City of Glendive
Public Water Supply
PWSID # MT0000229

Date of Report: March 17, 2003

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Operator/Manager:

Charles Mohr
300 South Merrill
Glendive, MT 59330
(406) 377-3318

Table of Contents

****Figures 3A, 3B, and 3C were updated and revised May 18, 2015**

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). Glendive public water supply (PWS) is located in Dawson County, Montana, about 78 miles northeast of Miles City and about 220 miles from Billings (Figure 1). The DEQ PWS identification number, operator name, and operator number for the Glendive 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 Glendive 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 Glendive PWS operator in the identification of potential contaminant sources near and upstream from the city's surface water intake, and to encourage the development of a source water protection plan to help protect the city's drinking water for the long term.

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 Glendive public water supply and is based on published data including the most recent sanitary survey, 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 Glendive's public water supply, 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 Glendive are identified. Only potential sources of contamination in areas that contribute water to the identified drinking water sources are considered.

The term "contaminant" is used in this report to refer to constituents for which maximum concentration levels (MCLs) have been specified under the national primary drinking water standards, and to certain carcinogenic or toxic constituents that do not have MCLs but are considered to be significant health threats.

CHAPTER 1
BACKGROUND

The Community

Glendive is the county seat of Dawson County and is located on the banks of the Yellowstone River (Figure 1). Interstate 94 and the Northern Pacific/Burlington Northern Rail run through Glendive. The U.S. Census Bureau estimates the 2000 population of Dawson County at 8,670 people, 4,340 of whom reside in Glendive. Dawson County's population has decreased about 10% and Glendive's, has decreased by about 8.8%, since the 1990 census.

Transportation, recreation, and the service industry contribute significantly to the economy of Dawson County and Glendive. The largest revenue-generating industries in Dawson County in 2000 are listed as transportation and public utilities, 26.1 percent of earnings; services, 20.3 percent; and state and local government, 20.2 percent (www.bea.doc.gov/bea/regional/bearfacts).

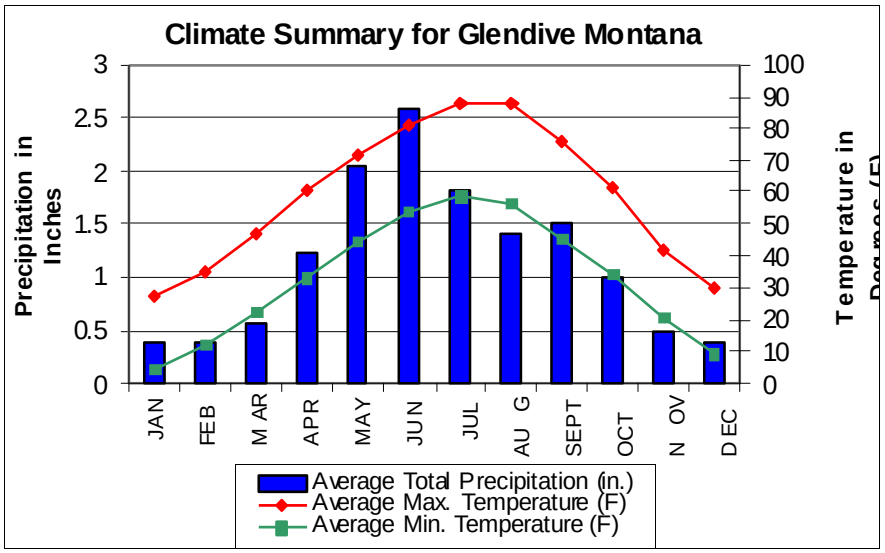
Within the city limits, residents obtain their drinking water from the municipal public water supply. The municipal sewer district services all residents within city limits. The city is also served by a wastewater treatment plant located about one and a half mile northeast of town. Residents in areas outlying town limits where sewer services are not available utilize on-site septic systems for waste disposal. There are 21 other public water supplies in the area of which 5 are community systems and the remaining 16 are non-community (Figure 3A). Four of the 21 public water supplies purchase water from Glendive and the remainder use groundwater as their source of water (Table 1).

Table 1. Public Water Supplies in the Glendive area.

PWS_ID	CLASS	PRIMARY_NAME	SOURCE_NAME
MT0003330	C	Culligan Water Treatment	Glendive City of
MT0000233	C	Forest Park Water RSID 24	501 Oak Street Well #3
MT0000229	C	Glendive, City of	Yellowstone River
MT0000570	C	Highland Park Utilities Association	West 175' Well #Hp3
MT0000412	C	Spring Grove Trailer Court	Well # 1
MT0003381	N	Albertsons #2023	Glendive, City of
MT0004141	N	Berg Automotive	Well 2
MT0001214	N	Cottonwood Country Club	Well #1
MT0001211	N	Frostys In and Out	Well # 1
MT0001210	N	Glen Bowl Lanes	Well # 1
MT0003977	N	Glendive Alliance Church	Well #1
MT0000407	N	Green Valley Campground	Well # 1
MT0003811	N	Interstate Cenex 017	Well #1
MT0003394	N	Larrys Exxon	Well
MT0003754	N	Reynolds Warehouse Grocery	Glendive, City of
MT0003475	N	Riverside Inn Glendive	Well
MT0003816	N	Subway of Glendive	Well #1
MT0001215	N	Trail Star Cafe and Truck Stop	Well # 1
MT0003706	N	Valley Fuel and Supply	Well
MT0001206	N	Wagon Wheel Bar Inc	Well # 1
MT0001209	P	Jefferson School District #1	Well # 1

Climate

Figure 2. Glendive Average Temperatures and Precipitation



Based on Western Regional Climatic Center data for the period of record, annual precipitation averages 13.77 inches. Monthly average precipitation ranges from 0.37 inches in February to 2.57 inches in June. Summer thunderstorms and winter snows provide a majority of the precipitation in the area. The annual mean snowfall in Glendive is 29.2 inches. A summary of the available climatic data for the Glendive area is presented in Table 2 below.

Table 2. Climate Summary for the Glendive.
Western Regional Climate Center, wrcc@dri.edu

GLENDIVE, MONTANA (243581)

1971-2000 Monthly Climate Summary

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	27.2	35.1	46.5	60.1	71.5	80.7	87.7	87.4	75.7	61.5	41.5	30.2	58.9
Average Min. Temperature (F)	4.8	11.7	22.1	33.2	44.6	53.8	58.3	56.5	45.6	34.2	20.2	9	32.9
Average Total Precipitation (in.)	0.4	0.37	0.57	1.22	2.05	2.57	1.81	1.41	1.5	0.99	0.49	0.39	13.77

Geographic Setting

Glendive is located in the non-glaciated 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 Glendive is approximately 2,028 feet above mean sea level and the town is located immediately next to the Yellowstone River (Figure 1). The Yellowstone River valley is about 1 to 1.5 mile wide in the vicinity of Glendive. Topographic relief in the area is low with highlands rising about 200 to 400 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 Glendive. Reports used for this section include Smith et al. (2000), Slagle (1983), Slagel et al (1984), Stoner and Lewis, (1980),

Torrey, A. E., and Swenson, F. A., 1951. 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 (Figure 5). The alluvium consists of lenses of unconsolidated clay, sand, and gravel. As much as 100 feet of alluvium is present in the Yellowstone valley and less thick deposits present in some of the tributaries (Smith 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 tens and hundreds of feet above the streams and are considered to be Quaternary age, ranging from Pleistocene to Recent. These terrace deposits consist of gravel, sand, silt, and clay.

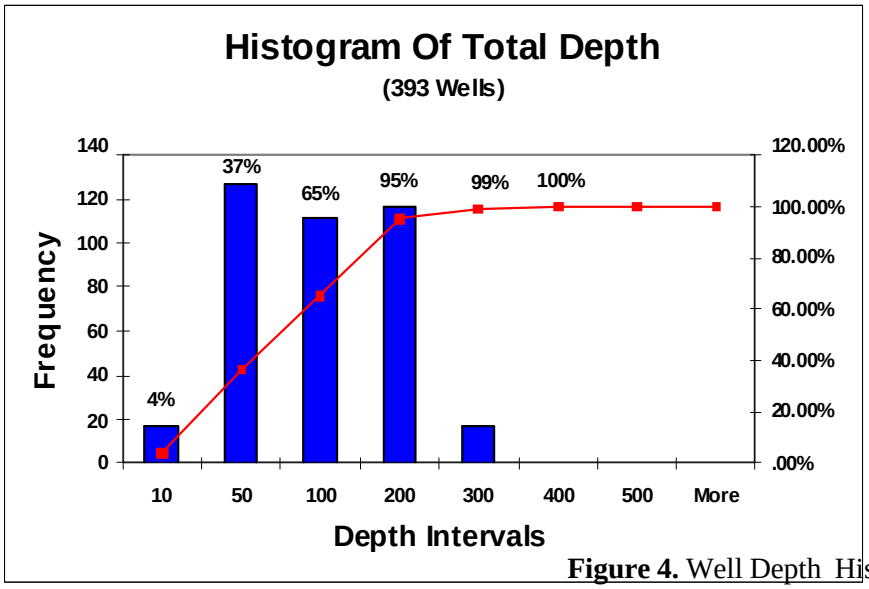
Bedrock exposed at the land surface in the vicinity of Glendive ranges in age from Upper Cretaceous to Tertiary. Around Glendive the Fort Union Formation dominates the landscape (Figure 5). The Fort Union can be on the order of 1,600 feet thick and can be divided into three members in descending order: the Tullock, Lebo Shale, and Tongue River. There are outcrops of red metamorphosed sedimentary rocks within the Fort Union Formation. 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, is up to 900 feet thick, and contains beds of silty shale, mudstone, sandstone, and coal. The Hell Creek is exposed at the land surface southeast of Glendive along the axis of the Cedar Creek Anticline. 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. Sandstone beds of the Fox Hills Formation and dark shale beds of the Pierre Shale also are found at the land surface along the Cedar Creek Anticline axis. The upper part of the Fox Hills in known as the Colgate Member and consists of light gray and white sandstone that is fine to medium grained. The Colgate Member is an important aquifer in this region.

General Hydrogeologic Setting

Although the City of Glendive obtains its source water from the Yellowstone River, seventeen of the other public water supplies in the vicinity use ground water as their source. Aquifers in this region have been grouped together based on their depth from the land surface. The groups are referred to as hydrologic units. The shallow hydrologic unit represents aquifers within 200 feet of the land surface (Slagle et al. 1983, Smith et al. 2000). In most places this includes aquifers with in the alluvium and terrace deposits and sandstones in the upper part of the Fort Union Formation. Ground-water flow within this shallow

hydrologic unit is generally from upland areas toward local stream tributaries and major streams. Recharge to the shallow hydrologic unit comes primarily from infiltration of precipitation; to a lesser extent recharge also comes from water loses from some stream channels, irrigation ditches, and return flows from irrigated fields (Smith et al. 2000). Below 200 feet a deeper hydrologic unit is present above the pervasive claystone and shale beds in the upper Hell Creek Formation. Ground-water flow within the deep hydrologic unit is from upland areas toward major streams and is generally thought to bypass or flow beneath local tributary valleys. Recharge areas for the deep hydrologic unit comes from near the Sheep Mountains in northern Prairie County and areas in southeastern Fallon County. Sandstones in the lower Hell Creek - upper Fox Hills represent a third hydrologic unit in this region. The Colgate Member of the Fox Hills is an important drilling target in this hydrologic unit (Smith et al, 2000). Ground-water flow in the lower Hell Creek - upper Fox Hills is generally toward major stream including the Yellowstone and Missouri rivers. Recharge appears to come some distance from upland areas south of the Glendive area (Smith et al. 2000).

About 70 percent of the wells in the Yellowstone River Area are completed in the shallow hydrologic unit (Smith et al, 2000). Yield from this hydrologic unit range from 10 gallons per minute (gpm) to 35 gpm, with the higher yields coming from well completed in the alluvial deposits adjacent the Yellowstone River. About 12 percent of the wells in the region are completed in the deep hydrologic unit with yields most often reported as less than 15 gpm (Smith et al, 2000). Ten percent of the wells in the region are completed in the Fox Hills-lower Hell Creek hydrologic unit and report yields routinely less than 15 gpm with some exceptional wells with yields approaching 100 gpm (Smith et al, 2000).



Examining well data from the Montana Ground Water Information Center (GWIC) for 393 wells in the vicinity of Glendive reveals that 95% of wells are less than 200 feet deep so they are completed in the shallow hydrologic unit. Average drilling depth for these wells is 84 feet below the land surface and the deepest well in the area is 410 feet. Average yield for these wells is 24 gpm and the highest yield reported is 500 gpm.

Figure 4. Well Depth Histogram for wells in the Glendive Vicinity.

The Public Water Supply

The Glendive 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 about 5,500 residents via approximately 2,044 active service connections.

Yellowstone River water is the source water for Glendive. The intakes for the system are located on the west side of town generally within the area shown on the maps of Figure 1a and Figure 3. According to the most recent sanitary survey, the intakes are in excellent condition and well maintained. The water from the river is treated through a conventional surface water treatment process that includes coagulation,

sedimentation, and multi-media filtration to produce the finished water. The water is chlorinated and pH is adjusted to maximize the effectiveness of the chlorination. Daily production is listed at 1,850,000 gallons per day (gpd) with a maximum design capacity of 7,920,000 gpd. There are two above ground storage reservoirs with total capacity of about 2,000,000 gallons, which represents approximately 2 days water supply for the City's customers. The tanks are inspection every three according to the sanitary survey. According to the latest sanitary survey, the distribution system at Glendive is in good condition with few or no leaks detected throughout the year.

Due to the fact that Glendive 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 criteria (1999), also see Table 3 below.

Table 3. 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)

Public water systems must conduct routine monitoring for contaminants in accordance with Federal Safe Drinking Water Act requirements. A community public water supply, like Glendive, 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 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.

Glendive 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, this includes nitrate. The highest nitrate value recorded at the PWS is 0.58 milligrams per liter (mg/l), which is significantly below the MCL of 10 mg/l (Appendix B).

CHAPTER 2
DELINEATION

The source water protection areas for the Glendive public water system are delineated in this chapter. The purpose of delineation is to map the source of water used by Glendive PWS and to define areas within which to prioritize source water protection efforts. Because Glendive uses the Yellowstone River for its public water supply, two types of management regions are mapped; a spill response region and a watershed region.

The goal of management in the spill response region is to avoid introducing contaminants directly into the river upstream of the public water supply. In addition, this region should be managed to prevent contaminants from reaching the intake or infiltration lines before natural processes reduce their concentrations. The goal of management in the watershed region is to maintain and improve water quality over long periods of time or increased usage.

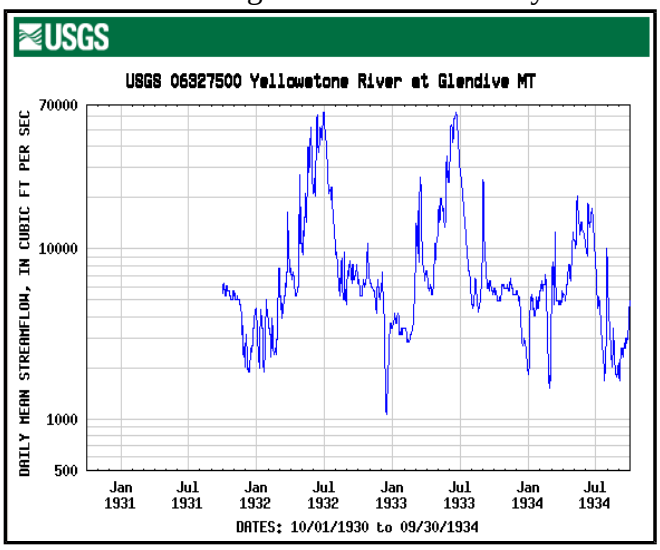


Figure 6. Daily flow for the Yellowstone River at Glendive.

Hydrogeologic Conditions

The U.S. Geological Survey operates a stream gauging station at Glendive MT (Station 06327500). The station has a period of record extending from October 1897 to May 1934 for daily streamflow values. The station is currently set up to provide realtime streamflow data. Annual average flow for the Yellowstone River at this station is 14,751 cubic feet per second (cfs). Maximum and minimum annual discharge for the same period are 19,320 and 11360 cfs (NWISWeb Data for the Nation). A hydrograph for 3 years of record is shown in Figure 6. The hydrograph shows a pattern of low flows in the fall and winter months and high flows during the spring and early summer.

Using DEQ Source Water Protection Program criteria for ranking aquifer/source water sensitivity (Table 3), the Glendive PWS source water is considered highly sensitive to contamination. The sensitivity ranking is a result of the surface water source for the Glendive PWS.

Conceptual Model and Assumptions

The headwaters of the Yellowstone River and its tributaries are the mountain ranges of south central Montana including: the Bridger Range, Crazy Mountains, Absaroka-Beartooth Range, Prior Mountains, and Bighorn Mountains (Figure 1C). 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.

Annual precipitation for the Glendive area is about 14 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 Glendive represent potential contaminant sources for the public water supply (Figure 7, Figure 8, and Figure 9). 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 Glendive intake (Table 8). The concern is that spills or leaks occurring in closer proximity to the Glendive could reach the intake before plant operators can close or isolate the intake. 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 adjacent the river 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 Glendive extends ½ mile downstream and approximately 10 miles upstream of the surface water intake (Figure 7). It extends ½ mile from each bank of the Yellowstone River and also extends up portions of several larger tributaries.

Watershed Region

The Watershed Region for the Glendive intake encompasses the land area within the Lower Yellowstone Watershed (HUC 1010004) upstream of Glendive (Figure 8 and Figure 9). The watershed has an area of 1,600 square miles.

Limiting Factors

The delineations for the Glendive 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 the 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, adsorption, mechanical dispersion, biological transformation, dilution, molecular diffusion, 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 Glendive 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 Glendive PWS include hazardous materials transported on railroads, interstates, and secondary roads; nitrate, pathogens, herbicides, and pesticides. The inventory for Glendive 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

Table 4 summarizes the significant potential contaminant sources that are located within the Spill Response Region (Figure 3B, Figure 3C, and Figure 7). The Burlington Northern Fueling Facility is a State of Montana superfund site listed as an area of 11 to 20 acres. The Dowell Schlumberger site is also a State Superfund site and listed at 1 to 5 acres in size but this site is located about one quarter mile outside the Spill Response Region, northeast of the rail yard (Figure 3B). Both sites are ranked "medium priority" by the State Superfund Program, which indicates they represent potential long-term threat to surface or ground water that requires action. Only the fueling facility is considered a significant potential contaminant source because it is within the Spill Response Region and may pose a threat to the city's water supply.

Several gravel pits are located up-stream of the city's intake and near the boundary of the Spill Response Region. Gravel pits are a concern if they are not controlled and maintained. Concerns with the pits are accidental spills or illegal dumping that could result in contaminants entering the shallow ground water system and discharging to the Yellowstone River up-stream from the city's intake.

The Cenex pipeline carries refined petroleum products and is in close proximity to the Yellowstone River at multiple locations upstream from the Glendive PWS intake (Figure 3B and Figure 8). The pipeline transports large volumes of petroleum products and if leaks were not detected immediately the result would be a significant product release close to the Yellowstone or a tributary. The Bridger Pipeline break highlighted this threat. The pipeline break occurred approximately 6 miles upstream from Glendive's intake. Note from Figure 3B that there is another pipeline crossing about 1 mile upstream from the town's intake (Figure 3B – Circled area labeled #8).

The Northern Pacific Railroad tracks are in close proximity to the Yellowstone River at multiple locations upstream from the Glendive PWS intake (Figure 3B and Figure 8). Large volumes of hazardous materials are transported by rail within the Spill Response Region. The concern with the tracks is the possibility of accidents and spills directly into the river above the intake.

One municipal wastewater discharge site is located within the Spill Response Region near the intake (Figure 3B). An industrial wastewater discharge site serving the Northern Pacific Rail yard is located about one half mile east of the intake and another storm water discharge serving a sand and gravel operation is located a little over 2 miles up-stream from the intake (Figure 3B). Of these wastewater discharge sites, the one at the rail yard is considered the more significant potential source of contamination due to the routine transportation of potentially hazardous material by rail, presence of fuels and solvents in and around the year, and presence of the State Superfund site.

There are at least 29 underground storage tank sites in the Glendive area and seven are located within the Spill Response Region (Figure 3B). One tank is active with a leak history, three of the tank sites are inactive but have had leaks on site, and the remaining three sites are active without a history of leaks. Several other tanks are located near the boundary of the Spill Response Region and some of the tanks have leak histories. There may also be other sites where some volume of petroleum was released in the past but due to the lack of accurate locational information for these sites they cannot be mapped. Appendix C is a list of petroleum releases in the Glendive area. Some of the sites appear on the map and others do not.

Land areas within the spill response and watershed region are sparsely populated and fairly rural (Figure 7 and Figure 8). The principal land cover in the Spill Response Region is agricultural land

(37%), grassland (34%), forest land (7%), and wetland (5%). Open water (10%) makes up the remaining landcover in the Spill Response Region. According to the Source Water Program criteria, the percentage of agricultural land in this region indicates that activities on agricultural land represent a moderate potential threat to the Glendive PWS. In addition, the ag-land use is concentrated along the Yellowstone River valley within the Spill Response and the Watershed regions (Figure 7 and Figure 8). The concern here is the potential for mismanagement or over- application of fertilizers and/or pesticides on the agricultural lands that could result in SOCs entering the river up-stream from the city's intake. Due to the location of ag-lands within the watershed, there would be a benefit to Glendive and other public water supplies in the watershed to participate in and encourage the use of best management practices (BMPs) by the agricultural industry.

The exact location of the surface water intake is not shown in this report but it is worth noting that two bridges cross the Yellowstone River at Glendive in the vicinity of the surface water intake. Accidents and spills occurring on the bridges could pose a threat to the intake and the public water supply. Depending on flow conditions at the time of a spill or accident, significant volumes of a range of potential contaminants could enter the river directly in fairly close proximity to the intake. Emergency response and spill containment would be critical to prevent compromising the source water.

Table 4. Significant potential contaminant sources in the Spill Response Region Glendive PWS.

Potential Source	ID Number On Maps	Potential Contaminants	Hazard
Bridge Crossings	Not Numbered	VOCs, and SOCs, , pathogens, nitrate, and other hazardous materials	Accidents and spills involving large trucks
State Superfund Sites	6 and 7	VOCs, fuels, petroleum products	Historic spills and leaks at inactive oil field service and Rail yard and roundhouse facility
Open Cut Mining – Gravel Pits	Not Numbered	VOCs, and SOCs,	Spills, leaks, and dumping resulting in infiltration into ground water
Pipelines	8 and others not numbered	Petroleum Products	Spills and leaks
Railroad	Not Numbered	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into ground water
Storm and Municipal wastewater discharge sites	Not Numbered	VOCs, and SOCs,	Spills and leaks
Underground fuel storage tanks (USTs)	Not Numbered	VOCs, fuels, petroleum products	Spills and leaks resulting in infiltration into ground water
Cultivated Cropland	Not Numbered	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff

From the above list of potential contaminant sources, some are considered significant based upon the following factors: 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 8.

Inventory Results/Watershed Region

Transportation corridors for rail and highways within the watershed represent significant potential sources of contamination (Figure 8 and Figure 9). As in the Spill Response Region, the concern is that accidents and spills along these transportation routes could result in relatively large volumes of hazardous material entering the river upstream from the public water supply intake. Spills occurring in the more distal up-stream portions of the watershed pose less of a threat than those occurring closer to the intake. Petroleum pipelines within the watershed also represent significant potential contaminant sources due to the fact that they transport large volumes of petroleum products, and they cross or are in close proximity to the Yellowstone and some of its tributaries. In addition, breaks in pipelines may not be detected immediately and can result in large volume releases.

It should be noted that assessing the hazard of spills and releases from any of the above sources could be complicated by the flow conditions present when the contaminants enter the river. Spills that reach the river during low flow conditions would tend to remain more intact and concentrated because there is less river water to dilute the contaminant plume. Low flow conditions are usually less turbulent and accomplish less mixing. On the other hand, spills occurring during low flow conditions would move more slowly which would give public water supply operators more time to respond to the threat. Spills entering the river during high flow conditions would move more rapidly downstream but more turbulent flow would result in more effective mixing and dilution of the contaminant plume into the river water.

Predominant land covers in the Watershed Region include grassland (72%), ag-land (25%), and forest (3%) (Figure 8). A large portion of the agricultural landcover within the watershed is concentrated in the river and stream valleys. For this reason, activities on agricultural land are considered be a significant potential contaminant source within the watershed region. Grassland and forestland are not considered to be potential contaminant sources.

Other businesses and land uses in and around Glendive are outside the Spill Response Region but within the watershed. They are also considered as potential sources of contamination. Some of these sites are located down-stream from the intake location (Figure 3B). Potential contaminant sources downstream of the intake are not considered to pose a threat to the Glendive PWS. This includes several industrial and municipal wastewater discharge points, underground storage tanks, and a State Superfund Sites (Dowell Schlumberger site). It also includes a hazardous spill site at the Halliburton Energy facility and the Glendive wastewater treatment lagoons (Figure 3A and Figure 3B). It appears that the Halliburton site is a petroleum release site. A full listing of businesses in and around the Glendive, based on the Standard Industrial Codes (SIC) codes, is presented in Appendix A. These sites are also shown on Figure 3B as small circles. Most of the businesses are not significant potential contaminant sources but some of the business names suggest that some of the sites may use, transport or store larger volumes of potential contaminants. These sites are represented by red circles and labeled with a number preceded by a question mark (Figure 3B). Additional information is needed to

verify if these businesses should be considered as significant potential contaminant sources. Some of these potential contaminant sources may pose a threat to other public water supplies in the area due to their location relative to those public water supplies (Figure 3A and Table 1). Source Water Delineation and Assessment Reports (SWDARs) for these public water supplies address hazards and concerns with these significant potential contaminant sources.

Most of the other significant potential contaminant point sources in the watershed are located west of Glendive's intake (Figure 9). These include a number of storm and wastewater discharges, landfills, underground fuel storage tanks, a crude oil pipeline, mining claims and sites, oil and gas test wells, and others (Table 5). If spills or releases occur at some these locations, it could result in a contaminants being released directly into the river or 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, unless the quantities release were large, the majority of the potential contaminant sources in the watershed are located far enough away from Glendive so as not to pose an acute threat to the public water supply (Figure 9). A full listing of businesses in the City of Glendive (based on SIC codes) was compiled and is present in Appendix A.

Low septic densities occur over the entire Watershed Region. The Glendive Wastewater Treatment Plant appears to be located at least two miles downstream from the public water supply intake and does not pose a threat to the public water supply (Figure 3A). Table 5 below lists the significant potential contaminant sources identified in the Watershed Region.

Table 5. Significant potential contaminant sources in the Watershed Region Glendive PWS

Potential Source	ID Number on Maps	Potential Contaminants	Hazard
Railroad	Not Numbered	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into ground water. River Crossings are a concern.
Highways, roads, and pipelines	Not Numbered	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into ground water. River Crossings are a concern.
Cultivated Cropland	Not Numbered	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff
Confined Animal Feeding Operation (CAFO)	Not Numbered	Nitrate, pathogens	Storm water runoff, infiltration into shallow ground water.
Hazardous Waste Spill Site	Not Numbered	Appears to be a petroleum release site	Infiltration in to ground water.
Storm Water / Wastewater Discharges	Not Numbered	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
Gas and Oil Wells	Not Numbered	Total Dissolved Solids, Petroleum Hydrocarbons	Migration of brine wastewater into shallow groundwater discharging to surface water, surface runoff to surface water

Table 5. Significant potential contaminant sources in the Watershed Region Glendive PWS

Potential Source	ID Number on Maps	Potential Contaminants	Hazard
Landfills	Not Numbered	Metals, Inorganics, VOCs, SOCs, pathogens, nitrate	Infiltration of leachate into shallow groundwater and subsequent discharging to the Yellowstone River; unauthorized dumping
Mining Operations	Not Numbered	Metals	Erosion and mobilization of metals in sediment and/or leached into surface water and groundwater
On-site residential septic systems	Not Numbered	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	Not Numbered	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	Not Numbered	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	Not Numbered	VOCs, petroleum hydrocarbons	Spills, leaks impacting groundwater and or reaching surface water
Assorted businesses in town	Not Numbered	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Releases or spills, mishandling of chemicals, improper disposal of chemicals anywhere near the river
Class V Injection Wells (existence and locations are not known) where storm and/or wastewater is concentrated and recharges groundwater.	Not Numbered	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 following factors: 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 Glendive 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 Glendive 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 Glendive and Custer 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 Glendive PWS operators and the community 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 Glendive's Spill Response Region depends on whether contaminants can discharge directly into the Yellowstone River or into its tributaries. 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 6. Barriers can be anything that decreases the likelihood that contaminated water will reach Glendive's surface water intake. Examples of barriers include: a vegetated riparian area, protective forest management practices, and dilution.

Table 6. 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

Table 6. Hazard of Potential Contaminant Sources, Determination of For Surface Water Sources

Potential Contaminant Sources	High Hazard Rating	Moderate Hazard Rating	Low Hazard Rating
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 7. 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 on the following page (Table 8).

Susceptibility Assessment Results

Table 8. Susceptibility Assessment for Significant Potential Contaminant Sources in the Spill Response and Watershed Regions Glendive PWS surface water intakes

Source	ID Number on Maps	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Petroleum Pipelines	8	Fuels, Hydrocarbons	Spills, leaks, and releases	**High**	-Leak detection - Local and state emergency response	**High**	Maintain preparedness of local emergency personnel through active training, storm water diversion
Railroad	Not Numbered	Pesticides, fertilizers, VOCs	Spills, storm water runoff, infiltration into ground water	**High**	-Local and state emergency response -Dilution at locations farther away from the intake;	**Moderate to High**	Maintain preparedness of local emergency personnel through active training, runoff diversion, continued remediation of former release sites
Tank Farm (petroleum)	2	Fuels, Hydrocarbons	Spills, leaks, and releases	**High**	-Leak detection - Local and state emergency response	**High**	Maintain preparedness of local emergency personnel through active training, storm water diversion
Highway	Not Numbered	Pesticides, fertilizers, VOCs, other	Spills, storm water runoff, infiltration into groundwater	**Moderate to High**	-Dilution at some locations farther away from the intake; County Emergency Response Plan, training and preparation of local response personnel	**Moderate**	Maintain preparedness of local emergency personnel through active training, storm water diversion
State Superfund Site	7	VOCs, fuels, petroleum products	Historic spills and releases at the rail yard and roundhouse facility	**Moderate**	None	**High**	Continue monitoring and encourage state and local officials to proceed to have site mitigated.
UST/LUSTs	Not Numbered	VOCs, petroleum hydrocarbons	Spills, leaks impacting groundwater and/or reaching surface water	**Moderate**	-Spill prevention, dilution, ongoing monitoring of groundwater, monitoring for spills, ongoing remediation of spill sites -Located downstream of the PWS intake	**Moderate to Low**	Spill response planning, tank and groundwater monitoring, spill catchment, active and ongoing remediation of spill sites
Municipal Sewer System	Not Numbered	Pathogens, nitrate	Leaks in sewer mains to groundwater, which may reach surface water	**Moderate**	-City's treatment facilities are down-stream from the intake	**Moderate to Low**	Ongoing testing and maintenance of lines and system, replacement of old lines, compliance with current regulations for discharges

Table 8. Susceptibility Assessment for Significant Potential Contaminant Sources in the Spill Response and Watershed Regions Glendive PWS surface water intakes

Source	ID Number on Maps	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Wastewater Discharges	Not Numbered	VOCs, SOCs, pathogens, nitrate, TDS	System failure, exceeding effluent limits	**Moderate**	-Dilution -Discharge points are significant distances upstream, others are downstream.	**Low to Very Low**	Ensure proper maintenance and operation of system; monitor leaks in system; develop an alternative treatment plan in the event of system failure
Cultivated Cropland	Not Numbered	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff adjacent the Yellowstone River and larger tributaries	**Moderate**	-Dilution	**Moderate**	Provide educational information, materials and resources to land owners on the proper application and storage of pesticide and fertilizers; implement agricultural BMPs
Oil Wells and Test Holes	Not Numbered	Total Dissolved Solids (TDS), Petroleum, Hydrocarbons	Improperly sealed or abandoned wells facilitating contaminant transport to shallow aquifers and possibly surface water bodies.	**Low**	-Areas of concentrated exploratory drilling are primarily along the Cedar Creek Anticline, some distance from the intake.	**Low**	Monitor drilling activities and oil field development near or adjacent the Spill Response Region.
Assorted Businesses in Town	Not Numbered	VOCs, SOCs, petroleum hydrocarbons , metals, pathogens, nitrate	Releases or spills, mishandling of chemicals, improper disposal of chemicals anywhere near the river	**Low**	-Some are located downstream of the PWS intake - Volumes of potential contaminants are relatively small	**Low to Very Low**	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. Scheduled days for the collection of hazardous wastes from the public
Mining Operations	Not Numbered	- variety of hazardous materials including VOC's and SOCs	Accidental spills or illegal dumping	**Low**	- Small size	**Low to Very Low**	Continue monitoring for metals and participate in watershed-wide efforts to maintain water quality and clean up high priority abandoned mines.

Table 8. Susceptibility Assessment for Significant Potential Contaminant Sources in the Spill Response and Watershed Regions Glendive PWS surface water intakes

Source	ID Number on Maps	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Confined Animal Feeding Operation (CAFO)	Not Numbered	Nitrate, pathogens	Storm water runoff, infiltration into shallow ground water.	**Low**	-Dilution, discharge points are significant distances upstream	**Low to Very Low**	Continue monitoring, encourage best management practices for CAFOs
Hazardous Waste Spill Site	Not Numbered	Appears to be a petroleum release site	Infiltration in to ground water.	**Low**	Downstream from the city's intake.	**Very Low**	Continue monitoring and encourage state and local officials to proceed to have site mitigated.
Septic Systems	Not Numbered	Pathogens, nitrate	Infiltration into shallow ground water and possible discharge to surface water.	**Low**	- Small areas of high and moderate septic density within the Spill Response Region.	**Low**	
Class V Injection Wells	Not Numbered	VOCs, SOCs, pathogens, nitrate	Infiltration of contaminants into aquifer	**Unknown**	-Unknown	**Unknown**	Inventory; Provide educational information, materials and resources to business owners and the public on proper waste disposal and recycling

Table 8. Susceptibility Assessment for Significant Potential Contaminant Sources in the Spill Response and Watershed Regions Glendive PWS surface water intakes

Source	ID Number on Maps	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Municipal Sewer System	Not Numbered	Pathogens, nitrate	Leaks in sewer mains to groundwater, which may reach surface water	**Moderate**	-City's treatment facilities are down-stream from the intake	**Moderate to Low**	Ongoing testing and maintenance of lines and system, replacement of old lines, compliance with current regulations for discharges
Wastewater Discharges	Not Numbered	VOCs, SOCs, pathogens, nitrate, TDS	System failure, exceeding effluent limits	**Moderate**	-Dilution -Discharge points are significant distances upstream, others are downstream.	**Low to Very Low**	Ensure proper maintenance and operation of system; monitor leaks in system; develop an alternative treatment plan in the event of system failure
Oil Wells and Test Holes	Not Numbered	Total Dissolved Solids (TDS), Petroleum, Hydrocarbons	Improperly sealed or abandoned wells facilitating contaminant transport to shallow aquifers and possibly surface water bodies.	**Low**	-Areas of concentrated exploratory drilling are primarily along the Cedar Creek Anticline, some distance from the intake.	**Low**	Monitor drilling activities and oil field development near or adjacent the Spill Response Region.
Assorted Businesses in Town	Not Numbered	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	Releases or spills, mishandling of chemicals, improper disposal of chemicals anywhere near the river	**Low**	-Some are located downstream of the PWS intake - Volumes of potential contaminants are relatively small	**Low to Very Low**	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. Scheduled days for the collection of hazardous wastes from the public
Mining Operations	Not Numbered	- variety of hazardous materials including VOC's and SOCs	Accidental spills or illegal dumping	**Low**	- Small size	**Low to Very Low**	Continue monitoring for metals and participate in watershed-wide efforts to maintain water quality and clean up high priority abandoned mines.

Table 8. Susceptibility Assessment for Significant Potential Contaminant Sources in the Spill Response and Watershed Regions Glendive PWS surface water intakes

Source	ID Number on Maps	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Confined Animal Feeding Operation (CAFO)	Not Numbered	Nitrate, pathogens	Storm water runoff, infiltration into shallow ground water.	**Low**	-Dilution, discharge points are significant distances upstream	**Low to Very Low**	Continue monitoring, encourage best management practices for CAFOs
Hazardous Waste Spill Site	6	Appears to be a petroleum release site	Infiltration in to ground water.	**Low**	Down stream from the city's intake.	**Very Low**	Continue monitoring and encourage state and local officials to proceed to have site mitigated.
Septic Systems	Not Numbered	Pathogens, nitrate	Infiltration into shallow ground water and possible discharge to surface water.	**Low**	- Small areas of high and moderate septic density within the Spill Response Region.	**Low**	
Class V Injection Wells	Not Numbered	VOCs, SOCs, pathogens, nitrate	Infiltration of contaminants into aquifer	**Unknown**	-Unknown	**Unknown**	Inventory; Provide educational information, materials and resources to business owners and the public on proper waste disposal and recycling

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

State Superfund Sites – The Burlington Northern Fueling Facility is assigned a moderate hazard because contaminants at the site could infiltrate into the shallow ground water and migrate to the Yellowstone River in the vicinity of the city's surface water intake. The site is ranked as a "medium priority" by the State Superfund Program, indicating it represents a potential long-term threat to surface or ground water that requires action. It is not clear from available information if remediation has been initiated at the site. With no barriers identified the susceptibility of the public water supply to this contaminant source is rated as high.

Petroleum Pipeline – The potential hazard represented by releases, spills, and leaks from pipelines within the Spill Response Region and the watershed is high because the pipeline crosses several tributaries and runs in close proximity to the Yellowstone River in several places. Susceptibility of the public water supply to the pipeline is high even with two barriers recognized. This is justified based on the 2015 Bridger Pipeline break that resulted in contaminated water entering the Glendive intake.

Railroads – The potential hazard represented by pesticides, fertilizers, VOCs and SOCs from spills along the Burlington Northern railway pose a moderate to high hazard, depending on the proximity of the spill to the Yellowstone River and the Glendive intake. Emergency response is considered a barrier for rail locations closer to the city's intake and dilution is considered a barrier for rail locations further from the intake. With these barriers, the susceptibility to this potential contaminant source is rated as moderate to high.

Highway- The potential hazard imposed by hazardous materials that could be accidentally spilled on or along the highway or secondary highways is moderate to high depending on whether a spill occurs in close proximity to the Yellowstone River. Susceptibility is rated moderate with emergency response counting as a barrier for spills closer to the intake and dilution for highway locations further away from the intake. Susceptibility is rated as moderate to high.

Cultivated Crop lands – The potential hazard from pathogens and nitrate originating from agricultural lands is moderate. Cropped agricultural lands occupy a significant part of the Yellowstone River alluvial valley within the spill response region. The susceptibility of the intake to these agricultural sources of nitrate and pathogens is also moderate because adequate dilution should be provided by the average discharge of the Yellowstone River.

UST/LUSTs- The potential hazard imposed by VOCs and petroleum hydrocarbons is moderate for three inactive tank sites with leak histories within the Spill Response Region and low for three active tank sites without leak histories. A moderate hazard is also assigned to the inactive tank site with a leak history that is located just west of the Spill Response Region Boundary (Figure 3B). Overall, the susceptibility ranges from moderate to low due to the presence of several barriers including spill prevention, dilution, ongoing monitoring of ground water and monitoring for spills. As noted earlier, there are other tank sites in the Glendive area that do not have accurate location information available and therefore cannot be mapped. Hazard and susceptibility for these sites is not analyzed for the tank sites listed in Appendix C.

Municipal Sewer System – The potential hazard imposed by pathogens and nitrate originating from Glendive's municipal sewer system is moderate. The area immediately east and up-stream from the intake location represents an older part of the city and occupies a significant part of the Spill Response Region near the intake. The susceptibility of the intakes to nitrate and pathogens originating from this source is rated as moderate, and the susceptibility of the intake to the waster water treatment plan and lagoons is low to very low because they are down-stream from the intake.

Wastewater Discharges- The potential hazard from VOCs, SOCs, pathogens, and nitrate originating from wastewater discharges is moderate. The susceptibility of the PWS intake to contaminants originating from these sources is low. The primary reason for the low rating is that the discharge points are either downstream from the public water supply intake, or a significant distance up-stream. In most situations, the Yellowstone River would provide sufficient dilution.

Oil Wells and Test Hole- Petroleum exploration activities in the Glendive area have been significant in the past 50 to 60 years. Numerous test holes and exploratory wells have been completed in the area. Most of this activity has been focused on the Cedar Creek Anticline southeast of Glendive. Due to their depth and distance from Glendive's surface water intake, the oil and gas wells and test holes are considered to represent a low hazard and susceptibility is also low.

Assorted Businesses in Town- Appendix A lists various businesses in town that are considered to represent non-significant potential contaminant sources based on the criteria within the Source Water Protection Guidelines (DEQ, 1999). Based on their location with respect to the public water supply intake, these businesses are not considered to pose a threat to the Glendive Public Water Supply. Some of the sites may represent significant potential contaminant sources for other public water supplies in and around Glendive. Source Water Delineation and Assessment Reports for those public water supplies will assess hazard and susceptibility for those water systems. However, a simple proactive step to reducing the risk of unnecessary contamination in the community is to provide educational information and resources to business owners and the public on proper waste disposal and recycling.

Mining Operations- Based on available information, the mining operations in the area are relatively small or simply represent sand and gravel operations. Due to their size and distance from the public water supply intake they are not considered to pose a threat to the water supply. The susceptibility is rated as low to very low.

Confined Animal Feeding Operations- Two Confined Animal Feeding Operations (CAFOs) are located in the Yellowstone River valley about 30 and 50 miles up-stream from the Glendive intake and likely do not pose a threat to the public water system. On June 10, 1974, the federal Environmental Protection Agency (EPA) delegated authority to Montana for administration of the Montana Pollutant Discharge Elimination System (MPDES). The MPDES issues permits to control point source discharges of pollution. A CAFO is defined in Section 502 of the Clean Water Act as a point source of pollution. Discharges from CAFOs require a permit.

Hazardous Waste Spill Sites- The Halliburton site is listed as a hazardous waste spill site and it appears that it is a petroleum release site. Because the site is over a mile in the down-stream direction from the water supply intake the hazard is rated as low and susceptibility is considered very low.

Septic Systems – Areas of high and moderate septic density are located within the Spill Response Region to the west of the city's surface water intake (Figure 3B). Both areas are relatively small and in a cross- or down-gradient position to the intake. As a consequence, hazard is low and susceptibility to pathogens and nitrate from septic systems is also low.

Class V Injection Wells – The potential hazard imposed by VOCs, SOCs, pathogens, nitrate, and other contaminants originating from the class V injection wells cannot be determined due to the fact that no inventory of Class V well is complete for most of Montana or the current inventory is inadequate. The susceptibility of the intake to contaminants originating from this source is unknown.

Management Recommendations

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.

Some management recommendations are also included in the susceptibility table for the Glendive PWS (Table 8). If these, and other, management recommendations are implemented, they may be considered additional barriers that will reduce the susceptibility of the 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 may reduce the susceptibility of the City's PWS to contamination from municipal septic wastes, and could also benefit other public water supplies in the Glendive area.

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 station 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.

The City’s public water supply operators, the city administration, and the Dawson County administration can consider these management recommendations along with their ongoing efforts to protect the public water supply. Should contamination reach the town's intake, the City and County will likely need to work cooperatively to address remediation or relocation of the intake.

CHAPTER 5
MONITORING WAIVERS

Waiver Recommendation

The City of Glendive had Phase 2 and 5 waivers for the last 9 yr compliance cycle. A new round of testing took place September 2002 for the full list of inorganics. Results are consistently and reliably below the MCLs and as a result the Phase 2 and 5 waivers are automatically renewed for this compliance cycle through 2010. Phase 2 and 5 inorganic constituents include Barium, Cadmium, Chromium, Fluoride, Mercury, Selenium, Antimony, Thallium, Beryllium, and Nickel. Based on past monitoring results or the susceptibility assessment of the intake, Glendive PWS may not be eligible for additional monitoring waivers. However, to be sure that eligibility for all available waivers is considered, the PWS Operators are encouraged to carefully review the following section on Monitoring Waiver Requirements. If after reviewing this section it is determined that an additional waivers are feasible, the Glendive PWS should submit a letter with the proper documentation to DEQ requesting monitoring waivers. Table 9 shows how identified potential contaminant sources affect the eligibility for monitoring waivers.

Table 9. Susceptibility Assessment as it relates to waiver eligibility for significant potential contaminant sources in the Spill Response Region Glendive PWS surface water intakes.

Source	Contaminant	Susceptibility	Waiver Eligibility
Petroleum Pipelines, State Superfund Site, UST/LUST Sites	VOCs, fuels, petroleum products	**High**	The number of sources in the Glendive area and the volume of petroleum products present or transported likely precludes a waiver
Railroad	Pesticides, fertilizers, VOCs	**Moderate to High**	Volume and type of chemicals and materials transported likely precludes waivers for some chemicals
Highway	Pesticides, fertilizers, VOCs, other	**Moderate to High**	Volume and type chemicals and materials transported likely precludes waivers for some chemicals
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	**Moderate**	Chemical use likely precludes waivers for some chemicals
Municipal Sewer System, Septic Systems, and CAFO.	Pathogens, nitrate	**Low to Very Low**	Waivers are not available for pathogens and nitrate
Wastewater Discharges	VOCs, SOCs, pathogens, nitrate, TDS	**Low to Very Low**	Waivers are not available for pathogens and nitrate
Oil Wells and Test Holes	Total Dissolved Solids (TDS), Petroleum, Hydrocarbons	**Low**	The number of drilling activity in the watershed likely precludes a waiver

Source	Contaminant	Susceptibility	Waiver Eligibility
Assorted Businesses in Town	VOCs, SOCs, petroleum hydrocarbons, metals, pathogens, nitrate	**Very Low**	Chemical use likely precludes waivers for some chemicals Waivers are not available for pathogens and nitrate
Mining Operations	Metals	**Low**	Extensive mining within the Yellowstone River watershed likely precludes waivers
Class V Injection Wells	VOCs, SOCs, pathogens, nitrate	**Very Low**	Waivers are not available for pathogens and nitrate

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 will 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.

REFERENCES

Alt, David, and Hyndman, Donald W., 1990, Roadside Geology of Montana, Mountain Press Publishing Company, Missoula.

Alt, David, and Hyndman, Donald W., 1998, Northwest Exposures, A Geologic Story of the Northwest, Mountain Press Publishing Company, Missoula.

Board of Water Well Contractors, Administrative Rules of Montana, 01/30/2001. 36.21.656-.660

Department of Environmental Quality, 1999. Montana Source Water Protection Program, Approved by EPA in November 1999, inclusive of personal communications with Joe Meek & others.

DEQ Permitting and Compliance Division, 2001. Sanitary Survey for Glendive PWS - PWS # 00291.

Freeze, R. Allan and Cherry, John A., 1979. Groundwater, Prentice-Hall, Inc.

Heath, R. C, 1984, Ground-Water Regions of the United States, U.S. Geological Survey Water Supply Paper 2242, p. 78.

Lewis, B.D. and Roberts, R.S., 1978, Geology and Water Yielding Characteristics of Rocks of the Northern Powder River Basin, Southeastern Montana; Miscellaneous Investigations Series Map, I847D, U.S. Geological Survey.

Montana Department of Environmental Quality, Permitting & Compliance Division and the Drinking Water Assistance Program - Montana Water Center: Ground Water Manual for Small Water Systems, January 1999.

Montana Bureau of Mines and Geology tabular well information, 2000: http://mbmgsun.mtech.edu/ & http://mbmggwic.mtech.edu/

Montana State Library - Natural Resource Information Service, 2000. Graphical and tabular information: http://nris.state.mt.us/mapper/

Montana State Library - Natural Resources Information System (NRIS) 2000 map base of the USGS Topographical coverage at 1:24,000 scale in MrSID format.

Slagle, S.E., 1983, Water resources of the Fort Union coal region, east-central Montana; U.S. Geological Survey Water-Resources Investigations WRI 83-4151-U.S. Geological Survey, 42 p.

Slagle, S. E. et al., 1984, Hydrology of area 45, northern Great Plains and Rocky Mountain coal provinces, Montana and North Dakota: U.S. Geological Survey Water-Resources Investigations open-file Report 83-527, 90p.

Smith, L. N., LaVave, J. I., Patton, T.W., Rose, J. C., and McKenna, D. P., 2000, Ground-Water Resources of the Lower Yellowstone River Area: Dawson, Fallon, Prairie, Richalnd, and Wibaux Counties, Montana; Montana Ground-Water Assessment Atlas No. 1, Montana Bureau of Mines and Geology Publication, p. 44.

Stoner, J.D., and Lewis, B. D., 1980, Hydrogeology of the Fort Union coal Region, eastern Montana: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-1236, 2 sheets.

U. S. Environmental Protection Agency (US EPA), 1991. Manual of Small Public Water Supply Systems, US EPA Office of Water (WH-550), EPA 570/9-91-003.

Torrey, A. E., and Swenson, F. A., 1951, Ground-Water Resources of the Lower Yellowstone River Valley between Miles City and Glendive Montana; U.S. Geological Survey Circular 93.

U.S. Geological Survey, 2000. National Landcover Dataset, Montana. 30-meter electronic digital landcover / land use data set interpreted from satellite imagery.

U.S. Geological Survey, 2002. Real-time streamflow and water quality information: http://mt.waterdata.usgs.gov/nwis/rt

Western Regional Climate Center, 2002. Climate Summary Data by City: http://www.wrcc.dri.edu/summary/climsmmt.html

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.

FIGURES

Figure 1. General Location Map.

Figure 2. Climate Summary– Imbedded in text on page 3.

Figure 3A. Public Water Supplies in the area.

Figure 3B. Inventory of Potential Contaminant Sources in the Glendive area.

Figure 3C. Spill Response Region and Potential Contaminant Sources.

Figure 4. Well Depth Histogram for wells in the Glendive Vicinity – Imbedded in text on page 5.

Figure 5. General Geology Map.

Figure 6. Peak flow for the Yellowstone River near Glendive – Imbedded in text on page 8.

Figure 7: Glendive PWS Spill Response Region Inventory Map.

Figure 8: Glendive PWS Watershed Region Landcover Map.

Figure 9: Glendive PWS Watershed Region Inventory Map.

APPENDICES

APPENDIX A - Listing of Potential Contaminant Sources based on SIC Code

NAME	ID NUMBER ON MAP	Standard Inducstrial Code Name 1	Standard Inducstrial Code Name 2
A & M Crisafulli Sales & Svc		Pumps (Wholesale)	
Aaa Emergency Road Svc		Road Service-Automotive	
Avis Rent A Car		Automobile Renting & Leasing	
B & H Welding & Machine Inc		Machine Shops	Indstrl/Coml Machinery/Equip Nec (Mfrs)
Baker Oil Tools		Oil Field Service	Oil Well Equipment & Supplies-Whol
Berg Tire Inc		Tire-Dealers-Retail	Wheel Alignment-Frame & Axle Svc-Auto
Birdsall Tire Co		Tire-Dealers-Retail	Wheel Alignment-Frame & Axle Svc-Auto
Bob's Body Shop		Automobile Body-Repairing & Painting	Glass-Auto Plate & Window & Etc
Bob's Pickup & Delivery		Trucking-Motor Freight	
Boss One Hour Photo		Business Services Nec	
Burlington Northern Santa Fe	**?16**	Railroads	
Butane Power & Equipment		Gas-Liquefied Petro-Bttld/Bulk (Whol)	Oil Field Service
Carquest Auto Parts		Automobile Parts & Supplies-Retail-New	
Cenex Convenience Store		Convenience Stores	Service Stations-Gasoline & Oil
Cenex Harvest States		Oils-Fuel (Wholesale)	Gas-Liquefied Petro-Bttld/Bulk (Whol)
Cenex Transportation	**?15**	Refuse Systems	
Certified Car Care		Automobile Repairing & Service	Transmissions-Automobile
Chevron Bulk Products	**?19**	Service Stations-Gasoline & Oil	
Classic Car Care		Car Washing & Polishing	Automobile Detail & Clean-Up Service
Community Home Oxygen Inc		Metals Service Centers & Offices	Oxygen (Wholesale)
Conoco Bulk Products	**?19**	Service Stations-Gasoline & Oil	
Conoco Oil Products	**?19**	Service Stations-Gasoline & Oil	
Cottonwood Country Club		Membership Sports & Recreation Clubs	
Creative Auto Trim		Automobile Customizing	
Cross Petroleum Svc	**?19 LUST SITE**	Oils-Lubricating-Wholesale	
Crossroads Conoco	**?19**	Service Stations-Gasoline & Oil	
Dawson Community Airport		Airports	
East End Conoco		Service Stations-Gasoline & Oil	
Exxon Bulk Plant		Oils-Petroleum (Wholesale)	
F T Reynolds Co		Grocers-Retail	
Farmers Elevator		Grain Elevators	
First National Pawn		Pawnbrokers	Guns & Gunsmiths
Fisher's Discount Tack Store		Tack	
Gate City Radiator & Welding		Automobile Repairing & Service	Automobile Radiator Repairing
Gibbs Equipment		Automobile Repairing & Service	
Glendive Auto Parts Co		Automobile Parts-Used & Rebuilt (Whol)	Truck Equipment & Parts-Used & Rebuilt
Glendive Auto Sales		Auto & Home Supply Stores	
Glendive Fire Hall		Public Order & Safety Nec	
Glendive Glass Paint Flooring		Paint-Retail	Wallpapers & Wallcoverings-Retail
Glendive Livestock		Livestock Auction Markets	
Glendive Monument & Granite		Monuments	
Glendive Plumbing & Heating		Plumbing Contractors	Water Heaters-Dealers
Glendive Sales Corp		Auto & Home Supply Stores	
Glendive Sales Corp		Auto & Home Supply Stores	Motorcycles & Motor Scooters-Dealers
Glendive Transfer & Storage		Movers	Storage-Household & Commercial
Goodale Auto & Truck Repair		Automobile Repairing & Service	Truck-Repairing & Service
Greyhound Bus Lines		Bus Charter Service-Except Local	Delivery Service

APPENDIX A - Listing of Potential Contaminant Sources - Continued

NAME	ID NUMBER ON MAP	Standard Inducstrial Code Name 1	Standard Inducstrial Code Name 2
Guns N Things		Guns & Gunsmiths	
Hedahls Automotive Parts		Automobile Parts & Supplies-Retail-New	Indstrl/Coml Machinery/Equip Nec (Mfrs)
Heinrich's Sinclair		Automobile Repairing & Service	
Hertz Rent A Car		Automobile Renting & Leasing	
Hess Feeds Inc		Feed-Dealers (Wholesale)	
Hkt Big Sky Motors		Automobile Body-Repairing & Painting	
Hkt Big Sky Motors		Auto & Home Supply Stores	Auto & Home Supply Stores
Holas Mid-America Sports Ctr		Motorcycles & Motor Scooters-Dealers	Lawn Mowers
Holiday Station Store		Convenience Stores	Service Stations-Gasoline & Oil
Hops Auto Sales		Auto & Home Supply Stores	
Instant Lube		Automobile Lubrication Service	
J & J Crisafulli Inc		Landscape Contractors	Mobile Home Dealers
J & S Feeds Inc		Feed-Dealers (Wholesale)	
Jim Bender Mechanic Svc		Farm Equipment-Repairing & Parts	
Jim's Automotive		Automobile Repairing & Service	
Jock Stop		Sporting Goods-Retail	
Joy's Glendive Svc		Automobile Repairing & Service	Recreational Vehicles-Storage
Kurtz Sanitation	**?17**	Garbage Collection	Sanitation Services
Larry's Exxon		Service Stations-Gasoline & Oil	Wrecker Service
Leo's Body Shop Inc		Automobile Body-Repairing & Painting	Automobile Repairing & Service
Milne Implement Co	**?18**	Farm Equipment (Wholesale)	Lawn & Garden Equip & Supplies-Retail
Mindt Machine		Machine Shops	Welding
Mini Mart		Convenience Stores	
Mort Distributing Inc		Oils-Fuel (Wholesale)	
Napa Auto Parts		Automobile Parts & Supplies-Retail-New	
Orcutt Bros		Automobile Parts-Used & Rebuilt (Whol)	
Osborn Photography		Photographers-Portrait	
Paul's Lock Shop		Locks & Locksmiths	Metals Service Centers & Offices
Pro Tech Diesel		Engines-Diesel-Fuel Injection-Svc & Rpr	Fuel Injection Equipment (Repairing)
Ra Ell's Mobile Moving		Mobile Homes-Transporting	Mobile Homes-Repairing & Service
Ranch & Farm Wholesale Supply		Hardware-Retail	Veterinarians Equipment & Supls (Whol)
Robins Service		Service Stations-Gasoline & Oil	Automotive Glass Replacement Shops
Ron Smith Auto Sales		Auto & Home Supply Stores	
Sevier Builders & Auto Sales		Auto & Home Supply Stores	
Sharpe Shades Auto Body		Automobile Body-Repairing & Painting	
Shell Oil Jobber	**?19**	Oil Marketers & Distributors	
Shell Western E & P Inc		Service Stations-Gasoline & Oil	
Silvernale Silha Funeral Homes		Funeral Directors	Funeral Plans (Pre-Arranged)
Tire-Rama Wholesale Distr		Tire-Dealers-Retail	
Trailstar Truck Stop Inc		Truck Stops & Plazas	
Truck Suppliers Inc		Truck-Repairing & Service	Bearings (Wholesale)
U-Haul Co		Truck Renting & Leasing	Moving Supplies & Equipment-Renting
United Parcel Svc		Delivery Service	Courier Services
Urbanec Motors	**LUST SITE**	Auto & Home Supply Stores	Auto & Home Supply Stores
Valley Motor Supply Co		Automobile Parts & Supplies-Retail-New	
Valley View #7 Day Adventist		Schools	
Western Area Power Administrtn		Refuse Systems	
Westgate Conoco	**?19**	Service Stations-Gasoline & Oil	
Whistle Stop		Convenience Stores	
Windshields Plus		Automobile Glass-Service & Installation	
Yellowstone Recycling	**?20**	Recycling Centers (Wholesale)	

APPENDIX B - DEQ PWS's Database Output

PWS NUMBER	PWS NAME	WATER TYPE	WATER SOURCE NAME	SAMPLE POINT LOCATION	ANALYTE NAME	CONCENTRATION	UNITS
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	1,1,1-TRICHLOROETHANE	0	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ANTIMONY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ANTIMONY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ANTIMONY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ANTIMONY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ANTIMONY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ANTIMONY	0	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0.001	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0.001	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0.001	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ARSENIC	0.001	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ARSENIC	0.002	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	ARSENIC	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0.1	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0.02	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0.01	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0.02	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0.01	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0.008	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0.011	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	BARIUM	0.019	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	BARIUM	0.027	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	BARIUM	0.05	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	BARIUM	0.01	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	BARIUM	0.011	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	BARIUM	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	BARIUM	0	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	BERYLLIUM	0	

Inorganic Water Quality Sampling Results – Glendive PWS

PWS NUMBER	PWS NAME	WATER TYPE	WATER SOURCE NAME	SAMPLE POINT LOCATION	ANALYTE NAME	CONCENTRATION	UNITS
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	0.49	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	0.48	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	0.43	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	0.46	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	0.34	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	0.34	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	0.46	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	0.36	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	0.44	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	FLUORIDE	0.42	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	FLUORIDE	0.4	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	FLUORIDE	0.5	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	FLUORIDE	0.38	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	FLUORIDE	0.54	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	FLUORIDE	0.28	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	FLUORIDE	0.4	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	FLUORIDE	0.43	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0.001	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	MERCURY	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	MERCURY	0	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NICKEL	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NICKEL	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NICKEL	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NICKEL	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NICKEL	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NICKEL	0	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.01	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.53	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.28	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.079	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.33	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.28	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.17	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0	
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.08	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.05	MG/L
MT0000229	GLENDIVE CITY OF	SW	DISTRIBUTION SYSTEM	SP001	NITRATE+NITRITE (AS N)	0.2	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NITRATE+NITRITE (AS N)	0.58	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NITRATE+NITRITE (AS N)	0.22	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NITRATE+NITRITE (AS N)	0.039	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NITRATE+NITRITE (AS N)	0	
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NITRATE+NITRITE (AS N)	0.36	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NITRATE+NITRITE (AS N)	0.38	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NITRATE+NITRITE (AS N)	0.48	MG/L
MT0000229	GLENDIVE CITY OF	SW	TP FOR YELLOWSTONE RIVER	EP502	NITRATE+NITRITE (AS N)	0.02	MG/L

<u>Inorganic Water Quality Sampling Results – Continued</u>

PWS NUMBER	SYSTEM NAME	LAB ASSIGNED ID NUM	COLLLECTION END DATE	SAMPLE TYPE CODE	PRESENCE INDICATOR CODE	CODE	ANALYTE NAME
MT0000229	GLENDIVE CITY OF	B03010244-001	1/6/2003	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B03010244-002	1/6/2003	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B03010244-003	1/6/2003	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B03010244-004	1/6/2003	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B03010244-005	1/6/2003	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02120542-001	12/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02120542-002	12/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02120542-003	12/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02120542-004	12/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02120542-005	12/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02110217-001	11/4/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02110217-002	11/4/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02110217-003	11/4/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02110217-004	11/4/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02110217-005	11/4/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02100491-001	10/8/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02100491-002	10/8/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02100491-003	10/8/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02100491-004	10/8/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02100491-005	10/8/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02090528-001	9/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02090528-002	9/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02090528-003	9/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02090528-004	9/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02090528-005	9/10/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02080373-001	8/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02080373-002	8/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02080373-003	8/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02080373-004	8/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02080373-005	8/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02070473-001	7/9/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02070473-002	7/9/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02070473-003	7/9/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02070473-004	7/9/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02070473-005	7/9/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02060152-001	6/3/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02060152-002	6/3/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02060152-003	6/3/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02060152-004	6/3/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02060152-005	6/3/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02050312-001	5/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02050312-002	5/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02050312-003	5/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02050312-004	5/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02050312-005	5/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02040344-001	4/8/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02040344-002	4/8/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02040344-003	4/8/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02040344-004	4/8/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02040344-005	4/8/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02030273-001	3/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02030273-002	3/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02030273-003	3/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02030273-004	3/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02030273-005	3/6/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02020224-001	2/5/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02020224-002	2/5/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02020224-003	2/5/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02020224-004	2/5/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	B02020224-005	2/5/2002	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	001-02-50183	1/7/2002	RT	A	3100	COLIFORM, TOTAL (TCR)

Bacteriological Sampling Data - Glendive PWS

PWS NUMBER	SYSTEM NAME	LAB ASSIGNED ID NUM	COLLLECTION END DATE	SAMPLE TYPE CODE	PRESENCE INDICATOR CODE	CODE	ANALYTE NAME
MT0000229	GLENDIVE CITY OF	005-00-56675	8/8/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-656	7/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-657	7/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-658	7/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-659	7/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-660	7/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-535	6/1/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-536	6/1/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-537	6/1/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-538	6/1/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-539	6/1/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-452	5/4/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-453	5/4/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-454	5/4/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-455	5/4/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-456	5/4/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-358	4/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-359	4/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-360	4/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-361	4/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-362	4/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	225	3/2/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	226	3/2/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	227	3/2/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	228	3/2/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	229	3/2/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	138	2/3/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	139	2/3/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	140	2/3/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	141	2/3/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	142	2/3/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	114	1/26/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	115	1/26/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-93	1/20/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-94	1/20/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-28	1/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-29	1/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-30	1/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-31	1/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	00-32	1/6/2000	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-1176	12/2/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-1177	12/2/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-1178	12/2/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-1179	12/2/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-1180	12/2/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-1088	11/4/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-1089	11/4/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-1090	11/4/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-1091	11/4/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-1092	11/4/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-976	10/6/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-977	10/6/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-978	10/6/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-979	10/6/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-980	10/6/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-843	9/1/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-844	9/1/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-845	9/1/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-846	9/1/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-847	9/1/1999	RT	A	3100	COLIFORM, TOTAL (TCR)
MT0000229	GLENDIVE CITY OF	99-766	8/9/1999	RT	A	3100	COLIFORM, TOTAL (TCR)

Bacteriological Sampling Data - Continued

APPENDIX C - Petroleum Release Data For the Glendive Area (For sites NOT shown in Figure 3B

SiteName	Location	AltEventID	Confirmed Release Date	Active
AT & T COMMUNICATION	BELL PRARIE RD NE OF GLENDIVE	1102407*2325	25-Aug-94	No
AUTO REPAIR CENTER	803 N MERRILL AVE	1113535*2343	20-Sep-94	No
AUTOVON SITE/MID-RIVERS TELE	NONE GIVEN	1109817*797	26-Jun-91	No
BALSAM, E G JR ETAL	HWY 10 E	1101286*1477	19-Nov-92	No
BN Rail Yard	107 N Sargent Avenue	1109528*4136	13-Sep-02	Yes
BN Rail Yard Glendive	310 N Merrill	1109528*4115	02-Oct-01	Yes
Cable Incorporated	N Anderson St E of Railroad Tracks	1111947*2687	16-Aug-95	Yes
Cenex Harvest States Bulk Facility	318 E Allard	1105497*3807	21-Jul-99	Yes
Cenex LTD- Cenex Supply	2111 W Town	1103214*1328	22-Dec-86	Yes
CENEX TRUCK TERMINAL	2415 W TOWNE	1100840*1285	30-Jul-92	No
CENEX TRUCK TERMINAL	2415 W TOWNE	1100840*1787	12-Aug-93	No
Cross Petroleum Bulk Facility	320 E Allard	1100032*3826	06-Oct-99	Yes
D & H Oil Field Service Inc.	Circle Hwy	1112788*1709	17-Jun-93	Yes
DAWSON COUNTY SHOP	N NOWLAND AVE	1100824*1417	30-Sep-92	No
Devier, John R	C.B.RR	1108238*1887	18-Oct-93	Yes
DOHRMANN-ENT-INC	1 1/2 MI W ON CIRCLE RD	1102249*1988	15-Nov-93	No
GEIGER, TOM	1005 HIGHLAND PARK	1110468*217	05-Mar-90	No
Glendive BN	Glendive	3749	28-Dec-88	Yes
GLENDIVE CENTER	FORREST PARK SUBDIVISION	1104541*1719	28-Jun-93	No
HAMMER, STEPHEN L	RIVERS EDGE - RIVER RD PO BOX 304	1112494*906	16-Sep-91	No
INSTANT LUBE	401 N MERRILL	1102372*537	11-May-91	No
LABREE MOBILE HOMES, INC	1003 W BELL ST	1101593*1360	27-Aug-92	No
MJZ INC	706 N SARGENT AVE	1101883*1598	16-Apr-93	No
PARAFFIN SERVICE, INC3TERMINAL	6 MI S GLENDIVE MARSH RD	1100935*1217	24-Dec-91	No
Realty One	322 S Merrill Ave	1113942*3767	22-Jul-99	Yes
S & M BUILDING	CRISAFULLI DR	1112759*1204	20-May-92	No
SIEGLE, FRED	CB RR	1106575*728	16-May-91	No
STAEHNKE, BUDD	906 E WREN LANE	1108282*575	02-Apr-90	No
TWILITE DINING & LOUNGE	209 N MERRILL	1109325*716	24-Apr-91	No
URBANEC MOTORS INC	100 FORD AVE BOX 1349	1103949*2230	18-May-94	No
VESTER PROPERTIES	117 N KENDRICK	1103177*978	22-Dec-88	No

APPENDIX D - Sanitary Survey

APPENDIX E - Concurrence Letter & Other Correspondence