City of Hysham
Public Water Supply

PWSID #MT0000428

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Date of Report: 17 September 2002

Operator/Manager:

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INTRODUCTION

This Delineation and Assessment Report was prepared by Jim Stimson, a hydrogeologist with the Source Water Protection Program of the Montana Department of Environmental Quality (DEQ), and by intern Shonna Jorgensen. The City of Hysham public water supply (PWS) is located in Treasure County, Montana, about 72 miles west of Miles City. The DEQ PWS identification number, operator name, and operator number for the Hysham PWS appear on the title page of this report.

Purpose

This report is intended to meet the technical requirements for the completion of the source water delineation and assessment report for the City of Hysham PWS as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182). The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to the protection of public drinking water supplies from contamination. The primary purpose of this source water delineation and assessment report is to provide information to assist the City of Hysham PWS operator in the identification of potential contaminant sources near the City of Hysham intakes and the need for a source water protection plan to protect the City of Hysham drinking water sources.

Delineation and assessment constitute major components of the Montana Source Water Protection Program. Delineation entails mapping the boundaries of source water protection areas, which encompass ground water and/or surface waters contributing to public water supply sources. Assessment involves identifying locations or regions within source water protection areas where contaminants may be generated, stored, transported, or disposed, and determining the relative susceptibility of drinking water to contamination from these sources.

Limitations

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

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 to certain carcinogenic or toxic constituents that do not have MCLs but are considered to be significant health threats.

CHAPTER 1
BACKGROUND

The Community

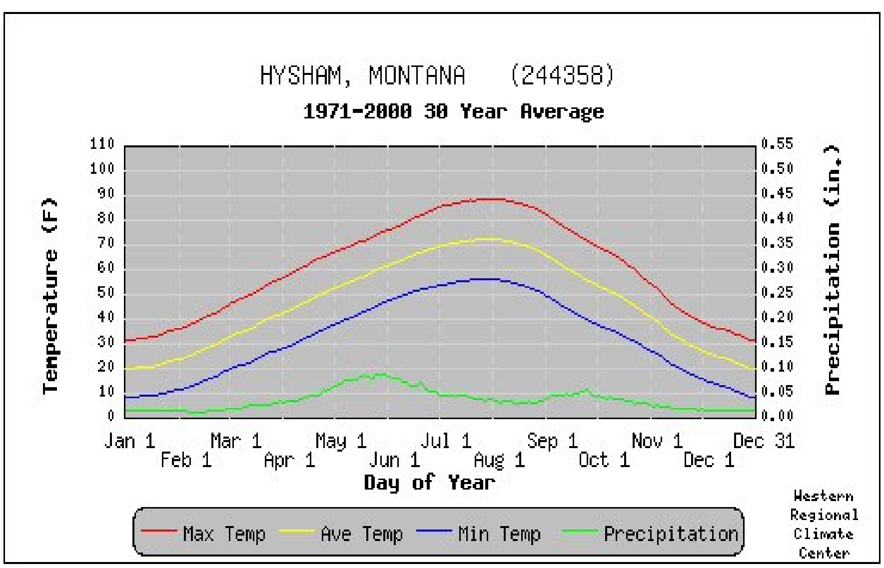
Hysham is the county seat of Treasure County and is about 72 miles west of Miles City, Montana. It is an agricultural community and is surrounded by pasture lands and cultivated fields. Popular recreation areas include the Howery Island Wildlife Viewing Area and Isaac Homestead Wildlife Management Area, which both offer wildlife viewing. Interstate 94 runs near Hysham and the Yellowstone River is located about 1 ½ miles north of town.

The U.S. Census Bureau estimates the 2000 population of Treasure County at 861 people, 330 of whom reside in Hysham. Treasure County's population decreased by about 1.5% and Hysham's decreased by about 8.6% since 1990.

The largest industries in 2000 were state and local government, 25.4% of earnings; transportation and public utilities, 24.2%; and farming, 23.8%. Of the industries that accounted for at least 5% of earnings in 2000, the slowest growing from 1999 to 2000 was farming, which decreased 18.0 %; the fastest was transportation and public utilities, which increased 4.3% (www.bea.doc.gov/bea/regional/bearfacts).

Within the city limits, residents obtain their drinking water from the municipal PWS. There are no other PWSs located in the vicinity of Hysham. The municipal sewer district services all residents within town limits. Municipal wastewater discharges to a multi-cell infiltration pond are located about one mile west of town. Residents in areas outlying town limits utilize on-site septic systems for waste disposal.

Figure 2. Hysham Average Temperatures and Precipitation



Climate

Based on Western Regional Climatic Center data for the period of record, annual precipitation averages 12.97 inches. Monthly average precipitation ranges from 0.39 inches in February to 2.21 inches in June. Summer thunderstorms and winter snows provide a majority of the precipitation in the area. The annual mean snowfall in Hysham is 35.0 inches. A summary of the available climatic data for the Hysham area is presented in Table 1 below.

Table 1. Climatic Summary
City of Hysham, Montana (244358)
Period of Record Monthly Climate Summary
Period of Record : 7/1/1948 to 12/31/2001

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	32.0	39.9	49.0	61.6	71.8	80.6	88.8	88.1	76.5	64.7	46.8	36.7	61.4
Average Min. Temperature (F)	7.3	13.8	21.3	31.7	41.8	50.0	55.1	53.2	42.8	32.7	21.2	12.4	31.9
Average Total Precipitation (in.)	0.47	0.39	0.76	1.38	2.21	2.21	1.34	0.96	1.20	0.99	0.57	0.49	12.97
Average Total Snow Fall (in.)	7.4	4.7	5.3	3.1	0.8	0.0	0.0	0.0	0.3	1.4	5.0	7.0	35.0
Average Snow Depth (in.)	1	1	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 98.6% Min. Temp.: 98% Precipitation 98% Snowfall: 88.8% Snow Depth: 62.7%
Source: Western Regional Climate Center, wrcc@dri.edu

Geographic Setting

Hysham is located in the non-glaciated Missouri Plateau portion of the Great Plains physiographic province of North America (Rocky Mountain Association of Geologists, 1972). This area is also designated as the non-glaciated central ground-water region of the United States (Heath, 1984). The elevation at Hardin is approximately 2,660 feet above mean sea level and the town is located a little over a mile south of the Yellowstone River (Figure 1a and 4). The Yellowstone River valley is approximately four miles wide in the vicinity of Hysham. Topographic relief in the vicinity of Hysham is low with highlands rising about 200 feet above the river valley. Many of the creeks and tributaries to the Yellowstone have moderately incised channels.

Geology

This section provides an overview of the geology and hydrology of the vicinity of Hysham. Reports used for this section include Stoner and Lewis, 1980, Lewis and Roberts (1978), and Vuke et al (2001). The geology of the area can be used to determine the locations, boundaries, and hydraulic properties of local aquifers. An understanding of hydrogeologic conditions also provides an explanation for the sensitivity of local aquifers to potential contamination sources. Geology is not just important for understanding the hydrologic conditions related to ground water but it is also valuable for public water supplies that use surface water. For example, the timing and runoff patterns of streams are influenced in part by the geology within a watershed. Watersheds with large areas of low hydraulic conductivity bedrock tend to respond quickly to precipitation and snowmelt events. Hydrographs from streams within such a watershed show numerous high flow peaks or spikes. On the other hand, streams within watersheds underlain by bedrock that has high hydraulic conductivity tend to have more subdued hydrographs, that is, fewer and more rounded high flow peaks. Infiltration of precipitation and snowmelt waters makes the high flow events rise more gradually and have more rounded peaks. Surface water quality can also be affected by the geology within a watershed and information in this section can be useful for gaining a better understanding of factors that control erosion and sedimentation.

Unconsolidated alluvium is present in the Yellowstone River valley and in many of the tributaries to the Yellowstone. The alluvium consists of lenses of unconsolidated clay, sand, and gravel. As much as 25 feet of alluvium is present in the Yellowstone River valley and up to 13 feet is present in some of the tributaries in the neighborhood of Hysham (Vuke et al (2001). The Yellowstone River alluvium yields economic quantities of water to wells and in most places represents an unconfined aquifer. Terrace deposits are also present within the main river valley and the tributaries. Some of the terraces are between 2 and 350 ft. above the streams and are considered to be Quaternary age, ranging from Pleistocene to Recent (Vuke et al (2001). These terrace deposits consist of gravel, sand, silt, and clay and range in thickness from 15 ft., to as much as 50 ft. in some places. Other terrace deposits are present above the Quaternary terraces. The higher terraces are considered to be Tertiary in age, ranging between Pliocene to Pleistocene (Vuke et al, 2001). The older terrace deposits consist of up to 30 ft. of gray gravel and sand. As in other areas of Montana, the terrace deposits can yield water to wells, particularly if agricultural irrigation water is applied on the upper terrace.

Bedrock exposed at the land surface in the vicinity of Hysham ranges in age from Upper Cretaceous to Recent (Vuke et al (2001). South and northeast of Hysham, the Fort Union, Hell Creek, and Lance formations dominate the landscape. The Fort Union can be up to 1,000 feet thick in the area and can be divided into three members in descending order: the Tullock, Lebo Shale, and Tongue River. There are outcrops of red metamorphosed sedimentary rocks within the Fort Union Formation southeast of Hysham. These beds are referred to as “clinker” and formed when underlying coal beds were ignited and baked the sandstone, siltstone, and shale beds. In some places the heat was so intense that the overlying rocks were metamorphosed into rock resembling volcanic rocks known as scoria. The Hell Creek Formation (Upper Cretaceous) is below the Fort Union, ranges between 200 and 300 feet thick, and contains beds of silty shale, mudstone, sandstone, and coal. Generally, the Hell Creek is more fine grained and contains less coal than the overlying Fort Union. Sandstone beds are more abundant in the lower part of the Hell Creek Formation. The Lance Formation lies between the Hell Creek and Fox Hills formations in this area. The Lance consists of medium grained sandstone lenses interbedded with shale. A conglomerate unit is located near the base of the Lance. The Lance can be up to 300 feet thick. The Fox Hills Formation (Upper Cretaceous) lies below the Lance and is marked by a light-colored sandstone bed ranging in thickness from 30 to 150 feet. The sandstone is known as the Colgate Member and is present over large areas in this region. The lower part of the Fox Hills is made up of sandstone, sandy shale, silty shale, and carbonaceous shale. Thickness of the entire Fox Hills is up to 200 feet thick in this area.

North of Hysham there is a fairly symmetrical fold known as the Porcupine Dome. Within the center and along the flanks of the Porcupine Dome there are older Cretaceous formations exposed at the surface including the Fox Hills Formation, Bearpaw Shale (also known as the Prairie Shale in some locations), Judith River Formation, Clagget Shale, and Gammon Shale. All of these bedrock formations consist of complex mixtures of sandstone, siltstone, shale, and coal. With the exception of the Porcupine Dome where bedrock formations dip between 4 to 6 degrees, bedrock is relatively flat-lying.

An examination of well logs in the area indicates that some wells are completed in the Cretaceous bedrock formations. These wells tend to be deep, greater than 100 feet and yield smaller amounts of water than shallower wells completed in the alluvium. Generally, there are four primary aquifers in this area that include: 1) the alluvial and terrace deposits within stream valleys, 2) the upper 200 feet of the Fort Union Formation, 3) sandstone beds within the lower Fort Union Formation, and 4) the lower Hell Creek - upper Fox Hills Formation (Colgate Member). Sandstone beds within the Lance Formation would be included in group 4. Water from formations below the Bearpaw or Pierre Shale tend to have high total dissolved solids and are too saline for domestic and stock water use.

The Public Water Supply

The Hysham PWS is classified as a community system under the Federal Safe Drinking Water Act, because the system serves at least 25 year-round residents through at least 15 service connections. The PWS services approximately 400 residents, 40 of which are transient, via 214 active service connections.

Hysham receives its water from one source. This source is an infiltration gallery that receives water from the Yellowstone River. Water is collected through two infiltration lines that are made from slotted PVC. These lines are located in the alluvial sand and gravel below a normally dry flood channel of the Yellowstone River and extend to the main river channel. Water from the two lines of the collection system drain into a 72 inch caisson and is then pumped into the treatment plant (DEQ Permitting and Compliance Division, 2000). Disinfection is provided by two in-line, 150- pound gas chlorine cylinders with automatic switchover controls. Chlorine is fed at a rate of about 25 pounds/day, or 2.5ppm. A 100,000 gallon elevated tank is used as a storage reservoir for the town of Hysham.

The treatment plant at Hysham uses filtration in its treatment process. Two low service pumps supply the treatment plant with raw water. The filtration process is a Contact Absorption Clarifier (CAC). The filters are in good condition and are well maintained (DEQ Permitting and Compliance Division, 2000).

The distribution system for Hysham feeds Potassium Permanganate for the removal of high iron concentrations, which can have an effect on the distribution system. High concentrations of iron will slough off of the insides of the mains, causing colored water problems. This is not a constant problem, but it is something that the operator of the system must be aware of in order to take appropriate precautions to prevent it (DEQ Permitting and Compliance Division, 2000).

Due to the fact that Hysham obtains its drinking water from a surface water supply, the source water is classified as highly sensitive to contamination, in accordance with Montana Source Water Protection Program aquifer/source water sensitivity criteria (1999).

Water Quality

Public water systems must conduct routine monitoring for contaminants in accordance with Federal Safe Drinking Water Act requirements. A community public water supply, like Hysham, must sample in accordance with schedules specified in the Administrative Rules of Montana (ARM). Monitoring includes coliform bacteria, lead, copper, nitrate, nitrite, volatile organic chemicals (including hydrocarbons and chlorinated solvents), inorganic chemicals (including metals), synthetic organic chemicals (including pesticides), and radiological contaminants. Transient, non-community PWSs are required to conduct routine monitoring only for pathogens (including coliform bacteria), nitrate, and nitrite. All contaminant concentrations detected in required samples must comply with numeric maximum contaminant levels (MCLs) specified in the Federal Safe Drinking Water Act.

The U. S. Geological Survey collects water quality data for the Yellowstone River at Forsyth, about 30 miles east of Hysham. Table 2 summarizes this data for a 5- year period from 1996 to 2001.

The State of Montana classifies the Yellowstone River mainstem as B-3 surface water. According to the classification, the Yellowstone River is to be maintained suitable for drinking, culinary and food-processing purposes after conventional treatment for the removal of naturally present impurities. These waters must also be maintained as suitable for bathing, swimming, and recreation; growth and propagation of salmonoid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply. These surface water classifications are pursuant to the Administrative Rules of Montana 17.30.600-625.

City of Hysham PWS Water Quality

Within the past five years, no positive fecal coliform samples were collected during routine contaminant monitoring. No MCL exceedances were noted for any other constituents monitored over the past five years.

Table 2 – Water Quality Data summary for select parameters from USGS Station 0629500 at Forsyth. Period of summary is 1996 to 2001.

	TEMPERATURE, WATER (DEG. C)	DISCHARGE, INSTANTANEOUS, CUBIC FEET PER SECOND	TURBIDITY (NTU)	SPECIFIC CONDUCTANCE (MICROSIEMENS/CM AT 25 DEG. C)	OXYGEN DISSOLVED (MG/L)
Average	12.15	13313.96	43.69	518.68	10.24
Max	24.50	51800.00	340.00	805.00	17.40
Min	0.00	2420.00	3.00	182.00	1.40

	PH, WATER, WHOLE, LABORATORY, STANDARD UNITS	CARBONATE, WATER, DISSOLVED, INCREMENTAL TITRATION, FIELD, MG/L AS CO3	BICARBONATE, WATER, DISSOLVED, INCREMENTAL TITRATION, FIELD, MG/L AS HCO3	NITROGEN NITRITE PLUS NITRATE DISSOLVED (MG/L AS N)	PHOSPHORUS TOTAL (MG/L AS P)
Average	8.10	2.70	150.34	0.21	0.15
Max	8.60	24.00	235.00	0.48	0.74
Min	7.50	0.00	71.00	0.05	0.01

	CALCIUM DISSOLVED (MG/L AS CA)	MAGNESIUM DISSOLVED (MG/L AS MG)	SODIUM DISSOLVED (MG/L AS NA)	POTASSIUM DISSOLVED (MG/L AS K)	CHLORIDE DISSOLVED (MG/L AS CL)
Average	45.19	16.14	40.00	2.83	7.23
Max	66.60	26.40	73.00	4.40	13.20
Min	16.60	5.18	10.40	1.21	2.30

	SILICA DISSOLVED (MG/L AS SIO2)	ARSENIC DISSOLVED (UG/L AS AS)	BARIUM DISSOLVED (UG/L AS BA)	BERYLLIUM DISSOLVED (UG/L AS BE)	BORON DISSOLVED (UG/L AS B)
Average	9.50	5.93	41.57	-	137.52
Max	13.00	9.90	54.70	0.00	203.00
Min	2.70	3.40	18.70	0.00	36.00

Table 2 Continued:

	COBALT DISSOLVED (UG/L AS CO)	COPPER DISSOLVED (UG/L AS CU)	IRON DISSOLVED (UG/L AS FE)	LEAD DISSOLVED (UG/L AS PB)	MANGANESE DISSOLVED (UG/L AS MN)
Average	0.18	1.50	13.33	0.08	5.65
Max	0.25	2.60	30.00	0.08	13.80
Min	0.09	1.10	10.00	0.08	0.40

	NICKEL DISSOLVED (UG/L AS NI)	SILVER DISSOLVED (UG/L AS AG)	STRONTIUM DISSOLVED (UG/L AS SR)	VANADIUM DISSOLVED (UG/L AS V)	ZINC DISSOLVED (UG/L AS ZN)
Average	1.49	#DIV/0!	463.91	1.85	2.16
Max	4.47	0.00	667.00	2.50	8.00
Min	0.15	0.00	132.00	1.20	1.00

	LITHIUM DISSOLVED (UG/L AS LI)	SELENIUM DISSOLVED (UG/L AS SE)	URANIUM, NATURAL, WATER, DISSOLVED, UG/L	ALKALINITY, WATER, DISSOLVED, FIXED ENDPOINT TITRATION, LAB, AS CACO3, MG/L	FECAL COLIFORM .7 UM-MF (COL./ 100 ML)
Average	35.64	1.22	3.38	129.45	57.67
Max	50.00	1.70	4.99	185.00	150.00
Min	11.90	0.60	1.19	59.00	21.00

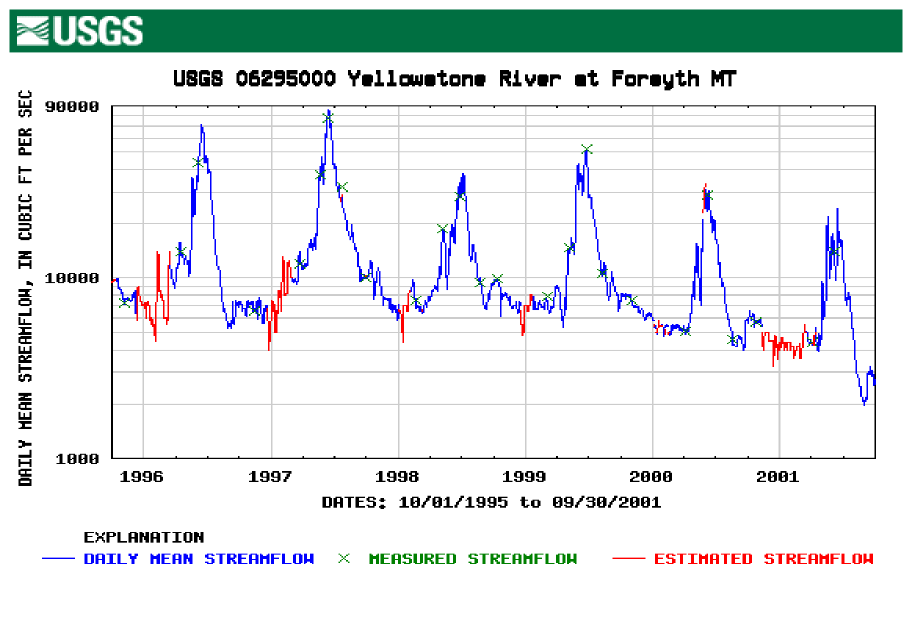
	ALACHLOR, WATER, DISSOLVED, RECOVERABLE, UG/L	ACETOCHLOR, WATER, FILTERED, RECOVERABLE, MICROGRAMS PER LITER	NITROGEN, PARTICULATE, WATER, FILTERED, SUSPENDED, MILLIGRAMS PER LITER	SEDIMENT, SUSPENDED CONCENTRATION (MG/L)	
Average	-	-	0.21	140.63	
Max	0.00	0.00	0.47	797.00	
Min	0.00	0.00	0.11	4.00	

CHAPTER 2
DELINEATION

The source water protection area, the land area that contributes water to the City of Hysham public water supply surface water intakes, is delineated in this chapter. The purpose of delineation is to map the source of Hysham's drinking water and to define areas within which to prioritize source water protection efforts.

Source water protection areas for surface water sources are subdivided into Spill Response and Watershed Regions, each with separate management goals. The Spill Response Region encompasses an area upstream of the Hysham PWS in which contaminants can be drawn into the intake with little lag time. The Watershed Region encompasses the entire area of the watershed upstream of the Hysham PWS.

Figure 5. Peak Flow Levels for the Yellowstone River at Forsyth



Hydrogeologic Conditions

The U.S. Geological Survey operates a stream gauging station near Forsyth MT (Station 06295000). The station has a period of record extending from July 1921 to present. The station lacks winter records from July 16, 1921 to September 30, 1923. Annual average flow for the Yellowstone River at this station is 10,300 cubic feet per second (cfs). Maximum and minimum annual discharge for the same period are 22,800 and 3,750 cfs (NWISWeb Data for the Nation). A hydrograph for the last 5 years of record is shown to the right (Figure 5). The hydrograph shows a pattern of low flows in the fall and winter months and high flows during the spring and early summer.

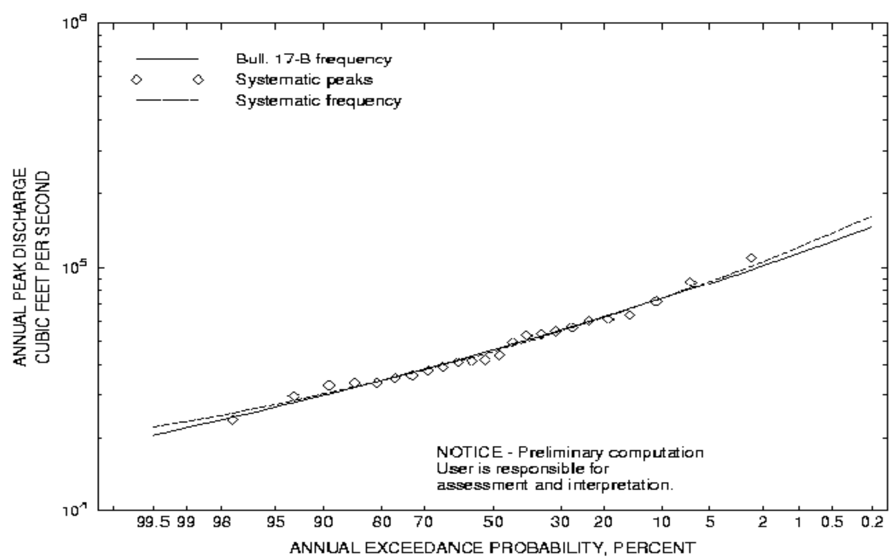
Table 3 summarizes the daily mean flow statistics for the USGS gauging station. In addition to maximum and minimum flows, Table 3 shows the percent of time the Yellowstone River flows at or above specific volumes. Figure 6 shows the flood frequency curve with exceedance flows probability shown as a percent.

Table 3 - Daily mean flow statistics for 8/2 based on 27 years of record in ft^3/sec

Minimum	Mean	Maximum	80 percent exceedence	50 percent exceedence	20 percent exceedence
3730	11,150	21,900	7,128	9,650	15,520

Figure 6. Flood Frequency Analysis for the Bighorn River at St. Xavier

20500	22000	26700	29900	34300	45700	62300	74100	89700	102000	115000	128000	147000
99.5	99	95	90	80	50	20	10	4	2	1	0.5	0.2



NOTE: Systematic peaks are those that are recorded within the period of gaged record. The computed systematic flood-frequency curve is based only on the systematic peaks. The computed Bulletin 17-B flood-frequency curve often is different from the systematic flood-frequency curve because of differences between station skew and regional skew, low- or high-outlier adjustments, or the presence of one or more historical peaks outside the systematic record. Historical peaks also result in historical adjusted plotting positions (exceedance probabilities) for all peaks.

Using DEQ Source Water Protection Program criteria for ranking aquifer/source water sensitivity (Table 4 below), the City of Hysham PWS source water is considered highly sensitive to contamination. The sensitivity ranking is a result of the surface water source for the Hysham PWS.

Table 4. Source water 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)

Conceptual Model and Assumptions

The headwaters of the Yellowstone River and its tributaries originate in the mountain ranges to the west and southwest of Hysham including: the Bridger Range, Crazy Mountains, Absaroka-Beartooth Range, Prior Mountains, and Bighorn Mountains (Figure 1b). Significant tributaries to the Yellowstone draining these land areas include the Shields River, Boulder River, Stillwater River, Clarks Fork of the Yellowstone, and the Bighorn River (Figure 4).

Annual precipitation for the Hysham area is between 10 and 18 inches, however, precipitation is much higher in the mountainous headwaters. Annual precipitation can range between 40 and 60 inches in the higher mountain ranges. A significant portion of that precipitation occurs as snow during the winter months and as spring rain, both of which contribute to high streamflow events (Figure 2). Peak flows for the Yellowstone River commonly occur in spring and early summer, and low flows are more common in late summer through the winter months.

Certain land uses and businesses located along the Yellowstone River and its tributaries upstream from Hysham represent potential contaminant sources for the Hysham public water supply. However, spills and leaks of contaminants are considered to represent a high hazard to the public water supply if they are located so that they result in direct discharge into Yellowstone River or into one of the its tributaries upstream in the vicinity of the Hysham PWS infiltration line (Table 8). The concern is that spills or leaks occurring in closer proximity to Hysham could reach the infiltration line before plant operators can close or isolate the line. Other contaminant sources may discharge to the river and its tributaries in a less direct manner. These contaminant sources are within the watershed but are farther from the river and contaminants can be flushed into the streams during spring snowmelt or storm events. Indirect discharge to streams can also come from contaminants that infiltrate into aquifers that then discharge to streams via hydraulic connections. Because these contaminants are not discharged directly into the river, they tend to pose a less immediate threat to the public water supply and are usually assigned a lower hazard rating.

Seasonal timing of direct contaminant discharges into rivers and streams can complicate the potential threat to the public water supply. Spills occurring during high water periods will tend to travel toward the surface water intake faster than during low water conditions. However, dilution during high flows in the spring and early summer may help reduce the hazard posed to the public water supply. Direct discharges to the river during low flow conditions will have less chance to be diluted before reaching the surface water intake.

Delineation Results

Spill Response Region

The Spill Response Region for the City of Hysham PWS extends 1/2 mile downstream and approximately 10 miles upstream of the City of Hysham surface water intake (Figures 4 and 7). It encloses the shoreline of the Yellowstone River and also parts of Muggins Creek and Alkali Creek, which are tributaries that join the Yellowstone River about 5 and 10 miles upstream from the intake, respectively. The width of the region extends 1/2 mile on either side of the Yellowstone River, Muggins Creek, and Alkali Creek. Muggins Creek and Alkali Creek are included in the spill response region because they are both major tributaries to the Yellowstone River upstream of the Hysham PWS intake.

Watershed Region

The Watershed Region for the City of Hysham PWS intake encompasses the portion of the Lower Yellowstone Watershed located upstream of the surface water intake (Figure 8).

Limiting Factors

The delineations for the Hysham PWS Spill Response Region and Watershed Region are based on fixed-distance and watershed mapping. The Spill Response Region represents an approximation of the distance required for contaminants released upstream to reach the surface water intake with relatively short lag time. Numerous assumptions are associated with these Source Water Protection Program (SWPP) criteria for Spill Response Region delineations. Contaminant transport rates and concentrations will vary depending on stream/river flow conditions, groundwater flux into the river, contributions from overland flow, soil types, slope, characteristics of riparian vegetation, the extent of riparian vegetation buffer zones, the extent and duration of contamination, contaminant solution density, mechanical dispersion, biological transformation, dilution, molecular diffusion, adsorption, precipitation, oxidation, complexation, and volatilization. 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 sources of contamination was conducted to assess the susceptibility of the City of Hysham PWS to contamination, and to identify priorities for source water protection planning. Inventories were conducted within the delineated Spill Response and Watershed Regions. The inventory focuses on facilities that generate, use, store, transport, or dispose of potential contaminants, and on land types on which potential contaminants are generated, used, stored, transported, or disposed. Additionally, the inventory identifies potential sources of all primary drinking water contaminants and Cryptosporidium. Only significant potential contaminant sources were selected for detailed inventory. The significant contaminants posing potential threats to the City of Hysham PWS include nitrate, pathogens, herbicides, and pesticides. The inventory for the Hysham PWS also focuses on all activities in the Spill Response Region, as well as general land uses and large potential contaminant sources in the Watershed Region.

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: Land cover is identified from the National Land Cover Dataset compiled by the U.S. Geological Survey and U.S. Environmental Protection Agency (U.S.G.S., 2000). Land cover types in this dataset were mapped from satellite imagery at 30-meter resolution using a variety of supporting information.

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 Standard Industrial Codes.

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

Step 6. All significant potential contaminant sources were identified in the inventory region and land uses and facilities that generate, store, transport, or dispose large quantities of hazardous materials were identified within the recharge region.

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) Hazardous waste contaminated sites
4) Underground storage tanks
5) Major roads 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
13) Abandoned or active mines

Inventory Results/Spill Response Region

Land areas within the spill response and watershed region are sparsely populated and fairly rural. The principal land cover in the Spill Response Region is ag-land (43%), grassland (20%), and open water (12%). The remaining land cover includes shrubland (8%), fallow (7%), forest (6%), and wetland (4%) (Figure 7). According to the Source Water Program criteria, the percentage of agricultural land in this region indicates that activities on agricultural land could pose a moderate potential threat to the City of Hysham PWS. The concern here is the potential for mismanagement or over- application of fertilizers and/or pesticides on the agricultural lands, most of which are located adjacent the Yellowstone River and some of the larger tributaries. Interstate 94, the Burlington Northern Railroad tracks, and other businesses and land uses in the area are also considered as potential sources of contamination. While some of these businesses are considered potential sources of contamination, they do not pose a threat to the PWS because they are located over a mile south of the Yellowstone River and the PWS intake. A full listing of businesses in and around the City of Hysham, based on the Standard Industrial Codes (SIC) codes and their potential to be contaminant sources and other types of facilities, was compiled and is present in Appendix A.

Septic systems in areas outside the city's sewer service are considered potential contaminant sources if they are located in close proximity to source water intakes or wells and if the density of multiple septic systems is significantly high. However, in the Hysham area, low septic densities occur over the entire spill response region. The Hysham municipal sewer system is located outside of the spill response region, and mainly downstream from the PWS intake. Main breaks or leaking connections in the system likely pose a minimal threat to the PWS. No concentrated animal feeding operations (CAFO) are located in the spill response region (Figure 7).

Table 5. Significant potential contaminant sources in the Spill Response Region City of Hysham PWS

Potential Source	Potential Contaminants	Hazard
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff
Burlington Northern Railroad	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into ground water
Class V Injection Wells (existence and locations are not known) where storm and/or wastewater is concentrated and recharges groundwater.	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Leaks, spills, improper handling and disposal/discharge of chemicals used by various businesses and are released to systems that allow infiltration of contaminants to the subsurface or to the storm water system

From the above list of potential contaminant sources, some are considered significant based upon the volume of potential releases, the volume of hazardous materials typically handled, the potential of the released materials to impact nearby surface water or groundwater, and the proximity of the sources to the PWS surface water intakes. Significant potential contaminant sources from the above list are discussed individually in the following section on Susceptibility Assessment and they are listed in Table 9.

Inventory Results/Watershed Region

The Watershed Region for the City of Hysham PWSs encompasses the Lower Yellowstone Watershed located upstream of the PWS intake (Figure 8). Most of the significant potential contaminant point sources in the watershed are located south of Hysham's PWS intake. Spills of fertilizers, pesticides, volatile organic compounds (VOCs), and synthetic organic compounds (SOCs) could occur along the interstate and the railroad tracks within the Watershed Region (Figure 8). However, the interstate is approximately 5 miles south of the intake, while the railroad tracks on the south side of the river are over a mile from the intake. It is unlikely that spills along these transportation routes would impact Hysham's water supply unless spills took place relatively close to Hysham. The Watershed Region encompasses the City of Hysham and the businesses located there. As such, it also encompasses a number of significant potential contaminant sources, such as storm and wastewater discharges, UST/LUST locations in and around town, and a crude oil pipeline. If spills or releases occur at these locations, it could result in contaminants being released into the shallow aquifer system that very likely is in hydraulic connection with the Yellowstone River. Under certain flow conditions, the contaminants could be discharged from the shallow aquifer system into the river. However, most of the potential contaminant sources in Hysham are located in a downstream position relative to the city's water supply intake. As a result, if contaminants were discharged, they would most likely be released downstream from the intake and would not impact the city's water supply. In general, potential contaminant sources in Hysham are located over a mile from the intake (Figure 8). Other public water supplies in the area that use ground water could be adversely affected by the release of contaminants to the shallow aquifer system. A full listing of businesses in the City of Hysham (based on SIC codes) was compiled and is present in Appendix A. Predominant land covers in the Watershed Region include grassland (77%), shrubland (8%), ag-land (8%), fallow (4%), forest (2%), and open water (1%) (see Figure 8). Almost all of the agricultural land cover is concentrated in the river and stream valleys (Figure 8). For this reason, activities on agricultural land are considered to pose a potential threat to the City of Hysham.

Low septic densities occur over the entire Watershed Region. The Hysham municipal sewage lagoon appears to be located over a mile south of the Yellowstone River and the public water supply intake and does not pose a threat to the public water supply (Figure 4). One concentrated animal feeding operation (CAFO) is located in the watershed region (Figure 8). Table 6 below lists the significant potential contaminant sources identified in the Watershed Region.

Table 6. Significant potential contaminant sources in the Watershed Region City of Hysham PWS

Potential Source	Potential Contaminants	Hazard
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff
Burlington Northern Railroad	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into ground water
Highways, roads, and pipelines	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into ground water
On-site residential septic systems	Nitrate, pathogens	Leaks in septic tanks, leaks in collection lines, system failure, infiltration of untreated effluent into shallow ground water, which may in turn reach surface water
Large capacity septic systems	Nitrate, pathogens	Leaks in septic tanks, leaks in collection lines, system failure, infiltration of untreated effluent into shallow ground water, which may in turn reach surface water
Municipal Sewer	Nitrate, pathogens	Leaks in mains/lines, system failure, infiltration of untreated effluent into shallow ground water, which may in turn reach surface water
USTs/LUSTs	VOCs, petroleum hydrocarbons	Spills, leaks impacting groundwater and or reaching surface water
Mining Operations	Metals	Erosion and mobilization of metals in sediment and/or leached into surface water and groundwater
Gas and Oil Wells	Total Dissolved Solids, Petroleum Hydrocarbons	Migration of brine wastewater into shallow groundwater discharging to surface water, surface runoff to surface water
Assorted businesses in town	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Releases or spills, mishandling of chemicals, improper disposal of chemicals anywhere near the lake
Class V Injection Wells (existence and locations are not known) where storm and/or wastewater is concentrated and recharges groundwater.	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Leaks, spills, improper handling and disposal/discharge of chemicals used by various businesses and are released to systems that allow infiltration of contaminants to the subsurface or to the storm water system
Storm Water / Wastewater Discharges	VOCs, SOCs, pathogens, nitrate, TDS	Leaks, spills, improper handling and disposal/discharge of chemicals used by various businesses and are released to systems that allow discharge of contaminants with wastewater to surface water

From the above list of potential contaminant sources, some are considered significant based upon the volume of potential releases, the volume of hazardous materials typically handled, the potential of the released materials to impact nearby surface water or groundwater, and the proximity of the sources to the PWS surface water intakes.

Inventory Update

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

Inventory Limitations

The extent of the potential contaminant source inventory is limited in several respects. The inventory is based on data readily available through state documents, published reports, and GIS data. Documentation may not be readily available on some potential sources. As a result, all potential contaminant sources may not have been identified. In some instances, inadequate location information precluded the inclusion of potential sources in the inventory.

CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

Susceptibility of the City of Hysham PWS's source water is determined by two factors: the potential of a contaminant reaching the intake and the resulting health hazard. Susceptibility is assessed in order to prioritize potential pollutant sources in the Spill Response Region in order to guide management actions undertaken by local entities, in this case the City of Hysham and Treasure County.

The goal of source water management is to protect the source water, manage significant potential contaminant sources in the Spill Response Region, and ensure that land use activities in the Watershed Region pose minimal threats to the source water. Management priorities in the Spill Response Region are determined by ranking the significant potential contaminant sources identified in the previous chapter according to susceptibility. Alternative management approaches that could be pursued by City of Hysham PWS owners and operators to reduce susceptibility are also included in this section of the report.

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 reach the PWS intake. The hazard presented by point sources of contaminants in Hysham's Spill Response Region depends on whether contaminants can discharge directly into the Yellowstone River or into two of its joining tributaries, Muggins Creek and Alkali Creek. Point source hazard is also dependent on the health affects associated with potential contaminants. Hazard ratings for point and nonpoint sources are assigned based on criteria listed in Table 8. Barriers can be anything that decrease the likelihood that contaminated water will reach Hysham's surface water intake. Examples of barriers include: a vegetated riparian area, protective forest management practices, and dilution.

Table 7. Hazard of Potential Contaminant Sources, Determination of For Surface Water Sources

Potential Contaminant Sources	High Hazard Rating	Moderate Hazard Rating	Low Hazard Rating
Point Sources of Nitrates or Pathogens	Potential for direct discharge to surface water	Potential for discharge to groundwater hydraulically connected to surface 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 surface water	Potential for discharge to groundwater hydraulically connected to surface water
Septic Systems (density)	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
Municipal Sanitary Sewer (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region
Cropped Agricultural Land (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

Barriers to contamination can be anything that decreases the likelihood that contaminants will reach a spring or well. Barriers can be engineered structures, management actions, or natural conditions. Examples of engineered barriers are spill catchment structures for industrial facilities and leak detection for underground storage tanks. Emergency planning and best management practices are considered management barriers. Thick clay-rich soils, a deep water table or a thick saturated zone above the well intake can be natural barriers.

Table 8. Susceptibility of Source Water based on Hazard rating and the presence of Barriers

	High Hazard Rating	**Moderate Hazard Rating**	**Low Hazard Rating**
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

Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant (Table 9).

Susceptibility Assessment Results

Table 9. Susceptibility Assessment

Significant Potential Contaminant Sources in the Spill Response and Watershed Regions

City of Hysham PWS surface water intakes

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff	**Moderate**	-Dilution	**Moderate**	Educate land owners on proper application and storage of pesticide and fertilizers; implement agricultural BMPs
Burlington Northern Railroad	Pesticides, fertilizers, VOCs	Spills, storm water runoff, infiltration into ground water	**Moderate**	-The rail line is over one mile from the river and partially down stream from the intake. -Dilution; County Emergency Response Plan, training and preparation of local response personnel.	**Low to Moderate**	Maintain preparedness of local emergency personnel through active training, runoff diversion, continued remediation of former release sites
Wastewater Discharges	VOCs, SOCs, pathogens, nitrate, TDS	System failure, exceeding effluent limits	**Low**	-Dilution	**Very Low**	Ensure proper maintenance and operation of system; monitor leaks in system; develop an alternative treatment plan in the event of system failure
Municipal Sewer System	Pathogens, nitrate	Leaks in sewer mains to groundwater, which may reach surface water	**Low**	-Dilution	**Very Low**	Ongoing testing and maintenance of lines and system, replacement of old lines, compliance with current regulations for discharges
Class V Injection Wells	VOCs, SOCs, pathogens, nitrate	Infiltration of contaminants into aquifer	**Low**	-Spill prevention, dilution, ongoing monitoring of groundwater, monitoring for spills, ongoing remediation of spill sites	**Very Low**	Inventory; Educate business owners and the public on proper waste disposal and recycling

Table 9, above, displays the susceptibility assessment results for the City of Hysham PWS surface water intake. The town's intake, located on the Yellowstone River, is susceptible to a number of different contaminants, including pathogens, nitrates, fertilizers, pesticides, VOCs, and total dissolved solids. The above assessment addresses the Spill Response Region for the City of Hysham PWS.

The susceptibility assessment results for each significant potential contaminant source identified is described below:

***Agricultural lands* –** The potential hazard imposed by pathogens and nitrate originating from agricultural lands is moderate. Cropped agricultural lands occupy 43% of the spill response region, falling between 20% and 50% of the total area of this region. The susceptibility of the intake to these agricultural sources of nitrate and pathogens is also moderate due to the presence of a single barrier. Adequate dilution is provided by the Yellowstone River to reduce water quality impacts to non-significant levels.

***Burlington Northern Railroad* –** The potential hazard imposed by pesticides, fertilizers, VOCs and SOCs originating from the railway and former spills along the railway pose a moderate hazard. This is because tracks are located over a mile from the river but there is potential for a spill originating on or near the tracks in some location southwest of Hysham along the Yellowstone River. These spills could indirectly discharge into the Yellowstone River upstream from the City of Hysham's surface water intake. The susceptibility of the Hysham PWS to contaminants originating from this source is considered to be low to moderate. Multiple barriers identified for this source include dilution in the river and use of a county emergency plan.

***Wastewater Discharges*-** The potential hazard imposed by VOCs, SOCs, pathogens, and nitrate originating from wastewater discharges related to Hysham's wastewater treatment operations is low due to the distance of the town from the surface water intake. The susceptibility of the Hysham PWS intake to contaminants originating from this source is low to very low. One barrier was identified for this source, dilution.

***Municipal Sewer System* –** The potential hazard imposed by pathogens and nitrate originating from Hysham's municipal sewer system is low due to the distance the sewer mains are located from surface water intake. The susceptibility of the intakes to nitrate and pathogens originating from this source is also low to very low.

***Class V Injection Wells* –** The potential hazard imposed by VOCs, SOCs, pathogens, nitrate, and other contaminants originating from the class V injection wells is considered low. The susceptibility of the intake to contaminants originating from this source is very low due to several barriers including spill prevention, dilution, monitoring of groundwater, and monitoring of spills.

It should be noted that even small releases of some chemicals in close proximity to a surface water intake can have significant negative impact on water quality, and is therefore a significant threat to the public water supply. Steps can be taken to reduce the likelihood of releases in the source water for the PWS or in the vicinity of the sources. Some of these steps (considered management recommendations) are listed below.

Management Recommendations

Management recommendations are included in the susceptibility table for the Hysham PWS (Table 9). If these management recommendations are implemented, they may be considered additional barriers that will reduce the susceptibility of Hysham's intake to specific sources and contaminants.

Management recommendations fall into the following categories:

- Sewer maintenance and leak detection
- Municipal sewer extension
- Agricultural best management practices
- Stormwater management
- Proper disposal and monitoring of oil and gas production wastewater
- Education
- Emergency Response Planning

***Sewer Maintenance and leak detection* –** Early warning of leaks and scheduled replacement of aging sewer lines will reduce the susceptibility of Hysham's intake to contamination from municipal septic wastes.

***Sewer Extension* –** Installation of advanced septic treatment systems such as sand filters can limit contamination from new rural residential development, however, annexation and extension of sewers is the only way to reduce contamination from existing unsewered developments.

***Agricultural and silvicultural best management practices (BMPs)* –** BMPs that address application and mixing of fertilizer and pesticides are a viable alternative to prohibition of their use. BMPs may also be utilized to minimize surface runoff and soil erosion on cultivated fields. Erosion control, selective logging, and other silvicultural practices (essentially BMPs) should be considered on a county-wide basis. BMPs are generally voluntary but their implementation can be encouraged through education and technical assistance. County planning can help promote the implementation of BMP on lands that are outside city limits but indirectly affect the city PWS.

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 will promote the efficiency and effectiveness of emergency responses to hazardous material spills. Likewise, educational workshops provided to rural homeowners will promote the proper maintenance and replacement of residential septic systems. The EPA and the State of Montana can provide educational materials on these topics.

***Hazardous Materials Collection Days* –** Several counties in the state that have vulnerable water supplies have implemented scheduled days for the collection of hazardous wastes from the public. These vary in the inclusiveness of what materials are collected, how the materials are handled, and how they are disposed of, but they all act to reduce the amount of unauthorized or improper disposal of these wastes. Used motor oil collection stations could be established and available to the public on a regular basis.

Emergency Response Plan **–** Several counties have compiled Emergency Response Plans that were then adopted by the local communities. The usefulness and effectiveness of a response plan are maximized if it contains a clear listing of all emergency contacts, emergency numbers, and resources available within the county to respond to an emergency situation, such as a hazardous material spill. Emergency plans are not difficult to develop or distribute, but have a significant benefit to the citizens and municipalities within the county.

These management recommendations should be considered by the City of Hysham PWS operator, the city administration, and the Treasure County administration. Should contamination reach the town's intake, the City and County will likely need to work cooperatively to address remediation or relocation of the Hysham PWS source.

Monitoring Waivers

Monitoring Waiver Requirements

The 1986 Amendments to the Safe Drinking Water Act require that community and non-community PWSs sample drinking water sources for the presence of volatile organic chemicals (VOCs) and synthetic organic chemicals (SOCs). The US EPA has authorized states to issue monitoring waivers for the organic chemicals to systems that have completed an approved waiver application and review process. All PWSs in the State of Montana are eligible for consideration of monitoring waivers for several organic chemicals. The chemicals diquat, endothall, glyphosate, dioxins, ethylene dibromide (EDB), dibromochloropropane (DBCP), and polychlorinated biphenyls are excluded from monitoring requirements by statewide waivers.

Use Waivers
A Use Waiver can be allowed if through a vulnerability assessment, it is determined that specific organic chemicals were not used, manufactured, or stored in the area of a water source (or source area). If certain organic chemicals have been used, or if the use is unknown, the system would be determined to be vulnerable to organic chemical contamination and ineligible for a Use Waiver for those particular contaminants.

Susceptibility Waivers
If a Use Waiver is not granted, a system may still be eligible for a Susceptibility Waiver, if through a vulnerability assessment it is demonstrated that the water source would not be susceptible to contamination. Susceptibility is based on prior analytical or vulnerability assessment results, environmental persistence, and transport of the contaminants, natural protection of the source, wellhead protection program efforts, and the level of susceptibility indicators (such as nitrate and coliform bacteria). The vulnerability assessment of a surface water source must consider the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the surface water intake. PWSs developed in unconfined aquifers should use a minimum fixed radius of 1.0 mile as an area of investigation for the use of organic chemicals. Vulnerability assessment of spring water sources should use a minimum fixed radius of 1.0 mile as an area of investigation for the use of organic chemicals. Shallow groundwater sources under the direct influence of surface water (GWUDISW) should use the same area of investigation as surface water systems; that is, the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the point of diversion. The purpose of the vulnerability assessment procedures outlined in this section is to determine which of the organic chemical contaminants are in the area of investigation.

Given the wide range of landforms, land uses, and the diversity of groundwater and surface water sources across the state, additional information is often required during the review of a waiver application. Additional information may include well logs, pump test data, or water quality monitoring data from surrounding public water systems; delineation of zones of influence and contribution to a well; Time-of-Travel or attenuation studies; vulnerability mapping; and the use of computerized groundwater flow and transport models. DEQ's PWS Section and DEQ's Source Water Protection Program will conduct review of an organic chemical monitoring waiver application. Other state agencies may be asked for assistance.

Susceptibility Waiver for Confined Aquifers
Confined groundwater is isolated from overlying material by relatively impermeable geologic formations. A confined aquifer is subject to pressures higher than atmospheric pressure that would exist at the top of the aquifer if the aquifer were not geologically confined. A well that is drilled through the impervious layer into a confined aquifer will enable the water to rise in the borehole to a level that is proportional to the water pressure (hydrostatic head) that exists at the top of a confined aquifer.

The susceptibility of a confined aquifer relates to the probability of an introduced contaminant to travel from the source of contamination to the aquifer. Susceptibility of an aquifer to contamination will be influenced by the hydrogeologic characteristics of the soil, vadose zone (the unsaturated geologic materials between the ground surface and the aquifer), and confining layers. Important hydrogeologic controls include the thickness of the soil, the depth of the aquifer, the permeability of the soil and vadose zones, the thickness and uniformity of low permeability and confining layers between the surface and the aquifer, and hydrostatic head of the aquifer. These factors will control how readily a contaminant will infiltrate and percolate toward the groundwater.

The Susceptibility waiver has the objective of assessing the potential of contaminants reaching the groundwater used by the PWS. A groundwater source that appears to be confined from surface infiltration in the immediate area of the wellhead may eventually be affected by contaminated groundwater flow from elsewhere in the recharge area. Contaminants could also enter the confined aquifer through improper well construction or abandonment where the well provides a hydraulic connection from the surface to the confined aquifer. The extent of confinement of an aquifer is critical to limiting susceptibility to organic chemical contamination. Regional conditions that define the confinement of a groundwater source must be demonstrated by the PWS in order to be considered for a confined aquifer susceptibility waiver. Confinement of an aquifer can be demonstrated by pump test data (storage coefficient), geologic mapping, and well logs. Site-specific information is required to sufficiently represent the recharge area of the aquifer and the zone of contribution to the PWS well. The following information should be provided:

- Abandoned wells in the region (zone of contribution to the well),
- Other wells in the region (zone of contribution to the well),
- Nitrate/Coliform bacteria analytical history of the PWS well,
- Organic chemical analytical history of the PWS well,

Susceptibility Waiver for Unconfined Aquifers
Unconfined aquifers are the most common source of usable groundwater. Unconfined aquifers differ from confined aquifers in that the groundwater is not regionally contained within relatively impervious geologic strata. As a result, the upper groundwater surface or water table in an unconfined aquifer is not under pressure that produces hydrostatic head common to confined aquifers.

Unconfined aquifers are usually locally recharged from surface water or precipitation. In general, groundwater flow gradients in unconfined aquifers reflect surface topography, and the residence time of water in the aquifer is comparatively shorter than for water in confined aquifers. Similar water chemistry often exists between unconfined groundwater and area surface water, and physical parameters and dissolved constituents can be an indicator of the hydraulic connection between groundwater and surface water. Consequently, unconfined aquifers can be susceptible to contamination by organic chemicals migrating from the ground surface to groundwater.

The objective of the susceptibility waiver application is to assess the potential of organic chemical migration from the surface to the unconfined aquifer. The general procedures make use of a combination of site-specific information pertaining to the location and construction of the source development, monitoring history of the source, geologic characteristics of the unsaturated soil and vadose zones, and chemical characteristics of the organic chemicals pertaining to their mobility and persistence in the environment. The zone of contribution of the unconfined groundwater source must be defined and plotted. This should describe the groundwater flow directions, gradients, and a 3-year time-of-travel. All surface bodies within 1,000 feet of the PWS well(s) must be plotted. Analytical monitoring history of the PWS well and those nearby should be provided as well.

<u>Waiver Recommendation</u>

The town of Hysham has a wavier for Phase 2 and 5 Inorganic constituents that includes Barium, Cadmium, Chromium, Fluoride, Mercury, Selenium, Antimony, Thallium, Beryllium, and Nickel. Based on past monitoring results and the susceptibility assessment of the Hysham PWS intakes, the City of Hysham PWS may not be eligible for additional monitoring waivers. However, to be sure that eligibility for all available waivers is considered, the City of Hysham PWS could submit a letter to DEQ requesting monitoring waivers. The PWS may also need to provide additional information to DEQ regarding chemical use within the Spill Response Region. Table 10 shows how the identified potential contaminant sources in the spill response and watershed regions could affect eligibility for monitoring waivers for the City of Hysham. It should also be noted that it is not possible to receive monitoring waivers for pathogens, nitrate, or arsenic.

Table 10. Susceptibility Assessment as it relates to waiver eligibility
for significant potential contaminant sources in the Spill Response Region
City of Hysham PWS surface water intakes

Source	Contaminant	Susceptibility	Waiver Eligibility
Cultivated Cropland	Fertilizers, pesticides	Moderate	Chemical use likely precludes waivers for some chemicals
Burlington Northern Railroad	Pesticides, fertilizers, VOCs	Moderate	Chemical use likely precludes waivers for some chemicals
Class V Injection Wells	VOCs, SOCs, pathogens, nitrate	Very Low	Waivers are not available for pathogens and nitrate

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GLOSSARY*

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

Alkalinity. The capacity of water to neutralize acids.

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

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

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

Confining Unit. A geologic formation that inhibits the flow of water.

Delineation. A process of mapping source water management areas.

Effective Porosity. The percent of soil, sediment, or rock through which fluids, such as air or water, can pass. Effective porosity is always less than total porosity because fluids can not pass through all openings.

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

Hazard. A measure of the potential of a contaminant leaked from a facility to reach a public water supply source. Proximity or density of significant potential contaminant sources determines hazard.

Hydraulic Conductivity. A coefficient of proportionality describing the rate at which water can move through an aquifer.

Inventory Region. A source water management area that encompasses an area expected to contribute water to a public water supply well within a fixed distance or a specified groundwater time-of-travel distance.

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

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

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

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

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

Porosity. The percent of soil, sediment, or rock filled by air, water, or other fluid.

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

SIC Code. The U.S. Standard Industrial Classification (SIC) Codes classify categories of businesses. SIC Codes cover the entire range of business categories that exist within the economy.

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

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

Synthetic Organic Compounds (SOC). Man made organic chemical compounds (e.g. pesticides).

Total Dissolved Solids (TDS). The dissolved solids collected after a sample of a known volume of water is passed through a very fine mesh filter.

Total Maximum Daily Load (TMDL). The total pollutant load to a surface water body from point, non-point, and natural sources. The TMDL program was established by section 303(d) of the Clean Water Act to help states implement water quality standards.

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

Transmissivity. The ability of an aquifer to transmit water.

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

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

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

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

APPENDICES

APPENDIX A

Listing of Potential Contaminant Sources
by SIC Code
and Other Sources

NAME	ADDRESS	CITY	STAT	ZIP	PHONE	SIC1	SIC2	SIC3	SIC4	LATITUDE	LONGITUDE	COUNTYNAME
Burlington Northern Inc	PO Box 331	Hysham	MT	59038-0331	406-342-5504	401101				46.370760	-107.39220	Treasure
County Clerk & Recorder	307 Rapelje St	Hysham	MT	59038	406-342-5547	911103				46.292100	-107.23392	Treasure
Cowboy Express Livestock	Hc 73 Box 520	Hysham	MT	59038-9501	406-342-5489	421203				46.370760	-107.39220	Treasure
Cramer Irrigation & Seed	101 Elliot Ave	Hysham	MT	59038	406-342-5281	508305				46.370760	-107.39220	Treasure
Farmer's Union Oil Co	123 Elliot Ave	Hysham	MT	59038	406-342-5231	554101				46.370760	-107.39220	Treasure
French Trucking	W Of Hysham	Hysham	MT	59038	406-342-5854	421203				46.370760	-107.39220	Treasure
Friendly Corner	718 Elliott Ave	Hysham	MT	59038	406-342-5888	541103				46.293060	-107.22648	Treasure
Genes Auto & Wrecker Svc	18 Division St	Hysham	MT	59038	406-342-5368	754901				46.370760	-107.39220	Treasure
Hysham Fire Dept	307 Rapelje St	Hysham	MT	59038	406-342-5311	922404				46.292100	-107.23392	Treasure
Hysham Irrigation District	Myers	Hysham	MT	59038	406-342-5339	497102				46.370760	-107.39220	Treasure
Hysham Public School	115 Summit St	Hysham	MT	59038	406-342-5237	821103				46.292880	-107.23068	Treasure
Jacobson Land & Livestock	Hc 72 Box 890	Hysham	MT	59038-9702	406-342-5678	515403				46.370760	-107.39220	Treasure
Manning International	Old Highway 10	Hysham	MT	59038	406-342-5571	508310	352304	551105		46.370760	-107.39220	Treasure
Mid-Yellowstone Electric Co-Op	203 Elliott Ave	Hysham	MT	59038	406-342-5521	491101				46.293120	-107.23362	Treasure
Schools Public		Hysham	MT	59038	406-342-5848	821103				46.370760	-107.39220	Treasure
Simplot Soil Builders	Industrial Site	Hysham	MT	59038	406-342-5660	519114				46.370760	-107.39220	Treasure
Station	116 Elliott St	Hysham	MT	59038	406-342-5283	553123				46.370760	-107.39220	Treasure
Town Market	313 Eliott St	Hysham	MT	59038	406-342-5230	541105				46.370760	-107.39220	Treasure
Treasure County Clerk Of Court	307 Rapelje St	Hysham	MT	59038	406-342-5545	911103				46.292100	-107.23392	Treasure
Treasure County School Supt	307 Rapelje Ave	Hysham	MT	59038	406-342-5545	821103				46.292100	-107.23392	Treasure

APPENDIX B

DEQ PWS's Database Output

APPENDIX C

Sanitary Survey

APPENDIX D

**Concurrence Letter &
Other Correspondence**