City of Havre
Public Water System

PWSID # MT0000524

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

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GLOSSARY*

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

Alkalinity. The capacity of water to neutralize acids.

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

Coagulation. A treatment process where chemical coagulants are used to clump together very fine particles into larger particles. Clumping particles together makes it easier to separate solids from water by settling, skimming, draining, or filtering.

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

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.

Delineation. A process of mapping source water management areas.

Filtration. A process for removing particulate matter from water by passage through porous media.

Flocculation. A treatment process where biological or chemical action is used to aggregate and remove clumps of solids in water.

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

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

Nitrate. An important plant nutrient and type of inorganic fertilizer. In water the major sources of nitrates are septic tanks, feed lots and fertilizers.

Nonpoint-Source Pollution. Pollution sources that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet.

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

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

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

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.

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

Sedimentation. A water treatment process where solid particles are settled out of water in a large clarifier or sedimentation basin.

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

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

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

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

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

Watershed. The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common delivery point.

* Definitions taken from EPA’s Glossary of Selected Terms and Abbreviations (http://www.epa.gov/ceisweb1/ceishome/ceisdocs/glossary/glossary.html)

INTRODUCTION

Shelly Nolan, former Havre Water Department Superintendent and Russell Levens, Hydrogeologist with Montana Department of Environmental Quality (DEQ) completed this Source Water Delineation and Assessment Report. A committee of interested parties from the Havre area contributed valuable advice and information in developing this plan. They are: Kristi Kline (City of Havre), Marlene Moon (Liberty County Conservation District), Pam Grubb (Hill County Conservation District), Clay Vincent and Denise Biggar (Hill County Sanitarian Office), Mike Woolrich (Burlington Northern Santa Fe Railway), and Marvin Cross (DNRC Water Resource Division, Havre).

Purpose

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the City of Havre 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 areas that contribute water used for drinking, called source water protection areas. Assessment involves identifying locations or regions in source water protection areas where contaminants may be generated, stored, or transported, and then determining the 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 Havre complete a source water protection plan to protect its drinking water source.

Limitations

This report was prepared to assess threats to Havre’s public water supply, and is based on published information and information obtained from local residents familiar with the community. The terms "drinking water supply" or "drinking water source" refer specifically to the source of Havre’s public water supply and not any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the Havre area are identified. Only sources of contamination in areas that contribute water to Havre’s drinking water source are considered potential contaminant sources.

The terms "contaminant" and "toxin" are used in this report to refer to constituents for which maximum concentration levels (MCLs) have been specified under the national primary drinking water standards and certain constituents that do not have MCLs but that are considered to be significant health threats. In this report we only consider those constituents that are threats to human health. We narrow our focus further by identifying those facilities or activities where contaminants in large volumes or high toxicity are generated.

CHAPTER 1

BACKGROUND

The Community

Havre is 115 miles northeast of Great Falls in Hill County. The population of Hill County was estimated at 17,373 in 1998 of which approximately 10,000 live in Havre (Figure 1). Havre was founded by the Great Northern Railroad and the economy continues to rely on the railroad, now the Burlington Northern Santa Fe Line, and on agriculture. Natural resources developed near Havre include coal, oil and gas, and gold. Havre is served by Big Sky Airline at the Havre City-County Airport. The Montana State University - Northern campus has an enrollment of approximately 1,500 in Havre and offers degrees in humanities, sciences, business, nursing, technology, and teacher education. The Rocky Boy's and Fort Belknap Indian reservations cover over 700,000 acres near Havre.

Businesses in Havre include the Burlington Northern Santa Fe Railway, agricultural implement dealers and chemical suppliers, equipment manufacturing and repair shops, and general retail. Primary agricultural products are dryland grains, cattle, and hogs. A sanitary sewer serves homes and businesses within the city. Septic systems are used outside the city limits.

Geographic setting

Havre is located just south of the Canadian border at 48.6° North Latitude and 109.7° West Longitude at 2,585 feet above sea level. The terrain around Havre consists of plains mantled by glacial sediments. Isolated mountain ranges of igneous intrusive rocks and alluvial valleys eroded by rivers and streams interrupt the plains. Milk River, the primary source of Havre's drinking water, is the main tributary to the Missouri River in north central Montana.

The average daily high and low temperatures in Havre are 84.4° F and 53.7° F in July and 24.0° F and 3.0° F in January. Annual precipitation averages 11.4 inches in town and increases to 20 inches over the Sweet Grass Hills and Bears Paw Mountains (Tuck, 1993). Precipitation comes mostly in the late spring and during infrequent intense summer storms. On the average, 45 inches of snow falls in Havre with more in the nearby mountains. Snowmelt in the Sweet Grass Hills, the Bears Paw Mountains and Glacier National Park is an important source of water for the Milk River. The Milk River is the drinking water source not only for Havre but for Hill County Water Districts, North Havre County Water District and the towns of Harlem and Chinook. Fresno Reservoir is a 5,760-acre irrigation control reservoir on the Milk River, 14 miles upstream from Havre.

General description of the Source Water

Havre gets the majority of its drinking water from the Milk River; groundwater is used occasionally as a backup supply during periods of high demand. The headwaters of the Milk River are on the Blackfeet Indian Reservation and Glacier National Park west of

Havre. Flow in the Milk River is augmented by a diversion from the St. Mary River and by tributaries draining the Sweet Grass Hills and Bears Paw Mountains.

The aquifer beneath Havre consists of shallow unconsolidated sediments deposited in a river valley eroded into shale bedrock. The aquifer is capped by as much as 50 feet of glacial sediments. Post-glacial fluvial deposits occur along the Milk River and Bullhook Creek. Wells drilled to gravel layers in the buried river valley yield over 500 gallons per minute (gpm).

The Public Water Supply

The City of Havre public water system serves 9,800 residents through 3,510 active service connections. Five public water supplies purchase water from the Havre public water supply and serve an additional 50 residents and 200 non-residents. They are Culligan of Havre (PWS ID 3000), Gary and Leo's Fresh Foods (PWS ID 3340), Albertsons (PWS ID 3513), and Mel's Food Store (PWS ID 3347) in Havre, and Last Chance Saloon (PWS ID 1540) in Raymond.

Havre purchases 1,000 acre-feet of Milk River water from the Bureau of Reclamation with the option to buy more if it is available. Water from the Milk River flows through a presedimentation pond and then by gravity to the water treatment plant. Water is treated by coagulation, flocculation, sedimentation, filtration, and disinfection. The capacity of the treatment plant is 3,100 gallons-per-minute. See Appendix A for a diagram of the Havre distribution system. Havre uses groundwater for an emergency backup supply during periods of peak demand and for temperature control to prevent pipe freezing in the winter.

Water Quality

The quality of water in the Milk River watershed varies considerably from place to place, mostly because of differences in geology, erosion rate, and land uses. Approximately 180 miles of streams and 4000 acres of reservoir in the Milk River Watershed upstream from Havre have been identified as being in need of Total Maximum Daily Load (TMDL) development (see details in Appendix B). Designation of a water body as needing TMDL development is based on impairment of a specified use such as aquatic life, fisheries, agriculture, or drinking water. Fresno Reservoir and 57 miles in the upper Sage Creek Watershed are listed because of impairment for drinking water uses.

Saline seep is a water quality problem prevalent in many areas of the Milk River watershed and is related to geologic conditions and agricultural practices. Saline seeps form when water infiltrates downward through surface layers of glacial till and flows to low-lying discharge points along impermeable marine shale bedrock. Salts in the soil and underlying shale are leached, resulting in high dissolved solids concentrations in surface waters.

Raw water from the Milk River at Havre has seasonally high turbidity, alkalinity, and total organic carbon (TOC) (Table 1). Intermittent tributaries to the Milk River are major sources of dissolved solids, especially in late winter and early spring when snowmelt flushes sediment and salts that build up during times of low flow. Intense summer rain events also flush poor quality water from intermittent streams.

Table 1. Selected raw water quality data for the Milk River as recorded by the Havre Water Treatment Plant from 1992 to 1996.

-	Turbidity (NTU)	TDS (mg/L)	Hardness (mg/L)	Alkalinity (mg/L)	Temp. ° F	pH	TOC (mg/L)
Minimum	1.8	190	77	88	1.4	7.4	2
Maximum	775	640	332	487	25.0	8.9	12
Average	16.0	336	175	177	11.3	8.3	7
Median	10.0	329	170	170	10.7	8.4	7

Water from Havre’s wells has higher concentrations of iron, manganese, sulfate and other dissolved solids than does the Milk River source (Table 2). Also, there is significant variation in concentrations among the wells. Leaching of salts contained in glacial sediments and bedrock probably influences the chemical makeup of water from Havre’s wells. Variation in concentrations among the wells probably is a result of variation in contributions of different sources of recharge.

Table 2. Concentration of common constituents in City of Havre wells.

-	Date	pH	Sc µ mhos/cm	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Fe mg/L	Mn mg/L	HCO_3 mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L	Hard.	TDS
Well #3	**09/23/99**	**-**	**-**	**-**	**-**	**-**	**-**	**2.31**	**1.50**	**-**	**-**	**687**	**0.12**	**-**	**-**
Well #5	**01/09/97**	**7.5**	**3410**	**277**	**151**	**437**	**9**	**0.42**	**1.2**	**641**	**47**	**1580**	**1.13**	**1310**	**2970**
Well #6	**09/23/99**	**-**	**-**	**-**	**-**	**-**	**-**	**0.27**	**0.25**	**-**	**-**	**845**	**11.3**	**-**	**-**

Influencing Factors

Havre is using Drinking Water State Revolving Fund money to upgrade its treatment plant, partly to address their difficulty in dealing with turbidity problems in the source water. Identifying and managing the origin of the turbidity will protect the investment in the plant upgrade.

CHAPTER 2

DELINEATION

The areas of concern for Havre's drinking water are delineated in this chapter. The Montana Source Water Protection Program specifies methods and criteria used to delineate subregions of the source water protection area for the City of Havre. The purpose of delineation is to focus efforts to inventory potential sources of contaminants on areas of greatest concern. This contaminant source inventory is presented in Chapter 3. Relative susceptibility to each of these potential contaminant sources is evaluated and management solutions are recommended in Chapter 4.

Subregions delineated for Havre's Milk River Source are the spill response and watershed regions. The control zone, inventory region, recharge region, and surface water buffer are delineated for Havre's groundwater sources. The Montana Source Water Protection Program (DEQ, 1999) specifies that the spill response region include all surface waters and land within one-half mile on either side of a river and its tributaries for ten miles or a four-hour time-of-travel upstream from a water intake. The spill response region is the focus of the most detailed contaminant source inventory for surface water sources. The watershed region comprising the remainder of the drainage basin upstream from an intake is subject to a less detailed inventory.

The control zone and the inventory region are the focus of the most detailed contaminant source inventory for wells. The control zone is a fixed 100-foot radius circle around each well while groundwater time-of-travel and hydrogeologic boundaries define limits of the inventory region. A surface water buffer is delineated for Havre because the aquifer tapped by their wells probably is hydraulically connected to surface water. The surface water buffer is delineated similar to a spill response region for river sources and is subject to a detailed inventory for sources of microbial contaminants. The recharge region covers the overall area that contributes water to a source aquifer and is subject to an inventory similar to the watershed region for rivers.

Geologic and Hydrologic Conditions

The headwaters of the Milk River are on the Blackfeet Indian Reservation and in Glacier National Park approximately 175 miles west of Havre. The Milk River flows into Alberta, Canada near its headwaters and then east until reentering Montana approximately 60 miles upstream from Havre. Flow in the Milk River is augmented by a diversion from the St. Mary River and tributaries flowing from the Sweet Grass Hills and the Bears Paw Mountains. In total, the Milk River drains approximately 5,785 square miles upstream from Havre.

The average and median flows of the Milk River are 432 and 178 cubic feet per second (cfs). Flow is highly variable, however. Peak annual flows ranged from 1,010 to 11,400 cfs between 1954 and 1996 while flows less than 10 cfs were recorded several times during that period. Flow is affected by annual and seasonal variations in runoff and water storage for irrigation. The majority of flow in the Milk River at Havre comes from snowmelt in its headwaters, the St. Mary Diversion, and tributaries that flow north from the Sweet Grass Hills (Table 3). Big Sandy and Beaver creeks are important tributaries to the Milk River near Havre. They flow primarily in response to brief storms in late spring and early summer and to runoff from snowmelt from the Sweet Grass Hills and Bears Paw Mountains in late winter and early spring.

Bedrock in the Milk River watershed varies from place to place (Figure 2). Sedimentary rocks, faulted and stacked in response to continent-wide forces, are found in Glacier National Park. The cores of the Sweet Grass Hills and Bears Paw Mountains are igneous rock that rose in molten form through layers of sedimentary rocks and then cooled. These rocks were exposed when the overlying sedimentary layers were stripped away by erosion. Sedimentary formations dip gently east from the flanks of the Sweet Grass Hills and underly the eastern portion of the watershed. Glacial till and outwash mantle bedrock over much of the eastern portion of the watershed and fluvial deposits are found in stream valleys.

Table 3. Stream flow data for streams in the Milk River Watershed (number of observations in parentheses).

Gauging Station	Area (mi^2)	Average (cfs)	Maximum (cfs)	Minimum (cfs)
Milk near Del Bonita (4)	325	83.4	5780	0
North Milk River (73)	60	24.7	1320	1.7
Milk at Eastern Crossing (81)	2506	470.8	7450	0
Big Sandy near Havre (15)	1805	19.9	5100	0
Sage Creek near Kremlin (6)	914	1.9	692	0
Beaver Creek near Havre (4)	87	11.3	498	0
Milk at Havre (62)	5785	377.4	16000	0

Havre is built on glacial deposits of clay, silt, and sand overlying sand and gravel deposited in a buried valley eroded into bedrock. This valley is believed to be the pre-glacial channel of the Missouri River (Alden, 1932). The buried channel follows Big Sandy Creek north from the current Missouri River channel then follows the Milk River downstream from the mouth of Big Sandy Creek. The Milk River and Bullhook Creek, a tributary to the Milk River at Havre, have eroded alluvial channels into glacial sediments.

Correlation of lithologic descriptions from well logs indicates there are shallow and deep water-producing intervals below Havre that appear to be separated by a continuous clay layer. The shallow water-producing interval is locally known as the 50-foot zone because of the typical depth of wells in north Havre. The City of Havre wells produce water from sand and gravel between 70 and 107 feet deep, probably in the deeper water-producing interval. Water levels in monitor wells near the Senior Citizen Center and the BN-Santa Fe Railyard indicate that groundwater flows north-northeast toward the Milk River at a gentle gradient.

Conceptual Model

The Milk River and its tributaries immediately upstream from Havre are of greatest concern for source water protection. Contaminants that spill into these streams or accumulate in flood plains can reach Havre before water plant operators can close the intake. Also, contaminants in groundwater can enter the Milk River where it is hydraulically connected to underlying glacial sediments. Activities in the remainder of the watershed contribute most of the dissolved solids transported by the Milk River, however they are less of a threat to Havre water users because mixing and residence in Fresno Reservoir reduces the concentrations of contaminants to less harmful levels.

Havre's wells tap gravel layers in a buried alluvial valley of the pre-glacial Missouri River (Figure 3). Groundwater flows toward the northeast in the area of Havre's wells. Some water probably discharges to the Milk River with the remainder following the buried channel to the northeast. The aquifer is recharged by precipitation south and southwest of town and surface water from Bullhook Creek that infiltrates through glacial sediments. Bedrock of the Judith River Formation probably is a less significant source of recharge. Flooding could cause water to flow from the Milk River to the surrounding alluvium and possibly reverse the groundwater gradient in the vicinity of Havre's wells temporarily.

Conclusions based on this conceptual model are uncertain because the extent and properties of the aquifer, and the direction and rate of groundwater flow are not known precisely. The main uncertainty is that the groundwater flow direction near Havre's wells can be approximated from water levels measured in monitoring wells near the Senior Citizen Center and the BN-Santa Fe Railyard. Groundwater probably converges from the south and west toward Havre's wells. Also, the direction of groundwater flow probably changes in response to seasonal changes in recharge rate and variability of aquifer properties.

Source Intakes

Havre obtains water from a concrete diversion structure in the Milk River built by the Bureau of Reclamation in 1985. Water then flows by gravity to a presedimentation pond and the water treatment plant. Four wells are available for use by Havre, however, only wells #3 and #6 are used. Table 4 gives information obtained from well logs for Havre's wells #3 and #6 and other nearby wells (see well logs in Appendix E).

Table 4. Source well information for City of Havre wells.

Information	***Well #3***	***Well #6***
MBMG #	166002	165989
Date Completed	4 – 29 – 1929	9 – 10 – 75
Depth	95.5 ft	88 ft
Lithology	18.5-ft Gravel	20-ft Gravel & Sand
Perforated Interval	61 – 95.5 ft	68 – 88 ft
Static Water Level Depth	19 ft	16 ft
Pumping Water Level Depth	NA	24 ft
Drawdown	NA	8 ft
Test Pumping Rate	750 gpm	400 gpm
Specific Capacity	NA	50 gpm/ft
Source Type	Unconsolidated Alluvium (semi-confined)	Unconsolidated Alluvium (semi-confined)
Sensitivity	Moderate	Moderate

Delineation Results

Spill Response Region – The mean velocity of the Milk River was 1.72 miles-per-hour and only exceeded 2.5 miles-per-hour once between July 1995 and November 1998 (data from USGS gaging station at Havre). Accordingly, to ensure a four-hour time-of-travel under the majority of flow conditions the upstream extent of the spill response region for Havre is 10 miles from the water intake (Figure 4).

Watershed Region - The watershed region for Havre straddles the Canadian Border and includes parts of the Rocky's Boy Indian Reservation and Glacier National Park (Figure 5).

Inventory Region – A three-year time of travel distance and boundaries of the buried alluvial aquifer define the inventory region for wells #3 and #6 (Figure 6). Time-of-travel distances for wells #3 and #6 are calculated assuming no well interference. In addition to the three-year time-of-travel distance, a one-year time-of-travel distance is calculated for use in the susceptibility assessment in Chapter 4. The down-gradient extents (stagnation points) and the lateral boundaries of the zones of contribution of wells #3 and #6 are calculated, also to define the limits of the inventory region (see Appendix C for equations).

Estimates of input parameters including well discharge rate, ambient ground water flow direction, ground water gradient, and aquifer flow properties are used to calculate one-year and three-year times-of-travel distances for each well (Table 5). Well discharge rates are based on estimated water use per person (EPA, 1991) and the population of Havre. Groundwater flow direction and gradient are taken from reports on groundwater contamination near the Senior Citizens Center (Maxim, 1998) and the BN-Santa Fe, Railyard (Kennedy/Jenks Consultants, 1999). Effective porosity is estimated at 20%, a typical value for a sand or gravel aquifer. Transmissivity is estimated from specific capacity from well logs of all Havre wells using the following equation: [transmissivity equals (2000 multiplied by specific capacity)] (Driscoll, 1995), where specific capacity is in gpm/ft units and transmissivity is in gpd/ft units. The thickness of water-producing intervals is used to estimate aquifer thickness and to calculate hydraulic conductivity [hydraulic conductivity equals transmissivity multiplied by aquifer thickness]. Results of time-of-travel calculations are most sensitive to uncertainty in hydraulic conductivity, hydraulic gradient, and porosity. Changes in pumping rate and thickness have negligible effect on results.

Table 5. Input parameters and calculated times-of-travel**.**

Input Parameter	Range	Values Used	
Transmissivity	3,000 – 19,950 ft^2/d	16,200 ft^2/d	
Thickness	15 – 20 ft	18 ft	
Hydraulic Conductivity	180 – 1,330 ft/d	900 ft/d	
Hydraulic Gradient	0.001 – 0.008	0.003	
Flow Direction	N10° W – N35° E	N12° E	
Effective Porosity	0.15 - 0.30	0.20	
Pumping Rate	0 – 1,500,000 gpd	0 gpd	750,000 gpd
1-Year TOT	0.44 – 1.55 mi	0.93 mi	1.11 mi
3-Year TOT	0.87 – 4.36 mi	2.80 mi	3.04 mi
Stagnation Point	0 – 315 ft	0 ft	315 ft
Boundary Limit	0 – 990 ft	0 ft	990 ft

Surface Water Buffer – The surface water buffer includes the watershed of Bullhook Creek upstream from the boundary of the inventory region. The extent of the watershed was delineated instead of a one-half-mile buffer because of the small size of the watershed.

Recharge Region – The recharge region includes the watershed of Bullhook Creek and the buried pre-glacial Missouri River alluvial valley southwest of Havre.

Limiting Factors

Buffers for the spill response region were delineated using a geographic information system and digital maps of streams and therefore may not be exactly one-half mile from shorelines. During high water, the width may be significantly less than one-half mile. However, under most circumstances a minimum buffer width of at least 1,000 ft should be maintained. Therefore, spills outside the spill response region should not present an immediate threat to Havre’s water.

Groundwater flow direction near Havre’s wells was inferred from water levels measured in monitor wells near the Senior Citizen Center and the BN-Santa Fe groundwater contamination sites. These wells were completed in shallower intervals and may not give flow directions characteristic of the deeper aquifer.

CHAPTER 3

INVENTORY

Potential contaminant sources were inventoried to assess the susceptibility of Havre's drinking water sources to contamination. Sources of all primary drinking water contaminants and cryptosporidium were identified, however, only potential sources of contaminants that are the greatest threat to health were selected for detailed inventory. The contaminants of greatest concern to Havre are nitrate, microbiological contaminants, fuels, solvents, and pesticides.

The inventory for Havre focuses on facilities that generate, use, or store potential contaminants, and certain land uses in the spill response region of the Milk River source and the inventory region of the groundwater source. General land uses and sources of microbial contaminants are identified in the surface water buffer along Bullhook Creek. General land uses and large spill threats are identified in the remainder of the Milk River watershed and the recharge region for the wells.

Inventory Method

Available databases were searched to identify businesses and land uses that are significant potential sources of regulated contaminants. The following steps were followed:

Step 1: Land use was identified from an Arc/Info 90-meter land cover grid (Redmond et al., 1998).

Step 2: EPA's Envirofacts System was queried to identify EPA regulated facilities. This system accesses facilities listed in 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 should be classified as a significant potential contaminant source.

Step 3: DEQ databases were queried to locate underground storage tanks (UST), areas of known groundwater contamination, landfills, and abandoned mines.

Step 4: A business phone directory was queried to identify businesses that generate, use, or store chemicals. Equipment manufacturing and/or repair facilities, printing or photographic shops, dry cleaners, farm chemical suppliers, and wholesale fuel suppliers were targeted by standard industrial classification code.

Step 5: Major road and rail transportation routes were identified throughout the inventory region.

Step 6. All land uses and facilities that generate, store, or use large quantities of potential contaminants were identified within the recharge region and identified on the base map.

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

1. Large quantity hazardous waste generators
2. Landfills
3. Known groundwater contamination
4. Underground storage tanks
5. Major road or rail transportation routes
6. Cultivated cropland
7. Animal feeding operations
8. Wastewater lagoons or spray irrigation
9. Septic systems
10. Sewered residential areas
11. Storm sewer outflows
12. Floor drains, sumps, or dry wells

Aerial photographs were obtained and a windshield survey was conducted to observe the facilities first hand. The inventory was reviewed and corrected by the community advisory group.

Inventory Results for Milk River Source

Spill Response Region

Significant potential contaminant sources in the spill response region are mapped on Figure 7 and listed in Table 6. Land uses in the spill response region for the Milk River Source are primarily agricultural. Forty-four percent of the land is grassland or brush, twenty-seven percent is cultivated cropland, twenty percent is riparian vegetation or water, and five percent is developed. Population density is 10 persons-per-square-mile with the greatest density in a strip south of Highway 2 between Big Sandy and Beaver creeks.

The Northern Montana Agricultural Experiment Station has a MPDES discharge permit for a 0.7-acre feedlot along Beaver Creek. Animal wastes that accumulate in the feedlot could discharge directly to Beaver Creek during intense storms or prolonged wet periods. The Hill County Fairgrounds has a MPDES permit to discharge stormwater to a barrow pit near Beaver Creek. Saline seeps on the fairgrounds and runoff from barns and pasture during the Hill County Fair are the primary contaminant sources of concern. Highway and rail bridges and a remote train refueling station are potential sources of spills of fuels and other chemicals. Several businesses in the spill response region may use or store hazardous chemicals (see Appendix D for list). Most of these businesses use or store relatively small quantities of chemicals and therefore alone are minimal hazards to Havre’s drinking water. However, taken collectively several small businesses can be a hazard for stormwater runoff. Therefore, businesses considered minimal hazards individually are mapped as "minor sources" and lumped together under the category "stormwater runoff" in Table 6. Stormwater runoff from the Hill County Airport and an automobile salvage-yard are of particular concern.

Table 6. Significant potential contaminant sources in the City of Havre spill response region**.**

Map #	Contaminant Source	Description
1	Northern Montana Agricultural Experiment Station	Confined Animal Feeding Operation General Discharge Permit
2	Hwy 2 and 87 Crossings	Road Transport of Hazardous Materials
3	BN Santa Fe Railway Crossings	Rail Transport of Hazardous Materials; See Appendix D for Traffic Analysis
4	BN Santa Fe Remote Fueling Area	Diesel spills during refueling and overland flow toward the Havre Water Plant
5	Stormwater Runoff	Stormwater runoff from airport, Auto Salvage, and minor sources; See Appendix D for list of minor sources
6	Hill County Fairgrounds	MPDES stormwater discharge permit holder
7 - 13	7 Underground Storage Tank Leak Sites	See Appendix D for list and cleanup status
14	Unsewered Residential	Seepage of septic system effluent
15	Cultivated Cropland	Potential for spills or over-application of herbicides, pesticides, and fertilizer

Watershed Region

Cultivated cropland in the Havre watershed region is concentrated in the Sage Creek and Upper Milk River subbasins, and lower elevations of the Big Sandy Creek, Beaver Creek, and Milk Headwaters subbasins (Figure 8). Grassland is concentrated along stream bottoms in agricultural areas and in the foothills of the Sweet Grass Hills, Bears Paw Mountains, and Glacier Park. The higher elevations of the Bears Paw Mountains and Glacier Park are the primary forested areas of the watershed region. Urban buildup outside the Havre area is limited to the Rocky Boy's Reservation and small communities along Highway 2 and east of Glacier National Park. Hazardous waste handlers, agricultural chemical distributors, wastewater treatment facilities, and landfills are potential contaminant sources associated with these small communities (Figure 8 and Table 7). Mining activity in the Havre watershed region includes base and precious metals mining in the Sweet Grass Hills and Bears Paw Mountains, coal mining east of Big Sandy, and sand and gravel mining throughout the watershed. Oil exploration and production has occurred throughout the watershed, most heavily on the north slopes of the Sweet Grass Hills. Other mineral commodities mined in the Milk River Watershed include iron in the Milk River Headwaters subbasin and uranium in the south end of the Bears Paw Mountains.

Cropping practices can increase saline seeps and soil erosion. Excessive application of fertilizer, herbicides, and pesticides can release nutrients and synthetic organic chemicals to surface water. Livestock grazing and logging in riparian areas can accelerate erosion and increase turbidity. Improper livestock grazing also can contribute microbial contaminants and organic carbon. Wastewater treatment facilities discharge treated effluent directly to tributaries of the Milk River. Other facilities in Table 7 are primarily potential sources of accidental spills. Waste rock and mill tailings from mining and oil-well brine pits are potential sources of contaminants from mineral exploration and production activities. Drainage from mines can have low pH and contain metals. Brines produced with oil can increase total dissolved solids.

Table 7. Potential contaminant sources in the Havre watershed region (see Appendix D for detailed list).

Facility	Type	Description of Hazard
8 RCRA Facilities	Hazardous Waste Handlers	Small Spills
5 SSTS Facilities	Pesticide Handlers	Small Spills
6 Landfills	Domestic Solid Waste Disposal	Groundwater Contamination
Road, Rail, and Pipeline Crossings	Crude Oil Pipeline	Catastrophic Spills
Concentrated Animal Feeding Operation	Animal Wastewater Lagoon	Groundwater Contamination or Overflow
USBIA Rocky Boy’s Agency	Wastewater Treatment Facility	Discharge to Box Elder Creek
Toole County Commissioners	Wastewater Treatment Facility	Discharge to Unnamed Dry Lake
Lower Dry Fork WWTF	Wastewater Treatment Facility	Discharge to Box Elder Creek
City of Big Sandy	Wastewater Treatment Facility	Discharge to Big Sandy Creek

Inventory Results for Wells #3 and #6

Inventory Region

The inventory region for Havre’s wells is a mixture of agricultural and urban land use. Twenty-eight percent is sewered residential, thirteen percent is commercial and other urban, twenty-eight percent is cultivated cropland, and twenty-two percent is rangeland. Sewered residential and commercial development is the predominant land use within a one-year time of travel of the wells whereas cropland and rangeland are the predominant land uses between one- and three-year time-of-travel distances.

Potential contaminant sources of greatest concern in the inventory region are underground storage tanks, stormwater runoff from commercial and residential areas, and leakage from sanitary sewers (Figure 9 and Table 8). Groundwater contamination from an underground storage tank leak near the Senior Citizen Center and Havre’s well #3 is of particular concern. Contaminants from small spills at residences and small businesses in the inventory regions may discharge to the stormwater sewer (Bullhook Creek) and seep into groundwater where Bullhook Creek is channeled beneath Havre. Sanitary sewer lines may leak if actions are not taken to detect and repair leaks.

Groundwater in several areas of the BN-Santa Fe Railyard located between First Street North and the Milk River flood control levee is contaminated extensively by diesel fuel.

This site is down-gradient from the inventory region and therefore is not considered a significant potential contaminant source for Havre's public water supply wells.

Table 8. Significant potential contaminant sources in the inventory regions of Havre's wells**.**

Map #	Contaminant Source	Description
16 - 19	4 Underground Storage Tank Sites	See Appendix D for list and volumes stored
20 - 23	4 Underground Storage Tank Leak Sites	See Appendix D for list and cleanup status
24	Sewered Residential	Potential for leaks from deteriorated or broken sewer pipes
25	Stormwater Sewer	Potential for seepage from Bullhook Creek
26	Cultivated Cropland	Potential for spills or over-application of herbicides, pesticides, and fertilizer
27	Unsewered Residential	Potential for microbes or nitrate concentrations to exceed the natural attenuation capacity of soil and aquifer materials

Surface Water Buffer

Land use in the surface water buffer along Bullhook Creek is almost exclusively grass-rangeland. Population density in the surface water buffer is five persons-per-square-mile. One small unsewered development is located along Bullhook Road east of Bullhook Creek and west of Saddle Butte. There are no concentrated animal feeding operations or sewered residential developments. Fifteen miles of Bullhook Creek are listed as a low priority for TMDL development based on impairment of cold water fishery and aquatic life resources resulting from grazing practices and streambank modification.

Recharge Region

Land use in the recharge region for Havre's wells is predominantly agricultural. Many of the point contaminant sources listed in the inventory for the spill response region for the Milk River source (Table 6) also are potential sources of groundwater contamination in the recharge region of Havre's wells.

As in the watershed region for the Milk River source, cropping practices can impact water quality by increasing saline seeps and erosion. Excessive application of fertilizer, herbicides, and pesticides also can contaminate water draining from cropland. Spills of fuels and solvents stored at equipment manufacture and repair facilities and leaks from underground storage tanks also can impact water quality.

Inventory Update

The certified operator will update the inventory every year. Changes in land uses or potential contaminant sources will be noted and additions made as needed. The complete inventory will be submitted to DEQ every five years to ensure recertification of the source water protection plan.

Inventory Limitations

The potential contaminant sources for Havre's public water supply are identified from readily available information. Unregulated activities or unreported contaminant releases may have been missed. However, the use of multiple sources of data should ensure that the major threats to the source water for Havre are identified. Also, the local community advisory group and a windshield survey confirmed search results.

CHAPTER 4

SUSCEPTIBILITY ASSESSMENT

Susceptibility of Havre's source water is determined by two factors: the potential of a contaminant reaching the intake and the resulting health hazard. The purpose of assessing susceptibility is to prioritize significant potential contaminant sources for Havre to manage in order to minimize threats to their drinking water source.

Susceptibility is assessed in the spill response region for the Milk River source and the inventory region and surface water buffer for Wells #3 and #6. Susceptibility to potential point contaminant sources in the watershed or recharge regions is considered low because dispersion and dilution of contaminants should reduce their concentrations below levels associated with adverse health affects. Non-point contaminant sources in the watershed region do impact Havre's water quality, but management of these sources is beyond local control. Instead, efforts intended to reduce impacts in the watershed are better implemented through existing conservation and restoration programs, primarily the TMDL program.

Susceptibility is determined under the Montana Source Water Protection Program by the hazard associated with a source and the existence of barriers. Hazard ratings for point sources of contaminants in Havre's spill response region are assigned according to whether contaminants can discharge directly to the Milk River or one of its tributaries, and the kind of contaminant (Table 9). Hazard for wells is determined by the proximity of a potential contaminant source to a well. Hazard for significant potential contaminant sources located within a one-year time-of-travel is rated high. Those located between one-year and three-year times-of-travel are rated moderate.

Barriers can be engineered structures, management actions, or natural conditions. The existence of barriers lowers susceptibility by decreasing the likelihood that contaminated water will flow to Havre's Milk River intake or wells (Table 10). Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant.

Table 9. Hazard ratings for potential contaminant sources in Havre's spill response region.

-	High Hazard	Moderate Hazard	Low Hazard
Point Sources of Nitrate or Microbial Contaminants	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 Fuels, Solvents, 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
Septic Systems	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
Cultivated Cropland	More than 50 percent of spill response region	20 to 50 percent of spill response region	Less than 20 percent of spill response region

Table 10. Susceptibility to 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

Dilution is considered a barrier for potential contaminant sources in the spill response region if concentrations of contaminants discharged directly to the Milk River or one of its tributaries are reduced to insignificant levels. However, dilution is not considered a barrier to microbial contaminants under any circumstances. Land slope also is considered a natural barrier in the spill response region if contaminants spilled on land are not expected to flow rapidly to the Milk River or one of its tributaries. Up to 75 ft of clay and sandy clay glacial till present throughout Havre's inventory and spill response regions constitutes a natural barrier to groundwater contamination. The presence of a permit process that restricts activities at a potential contaminant source is considered a management barrier. For example, Montana Pollutant Discharge Elimination System (MPDES) permits include provisions such as runoff control that effectively reduces the susceptibility of a downstream water intake. Best Management Practices to reduce releases from non-point contaminant sources also are considered effective management barriers. Leak detection and leak prevention are the primary engineered barriers that are considered effective in reducing susceptibility.

The following are brief descriptions of the susceptibility assessments for each significant potential contaminant source included in Table 6 or Table 8. The results of this susceptibility assessment are summarized in Table 11.

Susceptibility Assessment / Milk River Source

Highway, Rail, and Pipeline Crossings - Hazard is rated high because large quantities of chemicals can spill directly to the Milk River or its tributaries. Susceptibility is rated very high because there are no barriers to prevent contaminants from flowing to the Havre intake.

BN Santa Fe Remote Fueling Area - Hazard is rated as moderate because spills of diesel may occur in close proximity to the Havre water plant. Susceptibility is rated moderate because land slope is a barrier that should prevent diesel from reaching the Havre water plant before emergency measures can be implemented.

Hill County Fairgrounds - Hazard is rated high because contaminants from animal wastes that are associated with acute health effects can accumulate during fairs and discharge directly to surface water during intense storms or prolonged wet periods. Susceptibility is very high with respect to microbial contaminants because there are no barriers. Susceptibility with respect to nitrate is moderate because dilution is a barrier.

Northern Montana Agricultural Experiment Station - Hazard is rated high because animal wastes that accumulate in the feedlot could discharge directly to Beaver Creek and because nitrate and microbial contaminants cause acute health affects. Susceptibility for nitrate is rated moderate because the facility's MPDES permit requires runoff control from the confined animal feeding operation (CAFO) and because dilution should reduce concentrations below significant levels. Dilution is not a barrier for microbial contaminants, consequently susceptibility for microbial contaminants is rated high.

Stormwater Runoff - Hazard is rated moderate because chemicals spilled at facilities throughout the spill response region can discharge directly to surface water during storms or prolonged wet periods. Areas of particular concern are the airport, an auto salvage yard near the Havre presedimentation pond, clusters of equipment manufacturing and repair businesses, city and county shops, and the Montana Department of Transportation property. Hazard is not rated high because the common contaminants are not associated with acute health affects at concentrations expected to reach the Milk River or its tributaries. Susceptibility is rated high instead of very high because dilution of the already low concentration runoff should keep concentrations at the intake below regulatory limits.

Underground Storage Tank Leaks – Hazard is rated low for the seven underground storage tank leak sites in the spill response region because direct discharge to surface water is unlikely to occur and because fuels are not associated with acute health effects at the concentrations expected to occur. Susceptibility is rated low because clay-rich soils should limit transport of contaminants through groundwater to the Milk River or its tributaries.

Septic Systems - Hazard is rated low for septic systems because septic system density in the spill response region is less than the 50 per square mile threshold designated in Montana's Source Water Protection Program. Susceptibility for nitrate and microbial contaminants is rated low because clay-rich soils are a barrier. The high-density development between Big Sandy and Beaver creeks exceeds the threshold of 300 per square mile for high hazard; continued development at this density will eventually increase the overall hazard rating for septic systems.

Cultivated Cropland – Hazard is rated moderate because 27% of the spill response region is cropland. Susceptibility is rated moderate because thick clay-rich soils should limit seepage of contaminants to the Milk River or its tributaries.

Susceptibility Assessment of Havre's Wells

Underground Storage Tank Leaks – Hazard is rated as high because all leak sites are within a one-year time-of-travel distance of Well #3 or #6. Susceptibility is rated very high because there are no barriers to contaminants reaching the well. Contamination near the Senior Citizen Center is of particular concern.

Underground Storage Tanks – Hazard is rated high for the three UST sites that are located within a one-year time-of-travel distance from either Well #3 or Well #6. Susceptibility is rated moderate because the tanks meet current leak prevention and detection requirements and clay-rich glacial till should limit contaminants from reaching the aquifer. Hazard for the one UST located between one- and three-year time-of-travel distances is rated moderate and susceptibility is rated low.

Septic Systems – Hazard is rated low because the density of septic systems in the inventory region outside the sewer limits and in the surface water buffer is less than 50 per square mile as estimated from census population data. Susceptibility is rated low because clay-rich soils should limit infiltration of contaminants.

Stormwater Runoff – Hazard is rated high because stormwater discharges to Bullhook Creek and flows in a partially unlined ditch beneath Havre. Only a few businesses use or store chemicals in the inventory region, although residential runoff may contain VOCs and SOCs. Susceptibility is rated high because clay layers between the surface and the aquifer should limit infiltration of contaminants.

Sanitary Sewers – Hazard is rated high because the wells are within a one-year time-of-travel distance of sewer lines. Susceptibility is rated high because clay layers above the aquifer constitute the only barrier that can prevent either nitrate or microbial contaminants from reaching the well intakes.

Cultivated Cropland – Hazard is rated moderate because 28% of the inventory region is cultivated. Susceptibility is rated moderate because thick clay-rich soils should limit infiltration of contaminants to the aquifer.

Management Recommendations for the Spill Response Region

Management recommendations are listed along with the susceptibility analysis in Table 11. These recommendations can be considered additional barriers that if implemented will reduce the susceptibility of Havre's source water to specific sources and contaminants. Recommendations fall into four categories: constructed barriers, construction restrictions, best management practices, and emergency planning.

Spill or runoff containment is recommended for potential contaminant sources where direct discharge to the Milk River or its tributaries may occur. Consideration should be given in all cases to probable spill or runoff quantities and additional capacity required in case of flooding. For other sources, county ordinances may be warranted to control or restrict construction in unsewered residential areas or to regulate siting of certain industrial activities. For all sources, spill prevention procedures and best management practices should be encouraged through education or, if necessary, required by county ordinance.

The only practical barrier that will safeguard against spills at road, rail, or pipeline crossings is emergency planning. An emergency plan that includes a list of types of chemicals and the frequency with which they are transported through the spill response region should be developed. In addition, the name of an emergency coordinator and a description of possible actions that can be taken if a problem arises should be included. The equipment and materials, short-term replacement water supply, and source of funds necessary in case of a spill should be specified.

Management Recommendations for the Watershed Region

Management of potential contaminant sources within the Watershed Region can be addressed through state initiatives such as the Total Maximum Daily Load (TMDL) program. Under House Bill 546, DEQ sets limits, known as TMDLs, for each pollutant entering a body of water. TMDLs are established for streams or lakes which fail to meet certain standards for water quality. The quantity of each pollutant a waterbody can receive without violating water quality standards is identified in the TMDL process. TMDLs take into account the pollution from all sources, including discharges from industrial plants and sewage treatment facilities, runoff from farms, forests and urban areas, and natural sources such as decaying organic matter or nutrients in soil. DEQ determines both the amount of a pollutant that enters the water naturally and the amount that enters the water from discharges and runoff. DEQ then balances the quantities of pollutants allowed from all sources so that the total amount does not exceed the limits necessary to maintain water quality. Through these limits, DEQ can make sure the water remains (or becomes) safe for fishing, drinking, recreation, and aquatic life.

House Bill 546 provided DEQ $1.4 million to be used to restore water bodies listed as in need of TMDL development. Developing TMDLs for stream segments in the Watershed Region listed as impaired by DEQ (see Appendix B) can abate sources of contamination upstream from Havre. The most common sources of impairment in the Milk River Watershed are cultivation of cropland, pasture grazing, and streambank modification or destabilization; these activities contribute to increased nutrients, salinity, and siltation.

Table 11. Summary of susceptibility assessments for significant potential contaminant sources in the Havre source water protection areas.

Source	Contaminant Source	Contaminant	Origin	Hazard	Barriers	Susceptibility	Management Recommendations
Milk River Source	Highway / Rail / Pipeline Crossings	VOCs and SOCs	Spills	High	None	Very High	Emergency response planning, Maintain a list of transported chemicals.
	Hill County Fairgrounds	Microbial Contaminants and Nitrate	Direct discharge due to storm event	High	None	Very High	Collect and dispose of animal wastes during fairs
	N. MT Ag. Experiment Station.	Microbial Contaminants and Nitrate	Direct discharge due to storm event	High	Runoff Control	High	Increase setback from Beaver Creek
	BN Santa Fe Remote Fueling Area	Diesel Fuel	Overland flow of diesel spilled during train fueling	Moderate	Land Slope	Moderate	Spill containment and spill prevention procedures, Emergency response planning.
	Stormwater Runoff	VOCs and SOCs	Direct discharge	Moderate	Dilution	Moderate	Runoff control, Waste chemical collection
	Cultivated Cropland	SOCs, Nitrate	Spills or excessive application of Ag. Chemicals	Moderate	Thick clay-rich soils	Moderate	Safe mixing and application of herbicides
	LUST Sites	VOCs	Seepage from groundwater	Low	Thick clay-rich soils	Low	Monitor remediation progress
	Septic Systems	Microbial Contaminants and Nitrate	Infiltration of effluent	Low	Tick clay-rich soils	Low	Growth management
Wells #3 and #6	LUST Sites	VOCs	Groundwater contamination	High	None	Very High	Monitoring,
	Sanitary Sewer	Microbial Contaminants and Nitrate	Leaks	High	Thick clay-rich soils	High	Leak monitoring and sewer maintenance

	Stormwater Runoff	VOCs	Spills	High	Thick clay-rich soils	High	Runoff control, Waste chemical collection.
	USTs	VOCs	Undetected leak	High	Compliance with leak detection/leak prevention regulations, Thick clay-rich soils	Moderate	Monitor compliance with state regulations
	Cultivated Cropland	SOCs, Nitrate	Spills or excessive application of Ag. Chemicals	Moderate	Thick clay-rich soils	Moderate	Safe mixing and application of herbicides
	Septic Systems	Microbial Contaminants and Nitrate	Infiltration of effluent	Low	Thick clay-rich soils	Low	Growth management, Sewer extension

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