Montana Aviation Research Company
PWSID # MT0000416

and

City of Glasgow
PWSID # MT0000415

Public Water Systems

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

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INTRODUCTION

This Delineation and Assessment Report was prepared by Perri P. May, Hydrogeologist in the Source Water Protection Program of the Montana Department of Environmental Quality (DEQ). The public water supplies (PWSs) discussed in this report are located in Valley County, Montana. The DEQ PWS identification numbers, operator names, and operator numbers for the PWSs appear on the title page of this report.

Purpose

This report is intended to meet the technical requirements for the completion of the source water delineation and assessment report for the City of Glasgow and Montana Aviation Research Company (MARCO) PWSs as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182). The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to the protection of public drinking water supplies from contamination. The primary purpose of this source water delineation and assessment report is to provide information to assist the City of Glasgow and MARCO PWS operators in the identification of potential contaminant sources near the surface water intake. This report also identifies the need for a source water protection plan to protect the City of Glasgow/MARCO drinking water source. A source water protection plan is warranted for these PWSs, as their source water is highly susceptible to a number of identified potential contaminant sources.

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

Limitations

This report was prepared to assess threats to the identified public water supplies. Information on land use and potential contaminant sources comes from a variety of sources including a preliminary land cover data layer produced by the United States Geological Survey (USGS), DEQ Public Water Supply files (including sanitary surveys), and other public sources of information. A web-based GIS application was also used to query and generate maps to support writing this report. This application is called the Source Water Protection Program Query System and is available at the following web address or URL: http://nris.state.mt.us/wis/swap/swapquery.asp. The application was developed by the DEQ Source Water Protection Program (SWPP) and provides access to data from the U.S. EPA, DEQ, Montana Bureau of Mines and Geology (MBMG) and other sources.

The terms “drinking water supply” and “drinking water source” refer specifically to the sources of the public water supplies, and not any other public or private water supply. Also, not all potential or existing sources of ground -water or surface-water contamination in the area of the surface water intake 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

The City of Glasgow is located approximately 17 linear miles northwest of the Milk River confluence with the Missouri River and 16 miles northwest of Fort Peck Dam in the southeastern area of Valley County (Figure 1). The town is situated on the northern bank of the Milk River, approximately one mile east of the Cherry Creek confluence with the Milk River. The U.S. Census Bureau estimates a 2000 population of 3,253 within the City of Glasgow. The Glasgow population has decreased from 3,574 in 1990. U.S. Highway 2 connects Glasgow with Malta to the west and Wolf Point to the east. Montana Route 24 connects Glasgow with Opheim to the north and Fort Peck to the south.

The largest Glasgow industries reported in the 2000 U.S. Census were education, health and social services, 24.8 percent of earnings; retail trade, 14.8 percent of earnings; arts, entertainment, and recreation, 11.7 percent of earnings; construction, 8.2 percent; public administration, 8.2 percent; other services, 7.4 percent; transportation, warehousing, and utilities, 6.4 percent; and agriculture, forestry, fishing, and mining, 4.8 percent. In Valley County, the largest industries in 2000 were services, 19.9 percent of earnings; farm, 16.2 percent; and state and local government, 15.0 percent. In 1990, the largest industries were services, 21.3 percent of earnings; state and local government, 19.2 percent; and transportation and public utilities, 18.5 percent. Of the industries that accounted for at least 5 percent of earnings in 2000, the slowest growing from 1990 to 2000 was state and local government, which increased at an average annual rate of 2.1 percent; the fastest was farm that increased at an average annual rate of 27.8 percent. (http://www.bea.doc.gov/bea/regional/bearfacts).

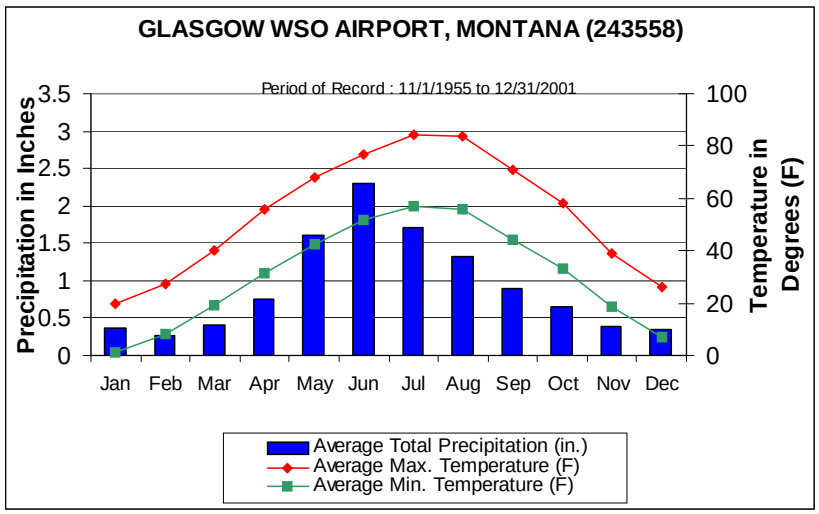
Within the boundaries of Glasgow city limits, residents obtain their drinking water from the municipal PWS. Several other PWSs are located in the vicinity of Glasgow. The Culligan of Glasgow PWS and the Albertson's of Glasgow PWS both purchase water from the City of Glasgow. These systems appear in Table 1 below. Only the City of Glasgow, Montana Aviation Research Company (MARCO), Culligan of Glasgow and the Albertson's of Glasgow PWSs will be addressed in this report. The other systems will be addressed in a separate Source Water Delineation and Assessment report. The Glasgow municipal sewer district services all residents within town limits. Municipal wastewater discharges to the Milk River southeast of town. Residents in areas outlying town limits utilize on-site septic systems for waste disposal.

Table1. PWSs in the vicinity of Glasgow

PWS Name	DEQ PWS ID	System Type	System Classification	Population Served	Operator/Owner
City of Glasgow	MT0000415	Community	Surface Water	3253	Jon Bengochea
Montana Aviation Research Company	MT0000416	Community	Surface Water	100	Lynn Blatter/ Darcel Wesen
Culligan of Glasgow	MT0003971	Community	Surface Water – Purchased	128	Kelly Jennings
Albertsons of Glasgow No. 2012	MT0004122	Transient	Surface Water – Purchased	25	Ebbie Hoitt
Aces and 8s Casino Trailer Court and RV	MT0003321	Transient	Ground Water	74	John Dowson
Cherry Creek WUA	MT0000228	Community	Ground Water	180	John Peterson
Trails West Trailer Court	MT0000613	Transient	Ground Water	73	Douglas Jacobson

Climate

Figure 2. Glasgow Average Temperatures and Precipitation



The climate in the vicinity of Glasgow is semi-arid. Based on Western Regional Climatic Center data for the November 1, 1955 to December 31, 2001 period of record, annual precipitation averages 10.99 inches. Monthly average precipitation ranges from 0.27 inches in February to 2.29 inches in June. Intense, localized thunderstorms commonly occur from May through July (Donovan, 1988). The annual mean snowfall in Glasgow is 29.2 inches. Periodic drought cycles (as defined by moving annual precipitation averages less than 10 inches) occur in the region at approximately 10 to 20 year intervals. Evaporation rates are high, averaging 25 to 35 inches per year.

Geographic Setting

Glasgow is located in the Great Plains physiographic province of North America (Rocky Mountain Association of Geologists, 1972), and the glaciated central ground-water region of the United States (Heath, 1984). The elevation of Glasgow is approximately 2100 feet above mean sea level. The town is situated on the north bank of the Milk River floodplain, approximately 17 miles northwest of the Milk River confluence with the Missouri (Figure 1). The Milk River valley is approximately 1.5 miles wide in the vicinity of Glasgow.

The glaciated topography in the vicinity of town exhibits relatively low relief, typically less than 100 feet over several miles (Donovan, 1988). The City of Glasgow is built on the Milk River floodplain. The floodplain is bordered by poorly defined benches, which are capped by glacial deposits and dissected by numerous drainages. An extensive perennial Milk River tributary drainage, Cherry Creek, is located approximately one mile north of town (Figure 1).

The City of Glasgow and MARCO share the cost and use of a surface water intake which is located on the northern edge of the Missouri River channel, approximately 14 miles southwest of the city. Here the flat Missouri floodplain is approximately two miles wide, and bordered by hummocky glaciated benches.

The City of Glasgow is located in the Lower Milk watershed. The U.S. Geological Survey hydrologic unit code for this watershed is 10050012. The City of Glasgow/MARCO PWS surface water intake is located on the Missouri River in the Prairie Elk-Wolf watershed, which has a hydrologic unit code of 10060001. The Missouri River drainage is oriented east - west near the City of Glasgow/MARCO PWS intake downstream of the Fort Peck Dam, with a flow direction to the east. Missouri River tributaries in this area are generally oriented north-northwest to south-southeast, with flows directed south or north towards the Missouri mainstem.

Geology

This section provides an overview of the geology and hydrology of the area in the vicinity of the City of Glasgow/MARCO PWS surface water intake. 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 and surface waters to potential contamination sources.

Quaternary alluvium blankets the broad Missouri River valley and major Missouri River tributaries in the vicinity of the town (Jensen and Varnes, 1964). Upper Cretaceous Bearpaw shale underlies the Quaternary alluvium, colluvium, and glacial deposits exposed at the ground surface. The Missouri River has incised through this formation, which is exposed in outcrops along the Fort Peck Reservoir shoreline, in some areas along the edge of the Missouri River floodplain, and in tributary drainages north and south of the river (Jensen and Varnes, 1964).

Four major glacial advances occurred in Montana during the Pleistocene Epoch (10,000 – two million years ago) (Alden, 1932; Simon et al., 1999). Ice covered the northern third of the state during the maximum extent of the glacial advance. Prior to glaciation, the ancestral Missouri River flowed north around the Bearpaw Mountains and occupied the course of the present Milk River. Approximately 50,000 to 70,000 years ago, advancing ice blocked the river near the present town of Big Sandy, diverting the flow to the south into its current channel.

The Missouri River has exhibited varied and complex channel dynamics since the early Pleistocene (Simon et al., 1999). At numerous locations, ice diverted the flow for both long and short durations, and sometimes re-routed the channel. During glacial recessions, the addition of glacial meltwater to runoff volumes and glacial reworking of till and fluvial deposits resulted in the increased transport and deposition of coarser-grained sediments and a higher rate of deposition than has occurred since. As a result, the older alluvium in the lower portion of the post-glacial Missouri River deposits is coarser-grained.

The modern Missouri River valley comprises interbeds of alluvium, lacustrine, and glaciofluvial silt, sand, clay, and gravel sediments (Donovan, 1988). Preglacial and glacial deposits are unconsolidated and extremely heterogeneous, varying in thickness from 30 to 100 feet (Hopkins and Tilstra, 1966). Silts and clays are exposed at ground level in most areas, and depths to water-bearing lenses of sands, sandy clay, or gravelly sand are not consistent (Hopkins and Tilstra, 1966). The Missouri River alluvium in the vicinity of Fort Peck contains significant vertical and horizontal variations in bedding (Simon et al, 1999). Individual stratigraphic horizons range in thickness from one inch to four feet, and all are lenticular in shape. Generally, the upper horizons of the alluvial deposits are finer-grained than the lower horizons.

General Description of the Source Water

The source water for the City of Glasgow, MARCO, Culligan of Glasgow and Albertson's of Glasgow is obtained through a surface water intake on the Missouri River. The intake is owned by Montana Aviation Research Company who shares expenses and use of the intake with the City of Glasgow. The two systems withdraw water during alternating time periods. The Culligan and Albertson's PWSs purchase water from the City of Glasgow.

The intake is located approximately five miles downstream of the Fort Peck Dam in an embayment on the north side of the river (Figure 3). The intake is located upstream of the Fort Peck Lake spillway. Water released through the Fort Peck penstocks and hydroelectric power plants are hypolimnial, or subsurface lake

water. Surface waters from Fort Peck Lake do not reach the intake, as they are periodically released over the spillway into the Missouri River approximately four miles downstream of the intake location.

The Public Water Supplies

City of Glasgow

The City of Glasgow 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 3,572 residents via 1,512 active service connections.

The Missouri River is the primary water supply source. The source water is obtained through an intake owned by MARCO on the north side of the river approximately five miles downstream from Fort Peck Dam (Figure 3). The latitude of the surface water intake location is 48.0697°N, and the longitude is –106.3956°W. The pump station, located just north of the Missouri River, houses four pumps (South Hills Environmental Management Consultants, 2000). Pumps 1 and 2 are rated at 1320 gallons per minute (gpm), pump 3 is rated at 600 gpm, and pump 4 is rated at 400 gpm. Typically, pumps 1,3, and 4 or pumps 2,3, and 4 are operated during the summer months, and pumps 1 and 3 or 2 and 3 are operated during the winter months. The Missouri River water is pumped northwest through an 18-inch raw waterline (the MARCO pipeline) to a T-connection where it is diverted to the City's water treatment facility. The City draws water at all times except 8:00 a.m. through 10:00 a.m. on Mondays, Wednesday, and Fridays, when the Montana Aviation Research Company utilizes the intake (South Hills Environmental Management Consultants, 2000) .

The City of Glasgow's water treatment facility is a reactor clarification plant. (See a diagram of the treatment and distribution systems in Appendix A.) The water is treated using conventional filtration with coagulation and flocculation via the addition of polymers. Flocculation is followed by sedimentation in the clarification chamber. The chamber is drained and cleaned twice a year (South Hills Environmental Management Consultants, 2000). Sludge from the clarifiers and backwashing filters is collected in a underground concrete enclosed sludge basin, then sent to the City's #3 sewage lagoon for ultimate disposal. Following clarification, the water is sent through dual media filters and disinfected with chlorine gas. The filters are typically backwashed twice daily. Subsequent to disinfection, the water drains into two clear well basins. From the clear wells, the water is pumped to the distribution system, a 1-million gallon capacity elevated storage tank, and two partially buried concrete reservoirs with capacities of 1.5 million gallons and 0.2 million gallons, respectively (Midwest Assistance Program, 2002).

Montana Aviation Research Company

The Montana Aviation Research Company (MARCO) 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 100 residents via 6 active service connections.

The Missouri River source water is pumped northwest from the surface water intake previously described through an 18-inch raw waterline (the MARCO pipeline) to MARCO's water treatment facility. The City draws water at all times except 8:00 a.m. through 10:00 a.m. on Mondays, Wednesday, and Fridays, when the MARCO utilizes the intake (South Hills Environmental Management Consultants, 2000). Summer pumping hours are 7:00 to 10:00 a.m. or until pumping is complete.

The MARCO treatment facility is a conventional plant with flash mix, three-stage flocculation, sedimentation, multimedia filtration, and gas chlorination (South Hills Environmental Consultants, 2000).

The treatment plant is operated for an average six hours per week. Following treatment, the finished water is sent to the distribution system and three elevated storage tanks with capacities of 300,000 gallons, 400,000 gallons, and 450,000 gallons, respectively.

Culligan of Glasgow

Culligan of Glasgow is located in Glasgow. The Culligan of Glasgow PWS is classified as a community system under the Federal Safe Drinking Water Act, because the system serves at least 25 year-round residents. The PWS services 128 residents via one active service connection. The Culligan of Glasgow PWS purchases its water from the City of Glasgow. Glasgow city water is treated with water softening, pressure carbon filtration, and reverse osmosis prior to bottling in 1-, 2.5-, 3- and 5-gallon containers for distribution to the general public.

Albertson's of Glasgow No. 2012

Albertson's is a grocery store franchise located in Glasgow. The Albertson's PWS is classified as a transient system under the Federal Safe Drinking Water Act, because the system does not regularly serve at least 25 of the same people for at least six months per year. The PWS services 25 residents via one active service connection. The Albertson's PWS purchases its water from the City of Glasgow. Glasgow city water is treated with activated carbon filtration, cartridge particulate filtration, reverse osmosis, and ultraviolet disinfection prior to distribution to the general public via a Glacier Water vending machine.

The City of Glasgow and the Montana Aviation Research Company obtain drinking water from a surface water supply. As a result, the source water is classified as highly sensitive to contamination, in accordance with Montana Source Water Protection Program aquifer sensitivity criteria (1999). These criteria are discussed in the next chapter.

Water Quality

Public water systems must conduct routine monitoring for contaminants in accordance with Federal Safe Drinking Water Act requirements. Parameters such as 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 must be sampled in community PWSs and non-community, non-transient PWSs in accordance with schedules specified in the Administrative Rules of Montana. Transient, non-community PWSs are required to conduct routine monitoring 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.

Background City of Glasgow and MARCO Surface Water Intake Water Quality

Missouri River water quality samples were collected by the U.S.G.S. at the Missouri River near Fort Peck gaging station. The location of the gaging station is illustrated in Figure 3. The station is located approximately 0.5 miles downstream of the Fort Peck Dam on the west bank of the Missouri River. Only the samples collected at this station within the past five years are reported in Table 2 below.

Table 2. Dissolved constituent concentrations in the Missouri River at the Missouri River below Fort Peck Dam U.S.G.S. gaging station (U.S. Geological Survey, NWIS, 2002)

Constituent	Sampling Dates (years)	Range of Dissolved Concentrations	MCL	MCLG	Secondary Standard
Discharge (cfs)	1980 - 1999	1,010 - 15,200	NA	NA	NA
Nitrite + Nitrate (as N) (mg/l)	1980 - 1987	≤ 0.10 - 0.11	NA	NA	NA
Nitrite (as N)	1985 - 1986	≤ 0.010	**1 mg/l**	**1 mg/l**	NA
Arsenic (ug/l)	1980 - 1987	3.0 – 5.0	**0.05 mg/l**	NA	NA
Cadmium (ug/l)	1980 - 1987	≤ 1.00 – 3.00	**0.005 mg/l**	**0.005 mg/l**	NA
Chromium (ug/l)	1980 - 1987	≤ 1.0 - 4.3	**0.1 mg/l**	**0.1 mg/l**	NA
Copper (ug/l)	1980 - 1987	1.0 – 15.0	NA	**1.3 mg/l**	**1.0 mg/l**
Iron (ug/l)	1980 - 1987	≤ 10 - 30	NA	NA	**0.3 mg/l**
Lead (ug/l)	1980 - 1987	≤ 1.00 – 16.0	**TT Action Level = 0.015 mg/l**	**zero**	NA
Manganese (ug/l)	1980 - 1987	≤ 1.0 - 20	NA	NA	**0.05 mg/l**
Selenium (ug/l)	1980 - 1987	≤ 1.0 – 2.0	**0.05 mg/l**	**0.05 mg/l**	NA
Fecal coliform, 0.7 UM-MF count/100 ml)	1980 - 1987	≤ 1 - >200	**0.003 mg/l**	**0.003 mg/l**	NA
Turbidity (NTU)	1980 - 1986	.4 - 13	**1 NTU not to exceed 0.3 NTU in 95% of daily samples in any month**	NA	NA
Mercury (ug/l)	1980 - 1987	≤ .1 - .70	**0.002 mg/l**	**0.002 mg/l**	NA

*E = estimated value

The State of Montana classifies the Fort Peck Reservoir and the segment of the Missouri River from the Fort Peck Dam to the Milk River confluence as B-2 surface water bodies. B-2 waters are considered suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supplies pursuant to the Administrative Rules of Montana 17.30.624. The Fort Peck Reservoir is included on Montana's 303(d) of water-quality impaired water bodies. DEQ has determined that drinking water use is not supported, and contact recreation use is partially supported. The probable causes of impairment have been identified as lead, mercury, metals, and noxious aquatic plants. The probable sources of impairment have been identified as agriculture, resource extraction, abandoned mining, atmospheric deposition and debris and bottom deposits.

The segment of the Missouri River from the Fort Peck Dam to the Milk River confluence is included on Montana's 303(d) of water-quality impaired water bodies. DEQ has determined that aquatic life and cold water fishery beneficial uses are partially supported on this segment, and agriculture, contact recreation, and industrial uses are fully supported. The probable causes of impairment for this segment have been identified as flow alteration, other habitat alterations, riparian degradation, and thermal modifications. The probable sources of impairment have been identified as hydromodification and flow regulation/modification.

The State of Montana classifies the segment of the Missouri River from the Milk River confluence to the North Dakota border as a B-3 surface water. B-3 waters are considered suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supplies pursuant to the Administrative Rules of Montana 17.30.625. The segment of the Missouri River from the Poplar River confluence to the North Dakota border appears on the Montana 2000 303(d) list as only partially supporting a warm water fishery and aquatic life uses, while fully supporting drinking water, agricultural, and recreational uses. The probable causes of impairment to warm water fishery and aquatic life support uses are identified by DEQ as flow alteration and thermal modifications due to upstream impoundments and flow regulation/modification.

City of Glasgow PWS Water Quality

Within the past five years, no confirmed positive fecal coliform samples were collected during routine contaminant monitoring. No maximum contaminant level (MCL) exceedances were noted for any other constituents monitored over the past five years, but detections of arsenic, barium, fluoride, nitrate + nitrite, selenium, bromodichloromethane, chlorodibromomethane, trihalomethanes, chloroform and radium were noted.

MARCO PWS Water Quality

Within the past five years, no confirmed positive fecal coliform samples were collected during routine contaminant monitoring. No MCL exceedances were noted for the constituents monitored over the past five years, but detections of arsenic, barium, chromium, fluoride, nitrate + nitrite, selenium, bromodichloromethane, chloroform, chlorodibromomethane, dichloromethane, trihalomethanes, radium 226/228 and and gross alpha were noted.

CHAPTER 2
DELINEATION

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

Source water protection areas for surface water sources are subdivided into spill response and watershed regions, each with separate management goals. The spill response region encompasses an area upstream of the Glasgow and MARCO PWSs in which contaminants can be drawn into the intake with little lag time. The watershed region encompasses a portion of the Prairie Elk – Wolf and Fort Peck Reservoir watersheds upstream of the Glasgow and MARCO PWSs surface water intake.

Hydrogeologic Conditions

The Missouri River flows east from Fort Peck Reservoir to Fort Peck. The river flow at Fort Peck is controlled by releases from Fort Peck dam. As a result, mean monthly Missouri flows gaged by the USGS near Fort Peck reflect an inverted hydrograph, with relatively higher flows released in August and September, and lower flows released in April, May, and June (Shields et al., 2000).

Snowmelt, direct precipitation, surface runoff, and lateral inflow from alluvial and bedrock aquifers contribute to flow in the Missouri River in the vicinity of Fort Peck, and water to the Fort Peck Reservoir. The Missouri loses water to infiltration through the riverbed to underlying or adjacent aquifers, evapotranspiration, and water withdrawals. Fort Peck Reservoir loses water to releases through the dam, other water withdrawals, infiltration through the bottom of the reservoir to underlying or adjacent aquifers, and evapotranspiration. Water in the Missouri River and the Fort Peck Reservoir originates from numerous tributary drainages as far away as the Madison, Jefferson, and Gallatin headwaters in the southwestern area of Montana. Along the Missouri River's course, flows are altered by numerous irrigation diversions and hydroelectric dams.

Donovan (1988) states that the flow of water within alluvial aquifers in the Missouri River valley is principally controlled by river stage. When pumped, wells finished in close proximity to the river induce river water to flow into the aquifer. Furthermore, he states that high-yield municipal wells finished in Missouri River alluvium and located proximal to the river induce significant infiltration. This hydraulic connection is indicated by generally lower total dissolved solids (TDS) concentrations in wells near the river than those located farther away from the river. These wells have higher TDS concentrations indicative of local ground water (Donovan, 1988).

Using DEQ Source Water Protection Program criteria for ranking aquifer sensitivity (Table 3), Glasgow and MARCO source water is considered highly sensitive to contamination. The sensitivity ranking is a result of the surface water source for the City of Glasgow and MARCO PWSs.

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)

Conceptual Model and Assumptions

If spilled or discharged directly into the downstream end of Fort Peck Reservoir or in the Missouri River between the City of Glasgow and MARCO intake location and the Fort Peck Dam, contaminants may be drawn into the surface water intake before plant operators can close it. Contaminants derived from sources farther removed from the intake throughout the watershed may be flushed into tributaries and subsequently into the Fort Peck Reservoir or the Missouri River during spring snowmelt or storm events, or may infiltrate aquifers which discharge to the reservoir or river via hydraulic connections.

Delineation Results

Spill Response Region

Hydrogeologic mapping was utilized to delineate the spill response region. The region extends from the surface water intake along the Missouri River upstream to the Fort Peck Dam, then 1/2 mile into Fort Peck Reservoir from the penstock intake location (Figure 3). The region is only approximately 5.5 miles in length, which deviates from the standard length of ten miles for a spill response region in accordance with SWP guidance (DEQ, 1999). The length of the region was abbreviated due to the enormous dilution capacity of the Fort Peck Reservoir. The region encompasses the Missouri mainstem upstream of the intake, as well as the trout ponds north of the channel that openly communicate with the Missouri River. The easternmost pond appears to be isolated from the river channel, but this pond was also included in the region due to the potential existence of hydraulic connections among the surface water in the pond, the shallow Missouri alluvial aquifer, and the river. The ½ mile radius circle extending outward from the Fort Peck Dam penstock intake was modified along the shoreline of the reservoir to follow the ridgelines dividing the areas within which surface waters drain away from the reservoir, and the areas within which surface waters drain into the reservoir.

Watershed Region

The watershed region for the City of Glasgow and MARCO PWSs encompasses a portion of the Fort Peck Reservoir and Prairie Elk – Wolf watersheds upstream of the surface water intake (Figure 4). The boundaries of three smaller scale 11-digit HUCs (hydrologic unit codes, or watersheds) located immediately upstream of the Fort Peck Dam penstock intakes within the enormous Fort Peck Reservoir watershed, as well as a small portion of the Prairie Elk – Wolf watershed upstream of the intake were used to delineate the watershed region.

Limiting Factors

The delineations for the City of Glasgow and MARCO PWSs 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 to reach the surface water intake with little lag time. Numerous assumptions are associated with these Source Water Protection Program (SWPP) criteria for spill response region delineations. Contaminant transport rates and concentrations will vary depending on river and reservoir flow conditions, ground water flux into the river and reservoir, 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, adsorption, precipitation, oxidation, complexation, and volatilization. As a result, some areas within the spill response region may be more conducive to contaminant transport than others, and should be designated as higher priority areas for source water protection efforts.

CHAPTER 3
INVENTORY

An inventory of potential sources of contamination was conducted to assess the susceptibility of the City of Glasgow and MARCO PWSs to contamination, and to identify priorities for source water protection planning. These inventories were conducted within the delineated spill response and watershed regions. The inventory for the City of Glasgow and MARCO PWSs focuses on facilities that generate, use, store, transport, or dispose potential contaminants, and on land types on which potential contaminants are generated, used, stored, transported, or disposed. Additionally, the inventory identifies potential sources of all primary drinking water contaminants and Cryptosporidium. Only significant potential contaminant sources were selected for detailed inventory. The significant contaminants posing potential threats to the City of Glasgow and MARCO PWSs include nitrate, pathogens, pesticides, fertilizers, metals, VOCs, and SOCs. The inventory for the City of Glasgow and MARCO PWSs also focuses on all activities in the spill response region, as well as general land uses and large potential contaminant sources in the watershed region.

Inventory Method

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

Step 1: Land cover is identified from the National Land Cover Dataset compiled by the U.S. Geological Survey and U.S. Environmental Protection Agency (U.S.G.S., 2000). Land cover types in this dataset were mapped from satellite imagery at 30-meter resolution using a variety of supporting information.

Step 2: EPA's Envirofacts System was queried to identify EPA regulated facilities. This system accesses the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), Permit Compliance System (PCS), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility is a significant potential contaminant source.

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

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

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

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

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

1) Large quantity hazardous waste generators
2) Landfills
3) Hazardous waste contaminated sites
4) Underground storage tanks
5) Major roads or rail transportation routes
6) Cultivated cropland
7) Animal feeding operations
8) Wastewater lagoons or spray irrigation
9) Septic systems
10) Sewered residential areas
11) Storm sewer outflows
12) Floor drains, sumps, or dry wells
13) Abandoned or active mines

Inventory Results/Spill Response Region

Land covers within the spill response region for the Glasgow/MARCO PWSs include open water, low intensity residential, commercial/industrial/transportation, forest, shrubland, grassland/herbaceous, pasture/hay, small grains/row crops, fallow ground, and woody wetlands (Figure 5). Predominant land covers in the region include open water (23%), grasslands/ herbaceous (13%), small grains/row crops (26%), and fallow ground (11%) (Figure 5). Cultivated cropland occupies 45% of the spill response region.

Low septic densities occur within 98% of the spill response region area. The Fort Peck municipal sewer system is partially located within the spill response region, but only occupies 2% of the area of the region. The Fort Peck wastewater treatment system discharges to three lagoons located on the west bank of the Missouri River downstream of the Fort Peck Dam and upstream of the PWS surface water intake (Figure 3). Pathogens and nitrates associated with main breaks or leaking connections in the system may present a threat to the PWS. Failure of the wastewater treatment system or overloading the wastewater lagoons may release nitrates and/or pathogens into the Missouri River shallow alluvial aquifer, or into the Missouri River.

No concentrated animal feeding operations are located in the spill response region, but grazing is permitted on the Charles M. Russell National Wildlife Refuge on the perimeter of Fort Peck Reservoir. Pathogens and nitrates from this source may runoff directly into the Fort Peck Reservoir.

Spills of fertilizers, pesticides, volatile organic compounds (VOCs), and synthetic organic compounds (SOCs) could occur along Montana Routes 24 and 117 (Figure 3). Route 24 crosses the Fort Peck Dam within the spill response region upstream of the intake. Route 117 parallels the Missouri River within the spill response region, and crosses the neck between the Missouri mainstem and the trout ponds to the west. A Federal government railway runs parallel and just to the east of Route 117 within the spill response region. The railway turns east and parallels the face of the Fort Peck Dam in the southern area of the spill response region (Figure 3). The tracks terminate at the hydroelectric power plants operated by the U.S. Army Corps of Engineers on the east side of the dam. Spills of fertilizers, pesticides, volatile organic compounds (VOCs), and synthetic organic compounds (SOCs) transported on the tracks could pose a threat to the surface water intake downstream.

Several underground storage tanks are located at businesses within the spill response region (Figure 3). In the event of spills, leaking piping or tank leaks, petroleum hydrocarbons may migrate into the shallow Missouri River alluvial aquifer and subsequently into the Missouri River. As a result, these tanks may present a hazard to the surface water intake downstream.

A landfill is also located just outside of the spill response region and northwest of Fort Peck (Figure 3). The Town of Fort Peck owns this landfill. The landfill was closed in 1989, but nitrates, pathogens, metals, SOCs and VOCs may leach out of the base of the landfill, migrate into the underlying shallow glacial

aquifer, and subsequently discharge to the Missouri River. If contaminants reach the Missouri River, they may present a hazard to the City of Glasgow and MARCO source water.

A number of businesses handling potential contaminants are located in the town of Fort Peck within the spill response region (Figure 3). If potential contaminants used by these businesses are improperly stored or disposed in the vicinity of a Class V injection well or the Missouri River, contaminants could present a threat to the surface water intake downstream. The EPA is currently conducting a nationwide inventory of Class V injection wells. The Agency has identified one Class V injection well in the vicinity of Fort Peck at the Western Area Power Administration. The location of this business is depicted in Figure 3. A PCB spill was reported at this facility. The Class V well and the PCB spill at the Western Area Power Administration were not included in the potential contaminant inventory because the site is located well outside of the spill response region. Additionally, PCBs bond readily to organic molecules in the soil and the unsaturated zone overlying the water table. As such, it is highly unlikely that these contaminants would migrate into the shallow aquifer and eventually discharge to the Missouri River located a few miles east of the site. No Class V wells were identified in the vicinity of the businesses handling potential contaminants listed below. Consequently, these businesses are not considered significant potential contaminant sources.

The Fort Peck Project Montana Superfund (CECRA) site is depicted on Figure 3. Figure 3 illustrates the location of one of five potential areas of concern identified by the Army Corps of Engineers during a Superfund site inspection. The areas of concern include: the Fort Peck closed Landfill (also depicted on Figure 3) and the Coulee Landfill, where waste oil, lead-based paints and solvents were disposed during dam construction and operation; the switchyards and the abandoned substation, where PCB-laden cooling oil may have leaked into the subsurface; and the rifle range, where lead from ammunition may have accumulated. The EPA recommended no further action at the rifle range, but recommended sampling at the remaining four areas of concern. In 1993, the Corps sampled the remaining four sites and reportedly found little evidence of contamination. A final report of the sampling results and an interpretation of the extent and degree of contamination has yet to be submitted to DEQ. The site is currently listed as ‘medium’ priority, but the status may be reduced to ‘low’ or ‘no further action’ based on the results in the Corp’s report. Given that the Corps reportedly found little evidence of contamination at these sites, they are considered insignificant sources for the purpose of this report.

A number of parks and boat ramps are located on the Missouri River northeast of Fort Peck (Figure 3). Petroleum hydrocarbons released form recreational boating on this segment of the Missouri River may present a hazard to the City of Glasgow and MARCO surface water intake, located a few miles downstream. However, hydrocarbons are not likely generated by recreational boat use in sufficient quantities to constitute a significant potential contaminant source.

Numbers on the spill response region map (Figure 3) identify the locations of potential contaminant sources, and correspond to Map ID numbers in Tables 4, 5, 6, and 7.

Table 4. Potential contaminant sources in the spill response region for the City of Glasgow and MARCO PWSs.

Source	Address Or Map ID Number	Potential Contaminants	Hazard
Grazing on CMR National Wildlife Refuge	1	pathogens, nitrate	surface runoff into reservoir
Montana Route 24	2	Pesticides, fertilizers, VOCs, SOCs	Spills, storm water runoff into Missouri River or Fort Peck Reservoir
Montana Route 117	3	Pesticides, fertilizers, VOCs, SOCs	Spills, storm water runoff into Missouri River
Federal Railway	4	VOCs, SOCs	Spills, storm water runoff into Missouri River
Missouri River Outpost - 1 active Leaking Underground Storage Tank (LUST)	5	Petroleum Hydrocarbons	Migration of residual soil contamination into ground water
Army Corps of Engineers – 3 active Underground Storage Tanks (USTs)	6	Petroleum Hydrocarbons	Spills, tank leaks, piping leaks
Town of Fort Peck wastewater lagoon MPDES discharge	7	Pathogens, nitrate	System failure, exceedence of effluent limits in the Missouri River, interaction of Missouri River with alluvial aquifer
Fort Peck Town Maintenance Office	8	Pesticides, SOCs, VOCs, metals	Spills, Surface runoff into Missouri River; infiltration into shallow aquifers and subsequent discharge to Missouri River
Sorenson Plumbing and Heating	9	SOCs, VOCs, metals	Spills, Surface runoff into Missouri River; infiltration into shallow aquifers and subsequent discharge to Missouri River
L. Scanlan Contractor	10	SOCs, VOCs, metals	Spills, Surface runoff into Missouri River; infiltration into shallow aquifers and subsequent discharge to Missouri River
Town of Fort Peck closed landfill	11	Pesticides, SOCs, VOCs, metals, pathogens, nitrate	Infiltration of leachate into shallow ground water, discharge to Missouri River
Town of Fort Peck municipal sewer	12	Pathogens, nitrate	Distribution main breaks, leaking connections, untreated effluent discharge to ground water
Cultivated Cropland	See Figure 5	Fertilizers, pesticides, pathogens, nitrates	Spills, over application, surface runoff into Missouri Riverf
Recreational Boating on Missouri River below Fort Peck Dam	13	Petroleum Hydrocarbons	Spills into the Missouri River
Fort Peck Project CECRA site	14	PCBs, lead, petroleum hydrocarbons	Migration of soil contamination into shallow ground water and subsequent discharge to the Missouri River

Table 5. Significant potential contaminant sources in the spill response region for the City of Glasgow and MARCO PWSs.

Source	Address Or Map ID Number	Potential Contaminants	Hazard
Grazing on CMR National Wildlife Refuge	1	pathogens, nitrate	surface runoff into Fort Peck Reservoir
Montana Route 24	2	Pesticides, fertilizers, VOCs, SOCs	Spills, storm water runoff into Missouri River or Fort Peck Reservoir
Montana Route 117	3	Pesticides, fertilizers, VOCs, SOCs	Spills, storm water runoff into Missouri River
Federal Railway	4	VOCs, SOCs	Spills, storm water runoff into Missouri River
Missouri River Outpost - 1 active Leaking Underground Storage Tank (LUST)	5	Petroleum Hydrocarbons	Migration of residual soil contamination into ground water
Army Corps of Engineers – 3 active Underground Storage Tanks (USTs)	6	Petroleum Hydrocarbons	Spills, tank leaks, piping leaks
Town of Fort Peck wastewater lagoon MPDES discharge	7	Pathogens, nitrate	System failure, exceedence of effluent limits in the Missouri River, interaction of Missouri River with alluvial aquifer
Town of Fort Peck closed landfill	11	Pesticides, SOCs, VOCs, metals, pathogens, nitrate	Infiltration of leachate into shallow ground water, discharge to Missouri River
Town of Fort Peck municipal sewer	12	Pathogens, nitrate	Distribution main breaks, leaking connections, untreated effluent discharge to ground water
Cultivated Cropland	See Figure 5	Fertilizers, pesticides, pathogens, nitrates	Spills, over application, surface runoff into Missouri Riverf

Inventory Results/Watershed Region

The watershed region for the City of Glasgow and MARCO PWSs encompasses three fifth code hydrologic units in the Fort Peck Reservoir watershed, and a portion of the Prairie Elk – Wolf fourth code watershed (Figure 4). Predominant land covers in the watershed region include grasslands/ herbaceous (59.5%), open water (24%), and shrubland (4.4%) (Figure 6). Cultivated cropland occupies only 6.9 % of the watershed region. No permitted confined animal feeding operations are located in the watershed region. Septic densities throughout the watershed region are predominantly low (99.8%). The Fort Peck municipal sewer system and high and moderate septic densities occupy less than 1% of the total area of the watershed region.

Five oil and gas wells are located in the watershed region (Figure 4). All of the wells are development or test wells, and are not currently utilized for oil or gas production. As a result, these wells are not considered significant potential contaminant sources.

The Fort Peck Marina, located approximately two miles west of the Fort Peck Dam, may constitute a significant potential contaminant source within the watershed region (Figure 4). Petroleum hydrocarbon spills associated with the transport, storage, or disposal of boat fuel at this site may present a contamination threat to the Glasgow and MARCO source water.

Table 6. Potential contaminant sources in the watershed region for the City of Glasgow and MARCO PWSs.

Source	Address Or Map ID Number	Potential Contaminants	Hazard
Cultivated Cropland	See Figure 6	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff into reservoir
Grazing on CMR National Wildlife Refuge	1	pathogens, nitrate	surface runoff into reservoir
Gas and Oil Wells	3	Total Dissolved Solids, Petroleum Hydrocarbons	Migration of brine wastewater into shallow ground water discharging to surface water; surface runoff to surface water
Fort Peck Marina	4	Petroleum Hydrocarbons	Spills directly into reservoir, surface runoff into reservoir

Table 7. Significant potential contaminant sources in the watershed region for the City of Glasgow and MARCO PWSs.

Source	Address Or Map ID Number	Potential Contaminants	Hazard
Cultivated Cropland	See Figure 6	Fertilizers, pesticides, pathogens, nitrate	Spills, over application, surface runoff into surface water
Grazing on CMR National Wildlife Refuge	1	pathogens, nitrate	surface runoff into reservoir
Fort Peck Marina	4	Petroleum Hydrocarbons	Spills directly into reservoir, surface runoff into reservoir

Inventory Update

The certified operators of the City of Glasgow and MARCO PWSs should update the inventory 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 every five years to ensure re-certification of the source water delineation and assessment report.

Inventory Limitations

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

CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

Susceptibility of The City of Glasgow's and MARCO's source water is determined by two factors: the potential of a contaminant reaching the intake and the resulting health hazard. Susceptibility is assessed in order to prioritize potential pollutant sources in the spill response region in order to guide management actions undertaken by local entities, in this case the Town of Fort Peck, the City of Glasgow and Valley County.

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

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will reach the PWS intake (Table 8). The hazard presented by point sources of contaminants in City of Glasgow's and MARCO's spill response region depends on whether contaminants can discharge directly to Fort Peck Reservoir and the Missouri River. Point source hazard is also dependent on the health affects associated with potential contaminants (Table 9). Hazard ratings for nonpoint sources are assigned based on criteria listed in Table 9 for septic systems, sanitary sewers, and cropped agricultural land. Barriers can be anything that decreases the likelihood that contaminated water will reach Fort Peck's surface water intake. Examples of barriers include: a vegetated riparian area, protective forest management practices, and dilution.

Table 8. Susceptibility to potential contaminant sources based on hazard and the presence of barriers.

	High Hazard	**Moderate Hazard**	**Low Hazard**
No Barriers	Very High Susceptibility	High Susceptibility	Moderate Susceptibility
One Barrier	High Susceptibility	Moderate Susceptibility	Low Susceptibility
Multiple Barriers	Moderate Susceptibility	Low Susceptibility	Very Low Susceptibility

Table 9. Hazard of potential contaminant sources for the Fort Peck public water system.

	High Hazard	**Moderate Hazard**	**Low Hazard**
Point Sources of All Contaminants	Potential for direct discharge to source water	Potential for discharge to GW that is hydraulically connected to SW	Potential contaminant sources within the watershed
Septic Systems	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
Municipal Sanitary Sewer (% land use)	More than 50 % of region	20 to 50 % of region	Less than 20 % of region
Cropped Agricultural Land (% land use)	More than 50 % of region	20 to 50 % of region	Less than 20 % of region

Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant (Table 10). The susceptibility of each well to each potential contaminant source is assessed separately.

Susceptibility Assessment Results

The City of Glasgow's and MARCO's source water is highly susceptible to potential contamination from Montana Route 117, the Federal railway, cultivated cropland, leaking underground storage tanks (LUSTs), and the Fort Peck municipal wastewater discharge to sewage lagoons. The source water is moderately susceptible to potential contamination from the Fort Peck municipal sewer and underground storage tanks (USTs). The source water is minimally susceptible to potential contamination from grazing on the Charles M. Russell Wildlife Refuge, Montana Route 24, the Fort Peck Marina, and the Fort Peck closed landfill (Table 9). Table 10 displays the susceptibility assessment results for the City of Glasgow and MARCO PWSs surface water intake. The intake is susceptible to number of contaminants, including pathogens, nitrates, fertilizers, pesticides, petroleum hydrocarbons, SOCs, metals, and VOCs. Tables 4, 5, 6, and 7 list all potential contaminant sources identified in the spill response and watershed regions for the City of Glasgow and MARCO PWSs.

The susceptibility results for each significant potential contaminant source identified follow:

Montana Route 117– The potential hazard imposed by pesticides, fertilizers, VOCs and SOCs originating from Montana Route 17 is high. The road poses a high hazard because there is high potential for a spill originating on the road to directly discharge into the Missouri River upstream from the City of Glasgow's and MARCO's surface water intake. The susceptibility of the PWSs to pesticides, fertilizers, VOCs and SOCs originating from this source is very high, due to the absence of any identifiable engineered, natural, or management barriers.

Federal Railway– The potential hazard imposed by VOCs and SOCs originating from the Federal railway is high. The road poses a high hazard because there is high potential for a spill originating on the tracks to directly discharge into the Missouri River upstream from the City of Glasgow's and MARCO's surface water intake. The susceptibility of the PWSs to VOCs and SOCs originating from this source is very high, due to the absence of any identifiable engineered, natural, or management barriers.

Cultivated cropland – The potential hazard imposed by pathogens and nitrate originating from agricultural lands is moderate. Cropped agricultural lands occupy 45% of the spill response region, and 7% of the watershed region. The hazard posed by this land use is considered moderate, as the percent occupation of cultivated croplands in the spill response region falls between 20% and 50% of the total area. The susceptibility of the intake to these agricultural sources of nitrate and pathogens is high due to the absence of any identifiable engineered, natural, or management barriers.

Active LUST– The potential hazard imposed by petroleum hydrocarbons originating from active USTs is moderate. The listed LUST poses a moderate hazard because of the potential for petroleum hydrocarbons to leach through the soil, infiltrate the underlying shallow alluvial aquifer, and subsequently discharge to the Missouri River. This leaking tank is located within 1/8 mile of the Missouri River. Consequently, contamination reaching the shallow ground water would only have to travel a short distance to reach the Missouri River. The susceptibility of the wells to petroleum hydrocarbons originating from this source is high, due to the absence of any identifiable engineered, natural, or management barriers.

Fort Peck wastewater lagoon MPDES discharge - The potential hazard imposed by pathogens and nitrate originating from the Fort Peck wastewater effluent to the three-cell lagoon adjacent to the Missouri River is moderate. The discharge is a moderate hazard because there is a potential for inadequately treated wastewater to infiltrate the underlying shallow alluvial aquifer, and subsequently discharge to the Missouri River. The susceptibility of the City of Glasgow and MARCO surface water intake to nitrates and pathogens originating from this source is high, due to the absence of any identifiable engineered, natural, or management barriers.

Active USTs – The potential hazard imposed by petroleum hydrocarbons originating from listed active USTs is moderate. These active USTs pose a moderate hazard because there is potential for petroleum hydrocarbon releases from these sources to infiltrate the underlying shallow alluvial aquifer, and subsequently discharge to the Missouri River. The susceptibility of the surface water intake to petroleum hydrocarbons originating from these sources is also moderate, as the leak detection systems legally required on active underground storage tanks provides a barrier between the tanks and the underlying aquifer.

Fort Peck municipal sewer – The potential hazard imposed by pathogens and nitrate originating from the Fort Peck municipal sewer is low. The area serviced by the municipal sewer covers only 2% of the spill response region. The susceptibility of the surface water intake to nitrates and pathogens originating from this source is moderate, due to the absence of any identifiable engineered, natural, or management barriers.

Montana Route 24– The potential hazard imposed by pesticides, fertilizers, VOCs and SOCs originating from Montana Route 24 is low. The road poses a low hazard because there is limited potential for a spill originating on the road to directly discharge into the Fort Peck Reservoir or the Missouri River upstream from the City of Glasgow's and MARCO's surface water intake. The susceptibility of the PWSs to pesticides, fertilizers, VOCs and SOCs originating from this source is also low. Multiple barriers identified for this source include dilution in the Fort Peck Reservoir and the limited traffic utilizing this route as a transportation corridor.

Grazing on Charles M. Russell National Wildlife Refuge – The potential hazard imposed by pathogens and nitrate originating from grazing on the Charles M. Russell National Wildlife Refuge is low. Grazing poses a low hazard because it will not likely result in concentrated discharges of animal waste and associated pathogens and nitrates into Fort Peck Reservoir or shallow glacial aquifers in the vicinity of the reservoir.

Fort Peck closed landfill –The hazard posed by the Fort Peck landfill is low, because the landfill is located just outside of the spill response region. Due to the considerable distance between the landfill and the Missouri River, it is improbable that leachate would migrate into the underlying shallow aquifer and subsequently discharge to the Missouri River at concentrations that would pose a hazard to the surface water intake. Natural attenuation constitutes a natural barrier between the potential contaminants leaching out of the closed landfill and the Missouri River. The resultant susceptibility of the surface water intake to the landfill is low.

Fort Peck Marina – The potential hazard imposed by petroleum hydrocarbons originating from the Fort Peck Marina is low. Potential does exist for direct discharge of motorboat petroleum hydrocarbons into the Fort Peck Reservoir at this location, but the marina is located approximately four miles west of the spill response region. Any petroleum spills at the location of the marina would likely be significantly diluted in the Fort Peck Reservoir prior to reaching the City of Glasgow and MARCO surface water intake downstream of the Fort Peck Dam.

Table 10. Susceptibility assessment for significant potential contaminant sources in the spill response and watershed regions for the City of Glasgow and MARCO PWSs surface water intake.

Source	Contaminant	Map ID Number	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Montana Route 117	Pesticides, fertilizers, VOCs, SOCs	3	Spills, storm water runoff into Missouri River	High	None	Very High	Maintain preparedness of local emergency personnel through active training
Federal Railway	VOCs, SOCs	4	Spills; Storm water runoff into Missouri River	High	None	Very High	Maintain preparedness of local emergency personnel through active training
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	See Figure 5 and Figure 6	Spills, over application, surface runoff into Missouri River	Moderate	None	High	Educate landowners on the proper handling, storage, and disposal of pesticides and fertilizers; utilization of agricultural best management practices
Missouri River Outpost - 1 active Leaking Underground Storage Tank (LUST)	Petroleum hydrocarbons	5	Migration of residual soil contamination into shallow ground water; spills, tank leaks, piping leaks	Moderate	None	High	Monitor for releases to ground water
Town of Fort Peck wastewater lagoon MPDES discharge	Pathogens, nitrate	7	System failure; exceedances of effluent limits; interaction of shallow alluvial aquifer with Missouri River	Moderate	None	High	Proper management of wastewater treatment system to ensure compliance with MPDES Permit requirements
Army Corps of Engineers – 3 active Underground Storage Tanks (USTs)	Petroleum hydrocarbons	6	Spills, tank leaks, piping leaks	Moderate	Leak detection system	Moderate	Monitor for releases to ground water
Town of Fort Peck municipal sewer	Pathogens, nitrate	12	Distribution main breaks; leaking connections; untreated effluent discharge to ground water	Low	None	Moderate	Ensure proper maintenance and operation of system; monitor leaks in system
Montana Route 24	Pesticides, fertilizers, VOCs, SOCs	2	Spills, storm water runoff into reservoir	Moderate	Dilution; Limited traffic on this rural route	Low	Maintain preparedness of local emergency personnel through active training
Town of Fort Peck closed landfill	Pesticides, SOCs, VOCs, metals, pathogens, nitrate	11	Infiltration of leachate into shallow ground water, discharge to Missouri River	Low	Natural attenuation	Low	Monitor infiltration and migration of leachate

Table 10 continued

Source	Contaminant	Map ID Number	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Fort Peck Marina	Petroleum hydrocarbons	4	Spills directly into reservoir, surface runoff into reservoir	Low	Dilution in Fort Peck Reservoir	Low	Maintain preparedness of local emergency personnel through active training; utilize waste recycling and minimization
Grazing on CMR National Wildlife Refuge	Pathogens, nitrate	1	Surface runoff into reservoir	Low	Dilution in Fort Peck Reservoir	Low	Implementation of grazing rotation best management practices (BMPs), focusing on reservoir riparian zones

Management Recommendations

Management recommendations are included in the susceptibility table for the Fort Peck PWS (Table 10). If these management recommendations are implemented, they may be considered additional barriers that will reduce the susceptibility of Fort Peck's intake to specific sources and contaminants.

Management recommendations fall into the following categories:

- Oversight of UST leaks
- Sewer maintenance and leak detection
- Agricultural best management practices
- Stormwater management
- Education
- Emergency Response Plan

Oversight of UST leak sites – Threats from UST leaks should be monitored to ensure that the surface water intake is protected from contamination. The level of contamination and progress of remediation at leak sites can be verified by contacting the DEQ Remediation Division.

Sewer Maintenance and leak detection – Early warning of leaks and scheduled replacement of aging sewer lines will reduce the susceptibility of the surface water intake to contamination from sanitary wastes.

Agricultural best management practices (BMPs) – BMPs that address application and mixing of fertilizer and pesticides are a viable alternative to prohibition of their use. BMPs are generally voluntary but their implementation can be encouraged through education and technical assistance. BMPs may also be utilized to minimize surface runoff and soil erosion on cultivated fields, and to minimize riparian vegetation impacts from grazing.

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

Education - Educational workshops provided to the general public by the city, county, or state promote safe handling and proper storage, transport, use, and disposal of hazardous materials. Ongoing training provided to designated emergency personnel 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.

Emergency Response Plan - An Emergency Response Plan should be compiled and adopted by the City of Glasgow and Valley County. The effectiveness of this response plan will be maximized if it is updated on an annual basis to reflect changes in emergency contacts, emergency numbers, and resources available within the county to respond to an emergency situation, such as a hazardous material spill.

The City of Glasgow and the MARCO PWS operators, the City of Glasgow administration, and the Valley County administration should consider these management recommendations. Should contamination reach the town's intake, the City and County will likely need to work cooperatively to address remediation or relocation of the surface water intake. Editorial contributions from the Fort Peck and MARCO PWS operators, as well as the City of Glasgow administration have been solicited and incorporated into this report.

CHAPTER 5
MONITORING WAIVERS

Waiver Recommendation

Based on past monitoring results and the susceptibility assessment of the City of Glasgow and MARCO PWSs intake, both PWSs appears to be eligible for additional monitoring waivers. See Table 11 for the affect of identified potential contaminant sources on monitoring waiver eligibility. Currently, Glasgow and MARCO have Phase II and Phase V inorganic chemicals monitoring waivers. The Glasgow and MARCO PWSs may be eligible for volatile organics and semivolatile organics waivers. For further monitoring waiver consideration, the Glasgow and MARCO PWSs should individually submit letters to DEQ requesting additional monitoring waivers. The PWSs also need to provide additional information to DEQ regarding chemical use within the spill response region. The following sections in this chapter describe Montana's monitoring waiver procedures in more detail.

Table 11. Effect of identified potential contaminant sources on eligibility of the City of Glasgow and MARCO PWSs for monitoring waivers.

Source	Contaminant	Map ID Number	Susceptibility	Waiver Eligibility
Montana Route 117	Pesticides, fertilizers, VOCs, SOCs	3	Very High	May render PWSs ineligible for VOC and SOC waivers
Federal Railway	VOCs, SOCs	4	Very High	May render PWSs ineligible for VOC and SOC waivers
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate	See Figure 5 and Figure 6	High	May render PWSs ineligible for SOC waivers
Missouri River Outpost - 1 active Leaking Underground Storage Tank (LUST)	Petroleum hydrocarbons	5	High	May render PWSs ineligible for VOC waivers
Town of Fort Peck wastewater lagoon MPDES discharge	Pathogens, nitrate	7	High	No waivers available for pathogens or nitrate
Army Corps of Engineers – 3 active Underground Storage Tanks (USTs)	Petroleum hydrocarbons	6	Moderate	May render PWSs ineligible for VOC waivers
Town of Fort Peck municipal sewer	Pathogens, nitrate	12	Moderate	No waivers available for pathogens or nitrate
Montana Route 24	Pesticides, fertilizers, VOCs, SOCs	2	Low	No or little effect on eligibility
Grazing on CMR National Wildlife Refuge	Pathogens, nitrate	1	Low	No waivers available for pathogens or nitrate
Town of Fort Peck closed landfill	Pesticides, SOCs, VOCs, metals, pathogens, nitrate	11	Low	No or little effect on eligibility
Fort Peck Marina	Petroleum hydrocarbons	4	Low	No or little effect on eligibility

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 miles 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 miles 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. Review of an organic chemical monitoring waiver application will be conducted by DEQ's Public Water Supply Section and DEQ's Source Water Protection Program. Other state agencies may be asked for assistance.

Susceptibility Waiver for Surface Water

Shallow unconfined aquifers and surface water bodies are the most common source of usable groundwater in Montana. Unconfined aquifers and many surface water bodies are usually locally recharged by precipitation. In general, shallow 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. Residence time in surface water bodies such as streams and narrow lakes is considered small, as the water moves through the system rather quickly. Water contained in large lakes and reservoirs may have variable residence times based on seasonal turnover, inversions, stagnant depths or reaches of the lake water, and throughput of water in the water body. Similar water chemistry often exists between shallow unconfined groundwater and 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. Alternately, surface water bodies directly or indirectly receive a considerable percentage of their water from groundwater. Therefore, surface water can be susceptible to contamination by organic chemicals migrating from groundwater into the surface water.

The objective of the susceptibility waiver application is to assess the potential of organic chemical migration of contaminants into surface water that is used as a source. The general procedures make use of a combination of site-specific information pertaining to the location and construction of the water source development, monitoring history of the source, geologic/hydrologic characteristics of the source water, and chemical characteristics of the organic chemicals pertaining to their mobility and persistence in the environment. The area of contribution to the surface water body at the PWS intake must be defined and plotted. This should describe the water flow directions, stream discharge and velocity, residence time of water in the lake or reservoir (if the information is available). All surface bodies within a 1,000 feet of the PWS well(s) must be plotted. The Montana DEQ Source Water Protection Program typically will delineate and assess a larger (more conservative) area called a Spill Response Region that extends 1/2 mile downstream and approximately 10 miles upstream of the PWS surface water intake. It encloses the shoreline of any lakes along the length of the region. The width of the region extends 1/2 mile surrounding any lakes and on either side of the primary stream tributaries. Analytical monitoring history of the PWS intake should also be provided as part of the susceptibility waiver application.

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APPENDICES

APPENDIX A

CITY OF GLASGOW PWS SITE PLAN

APPENDIX B

CITY OF GLASGOW AND MARCO SANITARY SURVEYS MASANITARYSANITARYSUSURVETSURVEY