large point contaminant sources (e.g. lead smelter) and non-point sources (cultivated cropland).

- The goal of management in the surface water buffer is to avoid introducing nitrates and microbial contaminants into surface waters that are hydraulically connected to aquifers that are the sources of drinking water. The surface water buffer includes ½-mile buffers around the surface waters that are within the three year time-of-travel of a public water supply well and will extend 10 miles upstream from the groundwater zone of contribution or to the watershed limits, whichever distance is shorter.

Because Helena obtains its drinking water from both surface water sources and, as demand dictates, from groundwater wells that are completed in either shallow fractured bedrock or alluvium, the source water sensitivity is classified as highly sensitive to contamination, in accordance with Montana Source Water Protection Program aquifer sensitivity criteria.

The specific source water management regions for each of Helena's water sources have been identified as part of this assessment and a summary of each is as follows:

Tenmile Creek Drainage

Source water protection management regions for the Tenmile Creek Drainage include control zones around each well and a combined inventory/ watershed region that includes the surface water intakes. Land cover within this drainage consists primarily of forests and a minor amount of agriculture. No significant potential contaminant sources were identified within the 100-foot control zones for the Tenmile Creek wells. Significant potential contaminant sources identified within the inventory region/ watershed include septic systems, underground storage tank (UST), a Federal Superfund Site, other mine sites, and gravel roads. It should also be noted that erosion due to increased road development or catastrophic forest fire could increase sediment loads into Tenmile Creek. The overall susceptibility of these water sources to septic

systems, mine sites, and gravel roads would be very high. The overall susceptibility to the UST would be high, and the overall susceptibility to the Federal superfund site would be moderate.

Eureka Well

A control zone and a combined Inventory/ Recharge Region were delineated for this well. Potential contaminant sources identified in the Eureka well 100-foot control zone include municipal sewer mains and city streets. Land cover in the combined inventory/ recharge region is primarily forestland. Significant potential contaminant sources identified in the for the Eureka well inventory/ recharge region include septic systems, municipal sewer mains, historic mine sites, knife making shop, and photo shop. The overall susceptibility of the drinking water to these potential contaminant sources is very high.

Missouri River Siphon

A spill response region and watershed region were delineated for the Missouri River siphon. Land cover in the siphon spill response region consists primarily of grasslands, Canyon Ferry Lake, and forestland. Significant potential contaminant sources identified in the spill response region include, Canyon Ferry Power Plant, septic systems, an above ground fuel storage tank, a UST, historic mine sites, and other potential contaminant sources. It should be noted that a mine site along Cave Gulch although not captured in the spill response region may be contributing metals to runoff water that flows into Canyon Ferry Lake. It should also be noted that increased road development and catastrophic forest fires in the vicinity of the siphon could contribute additional sediments to the surface water. The overall susceptibility of the siphon to the power plant, septic systems, and above ground fuel storage tank is high. The overall susceptibility to the mine sites and other potential contaminant sources in the vicinity is moderate. The susceptibility to the UST is low.

The Missouri River Siphon Watershed Region consists primarily of grasslands, evergreen forests, agricultural land, and open water. In addition to the potential contaminant sources identified in the spill response region there are additional mine sites, an additional UST, U.S. Highway 287, and a petroleum pipeline. Overall, septic system density is low in the watershed. There are however localized areas of moderate septic density along Canyon Ferry Lake.

The costs associated with contaminated drinking water are high. Developing an approach to protect that resource will reduce the risks of a contamination event occurring. In this report, the local geology and well construction issues have been summarized as they pertain to the quality of your drinking water source. The areas believed to be most critical to preserving the Helena Water Utilities water quality have been identified and the potential sources of contamination within each of these areas have been identified. Additionally, recommendations are provided, i.e., Best Management Practices, regarding the proper use and practices associated with some common potential contamination sources. Public awareness is a powerful tool for protecting drinking water. The information in this report will help the Helena Water Utilities increase public awareness about the relationship between land use activities and drinking water quality.

INTRODUCTION

Carolyn DeMartino, a Water Quality Specialist with the Montana Department of Environmental Quality, completed the Helena Water Utilities Public Water System (PWS) Source Water Delineation and Assessment Report (SWDAR). A special "Thank You" goes to Donald Clark, Helena Water/Wastewater Treatment Superintendent and Jason Fladland, Water Supervisor; for their assistance to make this a complete and accurate report.

Purpose

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the City of Helena 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 to provide information that helps the Helena Water Utilities PWS to protect its drinking water source.

Limitations

This report was prepared to assess potential impacts from potential contaminant sources to the Helena Water Utilities public water supply and is based on information obtained from the water operators, published information, and others familiar with the community. The terms "drinking water supply" or "drinking water source" refer specifically to the source of the Helena Water Utilities public water supply and not to any other public or private water supply. Not every potential or existing source of groundwater or surface water contamination in the area of the Helena Water Utilities PWS has been identified. Only potential sources of contamination in areas that contribute water to its drinking water source are considered.

The term "contaminant" is used in this report to refer to constituents that have maximum concentration levels (MCLs) 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 City of Helena is located in Lewis and Clark County. Helena is the county seat of Lewis and Clark County and it is the Montana state capital (Figure 1). Historically, Helena began as a mining town in 1864 when gold was discovered in Last Chance Gulch, the location of the present uptown business district. Today, Helena's economy relies heavily on state and federal government offices, St. Peter's Hospital, and retail businesses. According to the Census Bureau, the population of Lewis and Clark County in 2010 was 63,395 including the population of Helena, which was at 28,190 (in city only) or at 44,300 (including the Southeast Valley & West Central Valley).

The major transportation routes in the Helena area are U.S. Interstate 15, U.S. Highway 12, and U.S. Highway 287. Montana Rail Link transports freight on the former Burlington Northern tracks that run east and west through Helena. The Helena Regional Airport provides daily air service to Helena and surrounding communities.

Helena is served by a municipal sanitary sewer system. The wastewater treatment plant is located north of Custer Avenue. There are over 146 miles of sanitary sewer line, 2000 utility ports, and three lift stations in Helena that collect and transport wastewater to the treatment plant. Private septic system use continues in some outer areas of Helena.

Geographic Setting

Helena is located in an intermontane basin in west central Montana just east of the Continental Divide. The Helena valley slopes gently from the south and west towards an area of lower elevation near Lake Helena. The climate in the Helena area is considered semi-arid. Average daily maximum and minimum temperatures in Helena are 82.4° F and 53.3° F in July and 29.5° F and 11.1° F in January. Annual average precipitation is 11.99 inches with the wettest months being May and June. An annual average of 51.3 inches of snow is received in the Helena area mainly from November to April (Western Regional Climate Center, Monthly Climate Summary 7/1/1948 to 12/31/2001).

Elevations in the Helena area range from 3,600 feet near Lake Helena to over 9,000 feet in the nearby mountains. Four major geographic features surround Helena (Thamke, 2000). The North Hills are located about 12 miles north of Helena, the Scratchgravel Hills and Western Mountains are located to the west, and the South Hills are located south of Helena (Figure 2). Numerous faults including the Scratchgravel Fault, Silver Creek Fault, Helena Valley Fault, Eldorado Fault, Spokane Hills Fault, Regulating Reservoir Fault, Spokane Bench Fault, and Bald Butte Fault Zone bound the Helena Valley (Figure 3a).

Surface water drains from the surrounding hills and mountains via Tenmile, Sevenmile, Silver, and Prickly Pear Creeks. All surface water in the Helena Valley flows toward the lowest elevation at Lake Helena. Lake Helena then discharges into Hauser Reservoir behind the dam on the north flowing Missouri River.

General Source Water Description

The City of Helena obtains its drinking water primarily from surface water intakes located along the Tenmile Creek drainage. Water is also obtained from springs located in Oro Fino Gulch and a well located near the intersection of Park and Cruse Avenues in Helena. During summer months, water is also obtained from the Missouri River via a large siphon pipe located on the downstream side of Canyon Ferry Dam. Figure 4 shows the approximate locations of the Helena water sources. Figure 5, Figure 6, and Figure 7, respectively depict the Tenmile Creek Drainage, Eureka/ Oro Fino area, Missouri River area, and Missouri River Treatment Plant Area in greater detail.

The Tenmile Creek drainage, the Eureka/ Oro Fino area, the segment of the Missouri River, including Canyon Ferry Lake, and all the Helena PWS wells are located in the Upper Missouri Watershed. The hydrologic unit code (HUC) for the watershed is 10030101. The land area covered by the Upper Missouri Watershed is approximately 3,362.57 square miles.

The headwaters of Tenmile Creek originate in the western mountains. The Tenmile Creek drainage to the Helena Water Supply Intake is classified as A-1 water. This means that the water is to be maintained suitable for drinking, culinary, and food processing purposes after conventional treatment for removal of naturally present impurities. The water must also be maintained suitable for bathing, swimming and recreation, growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply [ARM 17.30.622 (1) & (2)].

Stream flow data was obtained from the United States Geological Survey (USGS) gauging station 06062500, located on Tenmile Creek, near the town of Rimini. Based on stream gauging data collected from 1914 through 2001, the mean monthly discharge at this station varied from 1.34 cubic feet per second (cfs) in February to 84.5 cfs in May. The average annual streamflow recorded at this station from 1915 through 1998 varied from a low of 3.6 cfs in 1977 to a high of 53.1 cfs in 1917. The mean monthly discharge at USGS gauging station 06062750, located on Tenmile Creek at the Tenmile Creek Water Treatment Plant varied from 106 cfs in February to 88.0 cfs in May. The average annual streamflow recorded at this station in 1998 was 20 cfs. No water quality data was indicated at either of these stream gauge stations.

The headwaters of the Missouri River are located near Three Forks, Montana where the Jefferson, Madison, and Gallatin rivers converge. Both the mainstream of the Missouri River and Canyon Ferry Lake are classified as B-1 waters. This means that these waters are to be maintained suitable for drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply [ARM 17.30.623 (1)].

Stream flow data for the mainstream of the Missouri River and Canyon Ferry Lake has not been included in this report because Canyon Ferry Dam artificially controls stream flow along this segment of the Missouri River and the level in Canyon Ferry Lake.

The Public Water Supply

The Helena PWS is classified as a community PWS because it serves 31,005 residents through 10,240 active service connections (DEQ SDWIS Database). The following description of the Helena PWS is taken from the Helena Water Treatment Division's 2002 Annual Water Quality Report. To meet Helena's daily water needs, the Helena Water Treatment Division operates two surface water treatment plants. The Missouri River Water Treatment Plant whose source is the Missouri River east of Helena is operated during summer.

months for peak demands and for the primary water supply during drought conditions throughout the year. The Tenmile Water Treatment Plant, located west of Helena and whose source is the Tenmile Creek drainage, is operated year round. Additional water is obtained from the Hale system, which consists of the the Eureka well collector located at Cruse and Park Streets.

The Helena water distribution system consists of six finished water storage reservoirs (Malben, Winnie, Upper Hale, Lower Hale, Nob Hill, and Woolston 2) and six pumping stations (Forrest Estates, Hale, Eureka, Dahlhausen, Nob Hill, and Reeders Village) linked together with 185 miles of water transmission and distribution pipelines. The Chessman and Scott Reservoirs in the Tenmile watershed also provide additional water for the Tenmile Water Treatment Plant (WTP) during low stream flows. These reservoirs are filled with spring runoff water.

In 1997, the Helena Water PWS system was evaluated and it was determined that the existing Missouri River Treatment Plant (MRTP) should be either rehabilitated or replaced. Rehabilitation of this water treatment plant will be completed in phases over the next ten years. On the upper east side of Helena, the new four million-gallon Nob Hill Reservoir, pumping station, and additional supply pipelines for the reservoir have been completed and are in service.

Water for the Helena PWS is treated via a series of steps. First aluminum sulfate and cationic polymer are added to the influent water, causing small particles to adhere to each other and making them heavy enough to settle into a basin from which sediment is removed. At the Tenmile Water Treatment Plant, these particles attach to small plastic media. The particles as sediment are then flushed to waste ponds. The water is then filtered through layers of fine coal and silicate sand, which removes the suspended particles. Chlorine, which is used as a disinfectant, is then added after filtration to the clear well. During filtration turbidity is removed and clear water emerges. Prior to the water being distributed to town, a small amount of chlorine is added again to ensure the water remains free of viruses or bacteria.

In 2003 and 2004, the Missouri River Water Treatment Facility underwent a complete renovation of its eight multi-media water filters (personal communication, D. Clark, October 25, 2004). The filters remove any remaining sediment out of the water. The filter to waste upgrade allows treated water that may not be up to water quality standards to be by-passed to waste ponds until water quality standards are met.

Additional information about this water system is available upon request from the Helena Water Department or DEQ.

Water Quality

As a community PWS, the Helena Water Utilities PWS is required to conduct routine monitoring of the drinking water for contaminants in accordance with the Federal Safe Drinking Water Act. Chlorine residuals, turbidity, pH, temperature, and color are monitored daily. Bacteria (total coliform) are monitored weekly. Trihalomethanes are monitored quarterly. Inorganic, volatile organic chemicals (VOCs), synthetic organic chemicals (SOCs), and nitrates are monitored annually. Lead and copper are monitored every three years and radioactivity is monitored every four years.

According to the DEQ Safe Drinking Water Information System, there have been three detections of coliform bacteria (9/03/2008, 9/10/2008, and11/12/2009) in the drinking water within the past five years. Within the past five years the concentration of nitrate detected in the drinking water has ranged from 0.68 mg/L (7/07/2009) to 1.58 mg/L (02/01/2012). The EPA's Maximum Contaminant Level (MCL) for nitrate is 10 mg/L.

Historically, groundwater monitoring results indicate that the Helena Valley groundwater is primarily a calcium bicarbonate type water (Moreland and Leonard, 1980).

CHAPTER 2 DELINEATION

The source water protection areas for the Helena PWS are delineated in this chapter. The purpose of delineation is to map the sources of Helena's drinking water supply and to define areas within which to prioritize source water protection efforts.

Three types of management regions are delineated for the Helena wells; they are the control zone, inventory region, and recharge region. The control zone is an area with a 100-foot radius around the wells. The management goal of the control zone, also known as the exclusion zone, is to protect against the direct introduction of contaminants into the wells or in the immediate area surrounding each well. The inventory region represents the zone of contribution to the wells. The management goal of the inventory region is to focus on pollution prevention activities at significant potential contaminant sources and to prevent contaminants from reaching a well before natural processes reduce their concentrations. The recharge region represents the entire portion of the aquifer that contributes water to the Helena PWS wells. Management within the recharge region should focus on maintaining and improving the quality of groundwater that could reach the wells over longer timeframes or with increase usage.

Two types of management regions are delineated for the Helena PWS surface water intakes; they are the spill response region and the watershed region. The spill response region represents the area of surface water upstream of the Helena PWS intakes in which contaminants could be drawn into the intakes in a relatively short period of time. The watershed region represents the entire region that is upstream of, and contributes water to the Helena PWS intakes.

In some cases, the source water protection areas for the groundwater wells and surface water intakes have been modified based on the hydrogeologic conditions at their specific locations.

Hydrogeologic Conditions

The Helena Valley is an intermontane basin, filled with a thick accumulation of unconsolidated material (Moreland and Leonard, 1980). This unconsolidated material is divided into three categories: 1) Tertiary-aged deposits composed primarily of volcanic derived (lake bed) clays interbedded with thin layers of sand, gravel, and lignite; 2) gravels of Pliocene age deposited locally on top of the lake bed deposits; and 3) Quaternary age deposits consisting of clay, silt, sand, gravel, and cobbles carried into the valley mainly by streams and deposited as alluvial fans.

Folded and faulted Paleozoic limestone, shale, and quartzite layers, more than 5,000 feet in total thickness, are exposed in the mountains south of Helena. These sedimentary rocks were metamorphosed by intrusion of the adjacent Boulder Batholith. Folded pre-Cambrian sedimentary rocks form the other mountains that surround the area (Lorenz and Swenson, 1951).

The primary aquifers in the Helena Valley are alluvial deposits, the underlying Tertiary valley-fill or lake-bed deposits, fractured volcanic intrusive rocks and carbonate rocks. The alluvial deposits are unconsolidated and unconfined. The Tertiary deposits are semi-confined, and in some areas of the valley produce large amounts of water. Wells drilled into deposits of coarse boulders, cobbles, welded tuffs along the southern margin of the valley yield smaller quantities of water to area wells and springs.

Groundwater flow in the Helena Valley is generally north-northeast towards Lake Helena, which is the natural groundwater discharge point in the valley (Wilke and Coffin, 1973). Depth to groundwater varies seasonally throughout the Helena Valley. The magnitude and timing of the seasonal fluctuations are

dependent upon the source of recharge. Water levels in most of the valley appear to be highest in July or August in response to widespread irrigation. Water levels in wells located near stream channels are at their highest during the spring snowmelt. High water-table conditions characterize a broad area in the northeastern part of the valley (Moreland and Leonard, 1980). During June 2001, private residences in the north Helena Valley experienced dry wells or water shortages (Lewis and Clark Water Quality District, 2001). Future studies will be conducted to determine if this is due solely to the number of years of drought conditions in the valley or if it is due to overuse of the aquifer.

The Tenmile Creek drainage is Helena's primary source of drinking water. The headwaters for Tenmile Creek are located in the Western Mountains. Tenmile creek flows through Cretaceous-aged granitic intrusive rocks and Elkhorn Volcanics (Figure 3). Recharge to Tenmile Creek occurs in the form of direct precipitation and snowmelt runoff flowing into the creek.

Additional drinking water is obtained, as needed, during the summer months from the Missouri River. A siphon pipe is located in the Missouri River on the down-stream side of Canyon Ferry Dam. Water is pumped into the siphon pipe and then flows through the Helena Valley Canal Tunnel and into the Helena Regulating Reservoir where the actual intake for the Missouri River is located. The headwaters of the Missouri River are located near Three Forks where the Jefferson, Madison, and Gallatin Rivers meet. River flow is controlled by the numerous irrigation diversions and hydroelectric dams along the river. Snowmelt, direct precipitation, surface runoff, and lateral inflow from alluvial and bedrock aquifers contribute to flow in the Missouri River. The Missouri River loses water via infiltration to the adjacent alluvium, evapotranspiration, and irrigation water withdrawals.

Helena also obtains drinking water from springs located in Oro Fino Gulch. According to the lithologic drill-hole log, the springs are flowing from the Madison Formation (Figure 3a). Two wells located along Tenmile Creek and a well located near the Missouri River Treatment Plant also provide drinking water to the Helena PWS as needed. The Tenmile Creek wells appear to be completed in fractured Cretaceous-aged granitic intrusive rocks and Elkhorn Volcanic rocks along the creek (Figure 3). According to the well log, the well near the Missouri River Treatment Plant is completed in Quaternary alluvium (Figure 3b).

Since Helena obtains its drinking water from both surface water sources and, as demand dictates, from groundwater wells that are completed in either shallow fractured bedrock or alluvium, the source water sensitivity is classified as highly sensitive to contamination, in accordance with Montana Source Water Protection Program aquifer sensitivity criteria (Table 1).

Table 1. Source Sensitivity Criteria (DEQ, 1999)

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

Source Water Information

Due to the complexity of the system, the Helena Water Utilities PWS wells and surface water intakes have been divided into their associated drainages. Depending on the season, some of the storage facilities, such as the two Winnie Tanks and the Knob Hill Tank, may store water from the Missouri River.

Ten Mile Creek Drainage

Source Description	Source ID
Ten Mile Intake	IN003
Ten Mile Treatment Plant	TP003
Well 2 - Ten Mile Creek	WL003
Well 3 – Ten Mile Creek	WL004
Clear Well – Ten Mile TP	CW003
Intake – Moose Creek	IN006
Intake 3 – Beaver Creek	IN004
Intake 4 – Minnehaha Creek	IN005
Intake 6 – Walker Creek	IN007
Chessman Reservoir	RS002
Scott Reservoir	RS003
Malben	ST005
Woolston 2	ST004
Storage – Winnie 1	ST006
Storage – Winnie 2	ST007

Eureka / Hale

Source Description	Source ID
Eureka Well Treatment Plant	WL002/ TP001
Upper Hale Reservoir	ST001
Lower Hale Reservoir	ST002

Missouri River

Source Description	Source ID
Chemical Feed Building TP	Chem Feed
Intake-Missouri River Plant	IN002
MRTP- Clear Well	CW001
MRTP- Clear Well 2	CW002
Missouri River Plant	TP002
Missouri River Siphon	Siphon
Helena Regulating Reservoir	RS001
Knob Hill Reservoir	ST008

The Tenmile Creek drainage is located approximately 10 miles west of Helena. Surface water intakes 2 through 6 are located in this drainage and include: the Ten Mile Creek Intake 2 (IN002), Beaver Creek Intake 3 (IN004), Minnehaha Creek Intake 4 (IN005), Moose Creek Intake 5 (IN006), and Walker Creek Intake (IN007). Scott Reservoir, Chessman Reservoir, and the proposed Travis Reservoir are also located in the Tenmile Creek drainage (Figure 5).

The Eureka Well and Hale Reservoir are located southwest of Helena (Figure 6).

The Missouri River and Canyon Ferry Lake are located approximately 20 miles east of Helena. The siphon, which pumps water from the river into the Helena Valley Canal and eventually into the Helena Regulating Reservoir, is located on the downstream side of Canyon Ferry Dam (Figure 7). The Knob Hill Reservoir is located on the southeast side of Helena.

Data for the Helena wells, where available, is summarized in Table 2. Available well logs are presented in Appendix A.

Table 2. Helena Well Data Summary

Information	Eureka Well	Well No. 2 Ten Mile Creek	Well No. 3 Ten Mile Creek
PWS Source Code	WL002	WL003	WL004
Well Location (T, R, Sec)	T. 9 N., R. 7 E., Sec. 07 SW¼ SE¼SE¼ (DDC)	T. 9 N., R. 7 E., Sec. 07 SW¼ SE¼SE¼ (DDC)	T. 9 N., R.5 W., Sec. 04 NW¼NW¼SE¼SE¼ (DDBB)
Latitude/ Longitude	46.5822/-112.0454	46.5482/ -110.8883	46.5629/ -112.2301
MBMG No.	62945	166716	63003
Water Right No.	N/A	N/A	N/A

Date Well Completed	0101/1933	01/20/1998	07/09/1946
Total Depth (feet)	42’	55’	60’
Perforated Interval	N/A	40 - 55’	NA
Static Water Level	40’	14.50’	50’
Pumping Water Level	N/A	38.50’	N/A
Drawdown	N/A	24’	NA
Test Pumping Rate	N/A	N/A	N/A
Specific Capacity	N/A	6.25’	NA
Geologic Formation	Meagher Limestone	N/A	Upper Cretaceous Plutonic Rock

* N/A- Not available

Conceptual Model and Assumptions

The City of Helena is located in the Helena Valley, an intermontane basin. The basin is filled with a thick accumulation of unconsolidated material ranging in age from oldest to youngest, volcanic derived Tertiary deposits, Pliocene gravels, and Quaternary-aged deposits of clay, silt, sand, gravel, and cobbles. Four major geographic areas surround the valley and include the North Hills, approximately 12 miles north of Helena, the Scratchgravel Hills and Western Mountains located to the west, and the South Hills located south of Helena. Major faults including the Scratchgravel Fault, Silver Creek Fault, Helena Valley Fault, Eldorado Fault, Spokane Hills Fault, Regulating Reservoir Fault, Spokane Bench Fault, and Bald Butte Fault Zone also bound the Helena Valley. The metamorphosed, folded, and faulted Paleozoic limestone, shale, and quartzite layers exposed in the mountains south of Helena resulted from the intrusion of the adjacent Boulder Batholith. Folded pre-Cambrian sedimentary rocks form the other mountains that surround the area.

Helena obtains its drinking water primarily from two surface water sources, the Tenmile Creek Drainage and the Missouri River. Drinking water is also obtained, on an as needed basis, from the Eureka well/ Oro Fino Gulch springs, and from two wells located along Tenmile Creek. All of these Helena PWS water sources are located in the Upper Missouri River Basin, which covers approximately 3,362.57 square miles. According to the well logs, the wells installed along Tenmile creek appear to be completed in weathered volcanic or intrusive rocks, the Eureka well is completed in Meagher Limestone, and the springs in Oro Fino Gulch are flowing from the Madison Formation.

Recharge to Tenmile Creek occurs in the form of direct precipitation, snowmelt water runoff flowing into the creek, and loss of water from nearby irrigation canals. Snowmelt, direct precipitation, surface runoff, and lateral inflow from alluvial and bedrock aquifers contribute to flow in the Missouri River. Recharge to the springs and the wells that supply drinking water to the Helena PWS occur in the form of precipitation percolating into fractured bedrock, from losing streams, and from irrigation ditch leakage.

Contaminants, if released upstream of the intakes on Tenmile Creek or directly into the Missouri River at the siphon, could potentially reach the intakes before the water operators could close them. Over longer periods of time, contaminants that accumulate throughout the Tenmile Creek drainage could be flushed into Tenmile Creek during periods of spring high flow run-off. The same situation could occur in the Missouri River. Where a hydraulic connection exists between groundwater and surface water, contaminants in

groundwater could eventually be discharged into the streams. Potential contaminant sources located within the control zones for the Helena PWS springs and wells could contaminate area groundwater if accidental releases occurred in these areas. Potential contaminant sources, located in the watershed regions or inventory regions for the springs and wells, could eventually contaminate these water sources over time if contaminants are released into area groundwater and flow to the springs and wells.

Methods and Criteria

DEQ's Source Water Protection Program specifies the methods and criteria used to delineate subregions of the source water protection area for Helena's PWS wells and intakes. Spill response regions and watershed regions have been delineated for the surface water intakes. Control zones, inventory regions, and recharge regions have been delineated for the Helena wells. The source water protection areas may be modified based on site-specific hydrogeologic characteristics.

Delineation Results

A combined inventory region, spill response, and watershed region was delineated around the Tenmile Creek Drainage including all the surface water intakes and wells #2 and #3 near the Ten Mile Water Treatment Plant (Figure 8). A combined inventory region and recharge region has been delineated for the Orofino springs and the Eureka well because these protection areas primarily cover the same area (Figure 9). A modified spill response region has been delineated for the Missouri River Siphon (Figure 10). The spill response region for the siphon extends approximately one-mile upstream.

Figure 8. Tenmile Creek Drainage Inventory/Watershed Region

Figure 9. Eureka Well Inventory/Recharge Region

Figure 10. Missouri River Siphon Spill Response Region

A watershed region has been delineated for the Missouri River siphon and encompasses the entire area of Canyon Ferry Dam and Canyon Ferry Lake that is upstream of the siphon (Figure 11).

Limiting Factors

Well logs that are available for the Helena PWS wells do not contain all the hydrologic parameters needed to complete TOT calculations. TOT calculations are based on data contained in the well logs where possible, on estimated groundwater flow and pumping conditions, and on hydrogeologic data contained in various reports written by others. The total amount of recharge to the system from streams and irrigation canals is unknown and varies seasonally.

TOT distances represent the time required for groundwater to travel through a specified aquifer to the public water supply well. These distances do not represent the time required for contaminants to reach a public water supply well. Travel times for the migration of free-phase contaminants that are not dissolved in the groundwater vary tremendously from groundwater travel times. The characteristics of the vadose zone, contaminant density, the slope of the water table, the slope of the base of the aquifer, aquifer porosity, lithologic heterogeneities, and the extent and duration of contamination; influence free-phase contaminant migration rates.

Travel times for dissolved contaminant migration also differ from ground-water travel times. Dissolved contaminants are affected by advection, or the component of solute movement attributed to transport by flowing groundwater (Freeze and Cherry, 1979). However, the migration of dissolved contaminant plumes is also affected by many additional factors, including the characteristics of the vadose zone, the extent and duration of contamination, contaminant solution density, mechanical dispersion, biological transformation, dilution, molecular diffusion, adsorption, precipitation, oxidation, complexation, volatilization, radioactive decay, lithologic heterogeneities, and water extraction.

Inventory regions delineated using TOT calculations should be used as a planning tool to identify areas within which the potential for contaminants to reach a public water supply source is highest. Groundwater TOT calculations should not be used to estimate contaminant migration rates.

The delineations for the Helena PWS spill response regions and watershed regions are based on fixed-distance and watershed mapping. The spill response regions represent an approximation of the distance required for contaminants upstream to reach the surface water intake in a short period of time. Numerous assumptions

Figure 11. Missouri River Siphon Watershed Region

are associated with the Source Water Protection Program criteria for spill response region delineations. Contaminant transport rates and concentrations will vary depending on the physical and chemical characteristics of both the river and the contaminants. Groundwater flow within adjacent riparian areas will also play a role in contaminant transport. As a result, some areas within the spill response region may be more conducive to contaminant transport than others, and should be designated as higher priority areas for source water protection efforts.

CHAPTER 3
INVENTORY

An inventory of potential contaminant sources was conducted to assess the susceptibility of the Helena PWS to contamination, and to identify priorities for source water protection planning. These inventories were focused primarily within the well inventory regions and the surface water intake spill response regions. Within the inventory and spill response regions, the inventory for both the inventory regions and spill response regions focuses on facilities that generate, use, store, transport, or dispose of potential contaminants, and on certain land types on which potential contaminants are generated, used, stored, transported or disposed. Additionally, the inventory process identifies potential sources of all regulated primary drinking water contaminants and pathogens. Only those potential contaminant sources that pose the most significant threat to human health were selected for detailed inventory. The most significant potential contaminants in the Helena PWS inventory and spill response regions include nitrate, pathogens, fuels, solvents, herbicides, pesticides, and metals. The inventory for the Helena PWS also focuses on general land uses and large potential contaminant sources in the recharge/ watershed regions.

Inventory Method

Available databases were initially searched to identify businesses and land uses that are potential sources of regulated contaminants in the inventory region. The following steps were followed:

Step 1: Urban and agricultural land uses were identified from landcover data collected by the USGS.

Step 2: EPA's Envirofacts System was queried to identify EPA regulated facilities. This system accesses the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), Permit Compliance System (PCS), 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 is a significant potential contaminant source.

Step 3: DEQ databases were queried to identify Underground Storage Tanks (UST), hazardous waste contaminated sites, landfills, and abandoned mines.

Step 4: A business phone directory was consulted to identify businesses that generate, use, or store chemicals in the inventory region. Equipment manufacturing and/or repair facilities, printing or photographic shops, dry cleaners, farm chemical suppliers, and wholesale fuel suppliers were targeted by SIC code.

Step 5: Major road and rail transportation routes were identified.

Step 6. All significant potential contaminant sources were identified in the spill response region, and land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the watershed region.

Potential contaminant sources are designated as significant if they fall into one of the following categories:

- Large quantity hazardous waste generators
- Landfills
- Hazardous waste contaminated sites

- Underground storage tanks
- Major roads or rail transportation route
- Cultivated cropland
- Animal feeding operations
- Wastewater lagoons or spray irrigation
- Septic systems
- Sewered residential areas
- Storm sewer outflows
- Floor drains, sumps, or dry wells
- Abandoned or active mines

Inventory Results

Inventory Results/ Ten Mile Creek Drainage Well Control Zones

Well 2 (WL003) is located at the Ten Mile Water Treatment Plant and the control zone is within their property. Well 3 (WL004) is located along the gravel road approximately one-mile south from the Ten Mile WTP.

Inventory Results/ Tenmile Creek Drainage Combined Inventory Region and Watershed Region

Land cover within the Tenmile Creek drainage consists primarily of forests and only a minor amount of agricultural land (Figure 12). Septic systems are utilized in the vicinity of the Ten Mile Creek wells. An on-site septic system is located at the Ten Mile WTP within the inventory/ watershed region. A localized area of moderate septic density is located immediately down gradient of Well #3 but up gradient of Well #2 (Figure 13). Significant potential contaminant sources are identified in Table 3 and on Figure 14 and are discussed in the text following the table. U.S. Highway 12 and the Yellowstone Pipeline are located within the inventory/watershed region; however, they are located down gradient from the Ten Mile WTP and the intakes in the Tenmile Creek Drainage.

Although not listed in Table 4, another potential contaminant source that should be mentioned for the Tenmile Creek Watershed Region is erosion. Erosion could occur as the result of catastrophic forest fires and cause increased turbidity in the drinking water source.

Table 3. Significant potential contaminant sources in the Tenmile Creek Drainage Inventory/ Watershed Region.

Significant Potential Contaminant Sources	Figure No.	Contaminants	Hazard
On-site Septic System	Figure 13	Nitrates and pathogens	Effluent leaching into groundwater
Other Septic Systems	Figure 13	Nitrates and pathogens	Effluent leaching into groundwater or surface water via interaction between groundwater and surface water
UST	Figure 14	VOCs	VOCs release into area groundwater
Federal Superfund Site Upper Tenmile Creek Mining Area	Figure 14	VOCs, SOCs, acid rock mine drainage from metals, and nitrates	Contaminants leaching into area groundwater and into area surface water

Table 3. Significant potential contaminant sources in the Tenmile Creek Drainage Inventory/ Watershed Region.

Significant Potential Contaminant Sources	Figure No.	Contaminants	Hazard
Mine Sites	Figure 14	VOCs, SOCs, acid rock mine drainage from metals, and nitrates	Contaminants leaching into area groundwater and into area surface water
Gravel Roads	Figure 14	VOCs, SOCs, nitrates, pathogens	Increased erosion; accidental spills could release contaminants into groundwater and surface water

On Site Septic System – is located southeast of the water treatment plant. As a result of its location within the inventory/ watershed region, it is identified as a potential point contaminant source. Should the septic system fail, nitrates and pathogens could potentially leach into area groundwater.

Other Septic Systems – a localized area of moderate septic density is located downgradient of Ten Mile Creek well #3 but upgradient of Ten Mile Creek Well #2. Should septic system failure occur in this localized area, effluent could leach to area groundwater or enter into Tenmile Creek via interaction of groundwater with surface water.

UST/LUST - one underground storage tank is located at the Ten Mile WTP. If a release were to occur, volatile organic chemicals could potentially contaminate area groundwater.

Federal Superfund Site – The Upper Tenmile Creek Mining Area federal superfund site is located in the Tenmile Creek watershed region. Within this area, surface water and sediment samples have been documented to contain elevated levels of arsenic, cadmium, copper, lead, and zinc from the historic mining activities (U.S. EPA, 1999). U.S. EPA efforts continue in this area to cleanup metals and acid mine rock drainage from historic tailings that have leached into area soils, groundwater, and surface water.

Gravel Roads – Vehicle usage may contribute to increased erosion and spills of petroleum or other hazardous materials that could contaminate Tenmile Creek and area groundwater.

Inventory Results/ Eureka Well Control Zone

The Eureka Well (WL002) is located at the intersection of Cruse Street and Park Avenue in Helena. Municipal sewer mains and city streets are located within the Eureka Well 100-foot control zone. Oro fino Springs (WL006) are located approximately 2 miles southwest of Helena and approximately three quarters of a mile north of Unionville in Oro Fino Gulch. The springs are located just off of the gravel road to Unionville.

Inventory Results/ Eureka Well Combined Inventory/ Recharge Region

Land cover in the Eureka Well and Oro Fino Springs combined Inventory/ Recharge Region is primarily forestland (Figure 15). Other types of land cover and their percentages are also identified on Figure 15. The residential area surrounding the Eureka Well is sewered. For the most part, the overall septic density in this inventory region is low. A localized area of moderate septic density is located in Grizzly Gulch upgradient of the Eureka well. A localized area of high septic density is located in the vicinity of Unionville and is upgradient of the springs (Figure 16). Additional significant potential contaminant sources are identified on Figure 17 and in Table 5 and are described in the text following the table.

Table 4. Significant potential contaminant sources in the Eureka Well and Orofino Springs Watershed Region.

Potential Contaminant Sources	Map ID	Contaminants	Hazard
Municipal Sewer Mains	Figure 16	Nitrates and pathogens	Effluent from leaking or broken pipes entering into area groundwater
Septic Systems	Figure 16	Nitrates and pathogens	Effluent leaching into area groundwater and surface water via groundwater
Mines/ Abandoned Mines	Figure 17	VOCs, nitrates, metals, acid mine rock drainage	Contaminants leaching into area groundwater and into surface water via interaction of contaminated groundwater with surface water
Gravel Roads	Figure 17	VOCs, SOCs, and nitrates	Accidental spills could release contaminants into area surface water and groundwater
Other PCSs Photography Shop Knife Making Shop	Figure 17	VOCs, SOCs, nitrates, pathogens, metals	Contaminants leaching into area groundwater

Municipal Sewer Mains – The residential area surrounding the Eureka Well is sewered. Leaky or broken pipes could allow effluent to leach into area groundwater and surface water.

Septic Systems – A localized area of high septic density in Unionville is located upgradient of the Oro Fino Springs. A localized area of moderate septic density is located in Grizzly Gulch upgradient of the Eureka well. Effluent containing nitrates and pathogens could potentially leach from these septic systems and into area groundwater and surface water.

Mines/Abandoned Mines – Abandoned mine sites are located in the vicinity of the Eureka well. Mine sites are also located upgradient of the Oro Fino Springs. Potential contaminants such as VOCs, nitrates, metals, and acid mine rock drainage from historic tailings could leach into area groundwater and surface water.

Gravel Roads – Vehicle usage could increase the risk of petroleum spills and other hazardous materials into area surface water and groundwater.

Other Significant Potential Contaminants Sources – Include a photography shop and a knife making shop. These types of businesses may handle potential contaminants that could enter groundwater should an accidental spill occur.

Inventory Results/ Missouri River Siphon Spill Response Region

Land cover in the Missouri River siphon spill response region consists primarily of grasslands, Canyon Ferry Lake, and forestland (Figure 18). Additional land covers are also identified on Figure 18. An area of moderate septic density is located on the west bank of Canyon Ferry Lake upgradient side of Canyon Ferry Dam (Figure 19). Significant potential contaminant sources are identified on Figure 20 and in Table 5 and are discussed in the text following Table 5. Although not captured within the spill response region, a former mine in the Cave Gulch area may be contributing metals to runoff water that flows into Canyon Ferry Lake.

Figure 18. Land Cover in the Missouri River Siphon Spill Response Region

Figure 19. Septic System Density in the Missouri River Siphon Spill Response Region

Figure 20. Significant Potential Contaminant Sources in the Missouri River Siphon Spill Response Region

Table 6. Significant potential contaminant sources in the Missouri River Siphon Spill Response Region.

Significant Potential Contaminant Sources	Figure / Map ID No.	Contaminants	Hazard
Canyon Ferry Power Plant	Figure 20	VOCs	Accidental releases of petroleum products entering directly into the river.
Septic Systems	Figure 19	Nitrates and pathogens	Effluent discharging directly to river or via contaminated groundwater
UST	Figure 20	VOCs	Petroleum spills leaching into area groundwater or into surface water via contaminated groundwater.
Above Ground Storage Tank	Figure 20	VOCs	Petroleum spills at marinas may enter directly into surface water.
Transportation Routes	Figure 20	VOCs, SOCs, and nitrates	Spills due to traffic accidents on Canyon Ferry Dam entering directly into the river in the vicinity of the siphon
Mines	Figure 20	VOCs, metals, acid rock mine drainage	Contaminants entering into groundwater and directly into tributaries of the Missouri River upgradient of the siphon
Other Potential Contaminant Sources	Figure 20	VOCs, SOCs, nitrates, pathogens	Accidental spills could allow contaminants to enter area groundwater or surface water

Canyon Ferry Power Plant - Accidental releases of petroleum products could enter directly into the river across from the siphon.

Septic Systems - Effluent from septic system failure could leach into area groundwater and into surface water via interaction with contaminated groundwater.

UST- Petroleum spills from USTs in the spill response region could leach into area groundwater or into surface water via contaminated groundwater.

Above ground storage tank (AGST) - Petroleum spills from above ground fuel tanks at area marinas could potentially enter directly into surface water.

Transportation Routes - Spills due to traffic accidents on Canyon Ferry Dam may discharge directly into the river in the vicinity of the siphon

Mines – In the Cave Gulch area mines may be leaching metals and acid rock mine drainage into area groundwater and directly into tributaries that flow into the Missouri River upgradient of the siphon.

Other Potential Contaminant Sources – Include businesses around Canyon Ferry Lake that may handle and store potential contaminants that if accidentally spilled could allow contaminants to enter area groundwater or surface water.

Inventory Results/Missouri River Siphon Watershed Region

The Missouri River Siphon Watershed Region consists primarily of grasslands, evergreen forests, agricultural land, and open water (Figure 21). Other types of land cover and their percentages are also identified on Figure 21 In addition to those significant potential contaminant sources in the spill response region there are additional mine sites, an additional UST, U.S. Highway 287, and a petroleum pipeline in the watershed region. Localized areas of moderate septic system usage occur along Canyon Ferry Lake. For the most part septic system usage throughout the watershed region is low. Figure 22 indicates potential contaminant sources in the watershed region and their locations.

Figure 21. Land Cover in the Missouri River Siphon Watershed Region

Figure 22. Significant Potential Contaminant Sources in the Missouri River Siphon Watershed Region

Inventory Limitations

The potential contaminant sources described in this section have been identified from readily available information. Consequently, unregulated activities or unreported contaminant releases may have been overlooked. In some cases, inadequate location information precluded the inclusion of potential contaminant sources in the inventory. The use of multiple sources of information, however, should ensure that the major threats to the source waters for the Helena Water Utilities PWS have been identified.

Inventory Update

To make the SWDAR a useful document in the years to come, the owners, managers, or the certified water system operator(s) for the Helena Water Utilities PWS should update the potential contaminant source inventory for their records every year. Changes in land uses or potential contaminant sources should be noted and additions made as needed. The complete potential contaminant source inventory should be submitted to DEQ at least every 5 years to ensure that this report stays current in the public record.

CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case the City of Helena.

The goal of source water management is to protect the source water by 1) controlling activities in the control zone, 2) managing significant potential contaminant sources within the inventory regions and spill response regions and 3) ensuring that land use activities in the Recharge/Watershed Region pose minimal threat to the source water. Management priorities 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 City of Helena to reduce susceptibility are recommended.

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers (Table 7). Barriers can be anything that decreases the likelihood that contaminated water will leach into the aquifer that supplies water to the Helena wells or flow into the Helena surface intakes.

Table 7. Susceptibility to specific contaminant sources as determined by hazard and the presence of barriers.

	High Hazard	**Moderate Hazard**	**Low Hazard**
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 10 describes the criteria that determine the hazard presented to wells and surface water intakes by potential sources of contaminants located in the Helena Water Utilities PWS inventory regions, combined inventory/ watershed regions, combined inventory/ recharge regions, and spill response regions. Hazard for groundwater wells is determined based on Time-of-Travel of groundwater. Hazard for the surface water intakes depends on whether contaminants can discharge directly into Tenmile Creek drainage intake areas or into the Missouri River siphon vicinity. Hazard ratings for septic systems, municipal sewer mains, and cropped agricultural land are based on the density of these potential contaminant sources within the inventory and spill response regions. The hazard ratings for point sources of contamination entering the surface water intakes are also dependent on the health effects associated with potential contaminants.

Table 8. Hazard of potential contaminant sources associated with proximity to a PWS well, intake, or density within a PWS inventory or spill response region**.**

Type of Contaminant Source		High Hazard	Moderate Hazard	Low Hazard
SURFACE WATER	**Point Sources of Nitrate or Microbes**	Potential for direct discharge to source water	Potential for discharge to groundwater hydraulically connected to source water	Potential contaminant sources in the watershed region
	Point Sources of VOCs, SOCs, or Metals	Potential for direct discharge of large quantities from roads, rails, or pipelines	Potential for direct discharge of small quantities to source water	Potential for discharge to groundwater hydraulically connected to source water
WELLS	**Point Sources of All Contaminants** (Unconfined)	Within 1-year TOT	1 to 3 years TOT	Over 3 years TOT
	Point Sources of All Contaminants (Confined)	PWS well is not sealed through the confining layer	Well(s) in the inventory region other than the PWS well are not sealed through the confining layer	All wells in the inventory region are sealed through the confining layer
ALL	**Septic Systems**	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
	Municipal Sanitary Sewer (% land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region
	Cropped Agricultural Land (% land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

Hazard ratings for each significant potential contaminant source and their associated contaminants in the Tenmile Creek Inventory/ Watershed region are presented in Table 9 on the following page.

Table 9. Hazard Ratings of Significant Potential Contaminant Sources in the Tenmile Creek Inventory/ Watershed Region

Significant Potential Contaminant Sources	Contaminants	Hazard	Hazard Rating
On-Site Septic System	Nitrates and pathogens	Effluent leaching into area groundwater	**High** –potential contaminant source (PCS) is a point source within the inventory region
Other Septic Systems	Nitrates and pathogens	Effluent leaching into area groundwater or surface water via groundwater surface water interaction	**High –** localized area acts as a point source within the inventory region
UST	VOCs	VOCs released into area groundwater	**High** - potential contaminant source (PCS) is within the inventory region
Federal Superfund Site Upper Tenmile Creek Mining Area	VOCs, SOCs, acid rock mine drainage from metals, and nitrates	Contaminants leaching into area groundwater and into area surface water	**High** - potential contaminant source (PCS) is within the inventory region
Mine Sites	VOCs, SOCs, acid rock mine drainage from metals, and nitrates	Contaminants leaching into area groundwater and into area surface water	**High** - potential contaminant source (PCS) is within the inventory region
Gravel Roads	VOCs, SOCs, nitrates, pathogens	Increased erosion; accidental spills due to traffic accidents could release contaminants into groundwater and surface water	**High** - potential contaminant source (PCS) is within the inventory region

Hazard ratings for each significant potential contaminant source and their associated contaminants within the Eureka Well Inventory/ Recharge Region are presented in Table 10.

Table 10. Hazard Ratings of Significant Potential Contaminant Sources in the Eureka Well Inventory/ Recharge Region

Potential Contaminant Sources	Contaminants	Hazard	Hazard Rating
Septic Systems	Nitrates and pathogens	Effluent leaching into area groundwater and surface water via groundwater	**High** - potential contaminant sources (PCS) are within the inventory region; upgradient of Eureka Well and Oro Fino Springs
Mines Sites	VOCs, nitrates, metals, acid mine rock drainage	Contaminants leaching into area groundwater and into surface water via interaction of contaminated groundwater with surface water	**High** - PCS are within the inventory region; upgradient of Eureka Well and Oro Fino Springs

Table 10. Hazard Ratings of Significant Potential Contaminant Sources in the Eureka Well Inventory/ Recharge Region

Potential Contaminant Sources	Contaminants	Hazard	Hazard Rating
Gravel Roads	VOCs, SOCs, and nitrates	Increased erosion, spills due to traffic accidents could release contaminants into area groundwater and surface water	**High** - PCS are within the inventory region and in the vicinity of the well and springs
Other PCSs Photography Shop Knife Making Shop	VOCs, SOCs, nitrates, pathogens, metals	Contaminants leaching into area groundwater due to accidental spills	**High** - PCS are within the inventory region; upgradient of Eureka Well

Hazard ratings for each significant potential contaminant source and their associated contaminants within the Missouri River Siphon Spill Response Region are presented in Table 11.

Table 11. Hazard rating of Significant Potential Contaminant Sources in the Missouri River Siphon Spill Response Region

Significant Potential Contaminant Sources	Contaminants	Hazard	Hazard Rating
Canyon Ferry Power Plant	VOCs	Accidental releases of petroleum products entering directly into the river.	**High** -potential for direct discharge to the river in the vicinity of the siphon
Above Ground Storage Tank	VOCs	Petroleum spills at marinas may enter directly into surface water.	**High** -potential for direct discharge to the river in the vicinity of the siphon
Transportation Routes	VOCs, SOCs, and nitrates	Spills due to traffic accidents on Canyon Ferry Dam entering directly into the river in the vicinity of the siphon	**High** -potential for direct discharge to the river in the vicinity of the siphon
Septic System Density	Nitrates and pathogens	Effluent leaching into area groundwater and then into river via contaminated groundwater	**High** –localized areas of moderate septic density act as point sources of potential contamination.
UST	VOCs	Petroleum spills leaching into area groundwater or into surface water via contaminated groundwater.	**Moderate** -contaminated groundwater entering into surface water via interaction between groundwater and surface water
Mines	VOCs, metals, acid rock mine drainage	Contaminants entering into groundwater and directly into tributaries of the Missouri River upgradient of the siphon	**Moderate** -contaminated groundwater entering into tributaries of the Missouri River and then into mainstream of river
Other Potential Contaminant Sources	VOCs, SOCs, nitrates, pathogens	Accidental spills could allow contaminants to enter area groundwater or surface water	**Moderate**-contaminated groundwater entering into surface water via interaction between groundwater and surface water

Susceptibility rankings are presented individually for each significant potential contaminant source and each

associated contaminant in Table 12 and in the text following the table. Management recommendations indicating how significant potential contaminant sources could be better managed to prevent impacts to the Helena Water Utilities PWS wells, springs, and surface water intakes are also provided. Table 12 displays the susceptibility assessment results for the Helena Water Utilities PWS well inventory regions.

Table 12. Susceptibility assessment for significant potential contaminant sources in the Helena Water Utilities PWS Inventory and Spill Response Regions

Contaminant Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Tenmile Creek Drainage Wells #2 and #3 and Surface Water Intakes						
Septic Systems Onsite septic systems/ others	Nitrates and pathogens	Effluent leaching to area groundwater	High	None	Very High	Proper operation and management
Gravel Roads	VOCs, SOCs, nitrates, pathogens	Increased erosion, accidental spills due to traffic accidents releasing contaminants into area groundwater and surface water	High	None	Very High	Implement a spill response plan
Mine Sites	VOCs, SOCs, acid rock mine drainage from historic tailings, metals, nitrates	Contaminants leaching into area groundwater and into surface water	High	None	Very High	Assess threats from mine sites, determine remedial efforts
UST	VOCs	Spills releasing VOCs to groundwater	High	Leak detection system	High	Proper operation and management
Federal Superfund Site Upper Tenmile Creek Mining Area	VOCs, SOCs, acid rock mine drainage from historic tailings, metals, nitrates	Contaminants leaching into area groundwater and into surface water	High	Site cleanup; groundwater, surface water, and soil monitoring	Moderate	Encourage continued cleanup of mining area
Eureka Well Inventory/ Recharge Region						
Septic Systems	Nitrates and pathogens	Effluent leaching to area groundwater	High	None	Very High	Proper operation and maintenance of system
Municipal Sewer Mains	Nitrates and pathogens	Leaky or broken pipes discharging effluent to groundwater	High	None	Very High	Periodically inspect pipes and replace portions of the sewer as needed
Mine Sites	VOCs, SOCs, acid rock mine drainage, metals, nitrates	Contaminants leaching into area groundwater and into surface water via groundwater	High	None	Very High	Assess threats and determine appropriate remedial efforts

Table 12. Susceptibility assessment for significant potential contaminant sources in the Helena Water Utilities PWS Inventory and Spill Response Regions

Contaminant Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Gravel Roads	VOCs, SOCs, and nitrates	Increased erosion, spills due to traffic accidents releasing contaminants into area groundwater and surface water	High	None	Very High	Implement emergency spill response plan
Other PCSs Photography Shop; Knife making shop	VOCs, SOCs, metals	Contaminants leaching into area groundwater and into surface via groundwater	High	None	Very High	Implement emergency spill response plan
Missouri River Siphon Spill Response Region						
Canyon Ferry Power Plant	VOCs	Accidental releases of petroleum products entering directly into river	High	Dilution	High	Implement emergency spill response plan
Septic Systems	Nitrates and pathogens	Effluent discharging directly into river or via contaminated groundwater	High	Dilution	High	Proper operation and maintenance
Above ground storage tank	VOCs	Petroleum spills at marina may enter directly into the river	High	Dilution	High	Implement emergency spill response plan
Mines	VOCs, metals, acid rock mine drainage	Contaminants entering into groundwater and into tributaries of the Missouri River upgradient of the siphon	Moderate	Dilution	Moderate	Assess mines potential to contaminate area groundwater and surface water and determine appropriate action plan
Other Potential Contaminant Sources	VOCs, SOCs, nitrates, and pathogens	Accidental spills could allow contaminants to enter area groundwater or surface water	Moderate	Dilution	Moderate	Implement emergency spill response plans; use BMPs
UST	VOCs	Petroleum spills leaching into area groundwater or into surface water via groundwater	Moderate	Dilution, leak detection	Low	Proper operation and maintenance
Asarco Lead Smelting Plant	VOCs, SOCs, nitrates, pathogens, metals	Contaminated groundwater plume under the site potentially migrating into Prickly Pear Creek	High	Groundwater monitoring	High	Continue to monitor groundwater plume concentrations and migration

Table 12. Susceptibility assessment for significant potential contaminant sources in the Helena Water Utilities PWS Inventory and Spill Response Regions

Contaminant Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
American Chemet	VOCs, SOCs, nitrates, pathogens	Contaminants leaching into area groundwater and surface water	High	Dilution	High	Use BMPs
Montana Rail Link Railroad	VOCs, SOCs, nitrates	Accidental spills could allow contaminants to enter area groundwater or directly into the creek	High	Dilution	High	Implement an emergency spill response plan
U.S. Highway 287/ Interstate 15	VOCs, SOCs, nitrates, pathogens	Spills due to traffic accidents could allow contaminants to leach into area groundwater upgradient of the well or directly enter surface water especially at bridge crossings	High	Dilution	High	Implement an emergency spill response plan
Municipal Sewer Mains	Nitrates and pathogens	Leaky or broken mains discharging contaminated water into area groundwater or surface water via contaminated groundwater	Low	None	Moderate	Periodically inspect older sewer mains and implement upgrades where necessary
Agricultural Land	SOCs, nitrates, and pathogens	Agricultural chemicals could enter into the creek via surface water runoff or irrigation return flows and eventually be drawn into the well	Moderate	Dilution	Moderate	Use BMPs

The susceptibility results for each significant potential contaminant source and their associated contaminants are identified as follows:

Tenmile Creek Drainage Inventory /Watershed Region

Septic Systems – An area of moderate septic density is located in the immediate the vicinity of Tenmile Creek Well #2 and upgradient of Tenmile Creek Well #1. This area of septic density will be treated as a point source of contamination. If any of these systems were to fail, nitrates and pathogens could potentially leach into area groundwater and surface water. The hazard is ranked high. The overall susceptibility is ranked very high as no barriers to contamination were identified.

UST/LUST - An underground storage tank is located at the Ten Mile WTP. If a release were to occur,

volatile organic chemicals could potentially contaminate area groundwater. The hazard is ranked high. The overall susceptibility is ranked high as one barrier to contamination, a leak detection system, was identified.

Federal Superfund Site – The Upper Tenmile Creek Mining Area is located in the watershed region. Metals and acid mine rock drainage from historic tailings could leach into area groundwater and surface water. The hazard is ranked high because this site is includes much of the drainage containing intakes for the Helena Water Utilities PWS. The overall susceptibility is ranked moderate as multiple barriers to contamination, including site cleanup, groundwater, surface water, and soil monitoring, were identified.

Gravel Roads – Increased erosion could release additional sediments into Tenmile Creek. Spills due to accidents along these roads could release contaminants into area groundwater and directly into Tenmile Creek. The hazard is ranked high. The overall susceptibility is ranked very high, as no barriers were identified.

Eureka Well Inventory/ Recharge Region

Septic Systems – A localized area of high septic density in Unionville is located upgradient of the Oro Fino Springs. Nitrates and pathogens could potentially leach from the drainfields into area groundwater and into surface water via groundwater. The hazard is ranked high. The overall susceptibility is ranked very high, as no barriers to contamination were identified.

Municipal Sewer Mains – Sewer mains surround the Eureka Well. Leaky or broken pipes could allow effluent to discharge to area groundwater. The hazard is ranked high. The overall susceptibility is very high as no barriers to contamination were identified.

Mines/Abandoned Mines – Abandoned mine sites are located in the vicinity of the Eureka well. Mine sites are also located upgradient of the Oro Fino Springs. Potential contaminants such as VOCs, nitrates, metals, and acid mine rock drainage from historic tailings could leach into area groundwater and surface water. The hazard is ranked high. The overall susceptibility is ranked very high as no barriers were identified.

Gravel Roads – Increased erosion could release additional sediments into area surface water. Spills due to accidents along these roads could release contaminants into area groundwater and directly into surface water. The hazard is ranked high. The overall susceptibility is ranked very high, as no barriers were identified.

Other Significant Potential Contaminants Sources – include a photography shop and a knife making shop. These types of businesses may handle potential contaminants that could enter groundwater should an accidental spill occur. The hazard is ranked high. The overall susceptibility is very high as no barriers were identified.

Missouri River Siphon Spill Response Region

Canyon Ferry Power Plant - Accidental releases of fuels could directly enter into the river in the vicinity of the siphon. The hazard is ranked high. The overall susceptibility is ranked high as only one barrier, dilution, was identified.

Above ground storage tank (AGST) - Petroleum spills from fuel pumps at marinas have the potential to enter directly into surface water. The hazard is ranked high. The overall susceptibility is ranked high as only one barrier to contamination, dilution, was identified.

Transportation Routes - Spills due to traffic accidents on Canyon Ferry Dam could potentially enter directly into the river in the vicinity of the siphon. The hazard is ranked high. The overall susceptibility is ranked high as only one barrier, dilution, was identified.

Septic Systems – Untreated effluent, resulting from septic system failure, could leach into area groundwater and into surface water through interaction between groundwater and surface water. The hazard is ranked high. The overall susceptibility is ranked high as only one barrier, dilution, was identified.

UST- Petroleum spills may leach into area groundwater or into surface water via interaction between groundwater and surface water. The hazard posed by the UST is moderate, as no direct discharge to surface would occur. The overall susceptibility is low, as multiple barriers to contamination have been identified.

Mines – Contaminants from mine sites in the Cave Gulch area are potentially entering into area groundwater and then into tributaries of the Missouri River upgradient of the siphon. The hazard posed by these mines is ranked as moderate and the overall susceptibility is moderate as only one barrier to contamination, dilution, as been identified.

Other Potential Contaminant Sources – include businesses that may handle and store potential contaminants such as fuels and lawn chemicals. If accidentally spilled these contaminants could leach into area groundwater or surface water. The hazard posed is moderate and the overall susceptibility is moderate as only dilution has been identified as a barrier.

Prickly Pear Creek Surface Water Buffer for the Missouri River Water Treatment Plant Well

City of East Helena - Potential contaminants from the city, such as nitrates and pathogens, could enter directly into Prickly Pear Creek or could enter the creek through interaction between groundwater and surface water. The hazard is ranked high. The overall susceptibility is ranked high as only one barrier dilution was identified.

Asarco Lead Smelting Plant – Contaminated groundwater underneath this facility could migrate into the Prickly Pear Creek via interaction between groundwater and surface water. The hazard is ranked high. The overall susceptibility is ranked high as one barrier, groundwater monitoring, is conducted at the site and can indicate if additional precautions are needed.

American Chemet - Accidental spills could cause the discharge of contaminants to discharge directly into Prickly Pear Creek or enter the creek via interaction between groundwater and surface water. The hazard is ranked high. The overall susceptibility is ranked high as only one barrier, dilution, was identified.

Montana Rail Link Railroad - Accidental spills could release contaminants directly into Prickly Pear Creek upstream of the Missouri River Water Treatment Plant well. The hazard is ranked high. The overall susceptibility is ranked high as only one barrier, dilution, is indicated as a possible barrier to contamination.

U.S. Highway 287 and U.S. Interstate 15 - Spills due to traffic accidents could enter directly enter into surface water, upstream of the water treatment plant well, especially at bridge crossings. The hazard is ranked high. The overall susceptibility is ranked high as only one barrier, dilution, is indicated as a possible barrier to contamination.

Agricultural land - Agricultural chemicals could enter the creek via surface water runoff or irrigation return flows. The hazard is ranked moderate because 25 percent of the land area within the surface water buffer is covered by agricultural land. The overall susceptibility is moderate as only one barrier, dilution,

was identified.

Management Recommendations

The Helena Water Utilities PWS Source Water Delineation and Assessment Report provides information concerning the groundwater wells, springs, and surface water intakes that supply water to Helena. The report also identifies the inventory region, spill response region, surface water buffer, recharge region and the watershed region, and within each of these protection areas the significant potential contaminants that may impact Helena's water sources are identified. The report also provides recommendations regarding how the potential contaminants could be managed to prevent impacts in the vicinity of the Helena Water Utilities PWS. If these management recommendations are implemented, they may be considered additional barriers that will reduce the susceptibility of Helena's water sources to specific potential contaminant sources and their associated contaminants.

Management recommendations fall into the following categories:

Sewer maintanence and leak detection. Early leak detection and scheduled replacement of older sewer lines will reduce the susceptibility of Helena wells to contamination from sanitary wastes.

Sewer extension. Annexation and extension of sewers is the only way to reduce contamination from existing unsewered developments.

Agricultural Best Management Practices. BMPs that address application and mixing of fertilizers and pesticides are a viable alternative to prohibition of their use. BMPs are voluntary, but their implementation can be encouraged through education and technical assistance. BMPs may also be utilized to minimize surface runoff and soil erosion on cultivated fields

Stormwater Management. Stormwater planning should address source and drainage control. Source control can be accomplished through educational programs focusing on residential and commercial chemical use, disposal, and recycling. Drainage control and pollutant removal can be accomplished through the use of vegetated retention basins at outfall locations.

Education. Educational workshops provided to the general public by the city, county, or state promote safe handling and proper storage, transport, use, and disposal of hazardous materials. Ongoing training provided to designated emergency personnel would promote the efficiency and effectiveness of emergency responses to hazardous material spills. Educational workshops provided to rural homeowners will promote the proper maintenance and replacement of residential septic systems. Educational materials covering these topics are available to the public and can be obtained from the US EPA and the State of Montana.

Emergency Response Plan. This is a management recommendation that the City of Helena itself could develop and implement. Coordination with county and state emergency response personnel would greatly benefit the plan. The plan should identify the procedures that the water operators and other emergency personnel should follow in the event that any of the sources supplying water to the Helena Water Utilities PWS are in danger of being contaminated. The emergency response plan should be updated annually to reflect changes in emergency contacts, phone numbers, and resources available within the city and county to respond to an emergency situation, such as a hazardous material spill.

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GLOSSARY*

Acute Health Effect. A negative health effect in which symptoms develop rapidly.

Alkalinity. The capacity of water to neutralize acids.

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.

Biennial Reporting System (BRS). An EPA database that contains information on hazardous waste sites. The data can be accessed through the EPA Envirofacts website.

Chronic Health Effect. A negative health effect in which symptoms develop over an extended period of time.

Class V Injection Well. Any pit or conduit into the subsurface for disposal of wastewaters. The receiving unit for an injection well typically represents the aquifer, or water-bearing interval.

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.

Community. A town, neighborhood or area where people live and prosper.

Comprehensive Environmental Cleanup and Responsibility Act (CECRA). Passed in 1989 by the Montana State Legislature, CECRA provides the mechanism and responsibility to clean up hazardous waste sites in Montana.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Enacted in 1980. CERCLA provides a Federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. Through the Act, EPA was given power to seek out those parties responsible for any release and assure their cooperation in the cleanup.

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS). A database that provides information about specific sites through the EPA Envirofacts website.

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.

Glacial. Of or relating to the presence and activities of ice or glaciers. Also, pertaining to distinctive features and materials produced by or derived from glaciers.

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.

Hydrology. The study of water and how it flows in the ground and on the surface.

Hydrogeology. The study of geologic formations and how they affect groundwater flow systems.

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.

Lacustrine. Pertaining to, produced by, or formed in a lake or lakes.

Leaking Underground Storage Tank (LUST). A release from a UST and/or associated piping into the subsurface.

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

Montana Pollutant Discharge Elimination System (MPDES). A permitting system that utilizes a database to track entities that discharge wastewater of any type into waters of the State of Montana.

National Pollutant Discharge Elimination System (NPDES). A national permitting system that utilizes a database to track entities that discharge wastewater into waters of the United States.

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.

Phase II (and IIb) Rules. EPA updated or created legal limits on 38 contaminants. The rules became effective July 30, 1992 and January 1, 1993. Some of these contaminants are frequently-applied agricultural chemicals such as nitrate and others are industrial solvents.

Phase V Rule. EPA set standards for 23 contaminants in addition to those addressed by the Phase II Rules. The Phase V Rule became effective January 17, 1994. Some of these contaminants include inorganic chemicals such as cyanide and other Phase V contaminants are pesticides that enter water supplies through run-off from fields where farmers have applied them or by leaching through the soil into groundwater. Six are probable cancer-causing agents. Others can cause liver and kidney damage, or problems of the nervous system and brain.

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).

Permit Compliance System (PCS). An EPA database that provides information on the status of required permits for specific activities for specific facilities. The data can be accessed through the EPA Envirofacts website.

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 elevation in a well when the pump is operating.

Recharge Region. A source water management region that is generally the entire area that could contribute water to an aquifer used by a public water supply. Includes areas that could contribute water over long time periods or under different water usage patterns.

Resource Conservation and Recovery Act (RCRA). Enacted by Congress in 1976. RCRA's primary goals are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner.

Resource Conservation and Recovery Information System (RCRIS). Is a database that provides information about specific sites through the EPA Envirofacts website.

Secondary Maximum Contaminant Levels (SMCL). The maximum concentration of a substance in water that is recommended to be delivered to users of a public water supply based on aesthetic qualities. SMCLs are non-enforceable guidelines for public water supplies, set by EPA under authority of the Safe Drinking Water Act. Compounds with SMCLs may occur naturally in certain areas, limiting the ability of the public water supply to treat for them.

Section Seven Tracking System (SSTS). SSTS is an automated system EPA uses to track pesticide producing establishments and the amount of pesticides they produce.

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.

Spill Response Region. A source water management area for surface water systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified four-hour water travel time in a stream or river.

Standard Industrial Classification (SIC) Code. A method of grouping industries with similar products or services and assigning codes to these groups.

Static Water Level (SWL). Water level elevation 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.

Synthetic Organic Compounds (SOC). Man made organic chemical compounds (e.g. herbicides and 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, nonpoint, and natural sources. The TMDL program was established by section 303(d) of the Clean Water Act to help states implement water quality standards.

Toxicity. The quality or degree of being poisonous or harmful to plants, animals, or humans.

Toxicity Characteristic Leachate Procedure. A test designed to determine whether a waste is hazardous or requires treatment to become less hazardous.

Toxic Release Inventory (TRI). An EPA database that compiles information about permitted industrial releases of chemicals to air and water. Information about specific sites can be obtained through the EPA Envirofacts website.

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

Underground Storage Tanks (UST). A tank located at least partially underground and designed to hold gasoline or other petroleum products or chemicals, and the associated plumbing system.

Volatile Organic Compounds (VOC). Chemicals such as petroleum hydrocarbons and solvents or other organic chemicals which evaporate readily to the atmosphere.

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.

* With the exception of the definitions for Lacustrine, Phase II and Phase V Rules, and Standard Industrial Classification Code, definitions were adapted from EPA's Term References System (formerly known as Glossary of Selected Terms and Abbreviations) which can be found at:
http://www.epa.gov/trs/index.htm

The definitions of glacial and lacustrine were taken from the Glossary of Geology by Robert L. Bates and Julia A. Jackson.

The definitions for Phase II and Phase V Rules were adapted from:
http://www.epa.gov/OGWDW/source/therule.html#PhaseII
http://www.epa.gov/OGWDW/source/therule.html#PhaseV

The definition for Standard Industrial Classification Code was adapted from:
EPA/Office of Enforcement and Compliance Assurance: Guide to Environmental Issues: Glossary of Terms & Acronyms *Term Detail*)

APPENDICES

APPENDIX A: Well Logs

Montana Bureau of Mines and Geology
Ground-water Information Center Site Report
CITY OF HELENA PUBLIC WORKS – Ten Mile WTP #1 (WL003)

Plot this site on a topographic map

Location Information

GWIC Id: 166716
Location (TRS): 09N 05W 04 DAA
County (MT): LEWIS AND CLARK
DNRC Water Right: W089047-00
PWS Id:
Block: Not Reported
Lot: Not Reported
Certificate of Survey: Not Reported

Source of Data: LOG
Latitude (dd): 46.5617
Longitude (dd): -112.2284
Geomethod: TRS-TWN
Datum: 1927
Addition: Not Reported
Type of Site: WELL

Well Construction and Performance Data (measurements are reported below land surface)

Total Depth (ft): 55.00
Static Water Level (ft): 14.40
Pumping Water Level (ft): 38.50
Yield (gpm): 150.00
Test Type: PUMP
Test Duration: 24.00
Drill Stem Setting (ft):
Recovery Water Level (ft):
Recovery Time (hrs):

How Drilled: ROTARY
Driller's Name: H & L
Driller License: WWC447
Completion Date: Jan 20, 1998
Special Conditions: None Reported
Is Well Flowing?: No
Shut-In Pressure:
Geology/Aquifer: Not Reported
Well/Water Use: Not Reported

Hole Diameter Information

No hole diameter records were found.

Casing Information

From (ft)	To (ft)	Dia (in)	Description
-2.0	55.0	12.0	STEEL

Annular Seal Information

From (ft)	To (ft)	Description
0.0	40.0	BENTONITE

Completion Information

From (ft)	To (ft)	Dia (in)	Description
40.0	55.0	12.0	80 SLOT SCREEN

Lithology Information

From (ft)	To (ft)	Description
0.0	7.0	MODERATELY SORTED GRAVELLY SAND 40% SUBROUNDED 30% SUBANGULAR 1/4 TO 1 INCH SILT 20% MODERATELY CMPCT
7.0	56.0	SANDY GRAVEL WITH COBBLES AND BOULDERS GRAVEL 30% SUBROUNDED 1/4 TO 3 INCHES SAND 25% SUBANGULAR BOULDERS 1% SILT 5%
56.0	62.0	BLACK SLATE

Montana Bureau of Mines and Geology
Ground-water Information Center Site Report
CITY OF HELENA WATER DEPARTMENT Ten Mile Creek (WL004)

Plot this site on a topographic map

Location Information

GWIC Id:	63003	Source of Data:	GW4
Location (TRS):	10N 05W 34 DDBB	Latitude (dd):	46.5741
County (MT):	LEWIS AND CLARK	Longitude (dd):	-112.2109
DNRC Water Right:	Not Reported	Geomethod:	TRS-TWN
PWS Id:		Datum:	1927
Block:	Not Reported	Addition:	Not Reported
Lot:	Not Reported	Type of Site:	WELL
Certificate of Survey:	Not Reported		

Well Construction and Performance Data (measurements are reported below land surface)

Total Depth (ft):	60.00	How Drilled:	Not Reported
Static Water Level (ft):	50.00	Driller's Name:	Not Reported
Pumping Water Level (ft):		Driller License:	Not Reported
Yield (gpm):	300.00	Completion Date:	Jul 09, 1946
Test Type:	Not Reported	Special Conditions:	None Reported
Test Duration:		Is Well Flowing?:	No
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	211PLNC
Recovery Time (hrs):		Well/Water Use:	PUBLIC WATER SUPPLY

Hole Diameter Information
No hole diameter records were found.

Annular Seal Information
No annular seal records were found.

Casing Information
No casing records were found.

Completion Information
No completion records were found.

Lithology Information
No lithology records were found.

Montana Bureau of Mines and Geology
Ground-water Information Center Site Report
CITY OF HELENA WATER – Eureka Well (WL002)

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

Location Information

GWIC Id:	62945	Source of Data:	GW4
Location (TRS):	10N 04W 36 ADBC	Latitude (dd):	46.5822
County (MT):	LEWIS AND CLARK	Longitude (dd):	-112.0454
DNRC Water Right:	Not Reported	Geomethod:	TRS-TWN
PWS Id:		Datum:	1927
Block:	Not Reported	Addition:	Not Reported
Lot:	Not Reported	Type of Site:	WELL
Certificate of Survey:	Not Reported		

Well Construction and Performance Data (measurements are reported below land surface)

Total Depth (ft):	42.00	How Drilled:	Not Reported
Static Water Level (ft):	40.00	Driller's Name:	Not Reported
Pumping Water Level (ft):		Driller License:	Not Reported
Yield (gpm):	500.00	Completion Date:	Jan 01, 1933
Test Type:	Not Reported	Special Conditions:	None Reported
Test Duration:		Is Well Flowing?:	No
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	374MGHR
Recovery Time (hrs):		Well/Water Use:	PUBLIC WATER SUPPLY

Hole Diameter Information

From (ft)	To (ft)	Dia (in)
0.0	42.0	0.0

Casing Information

No casing records were found.

Annular Seal Information

No annular seal records were found.

Completion Information

No completion records were found.

Lithology Information

No lithology records were found.