SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Loma County Water District

PWSID # MT0002669

Public Water System

Date of Report: 12/13/02

Loma County Water District Operators:

James Cornell
Tom Johnson
P.O. Box 167
Loma, MT 59460
(406) 739-4216

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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 supply (PWS) discussed in this report is located in Choteau County, Montana. The DEQ PWS identification number, operator names, and contact number for the Loma County Water District PWS appears 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 Loma County Water District 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 Loma County Water District PWS operators in the identification of potential contaminant sources near their surface water intake, and the potential need for a source water protection plan to protect the Loma County Water District drinking water source. A source water protection plan is warranted for the Loma PWS, as Loma source water is moderately 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

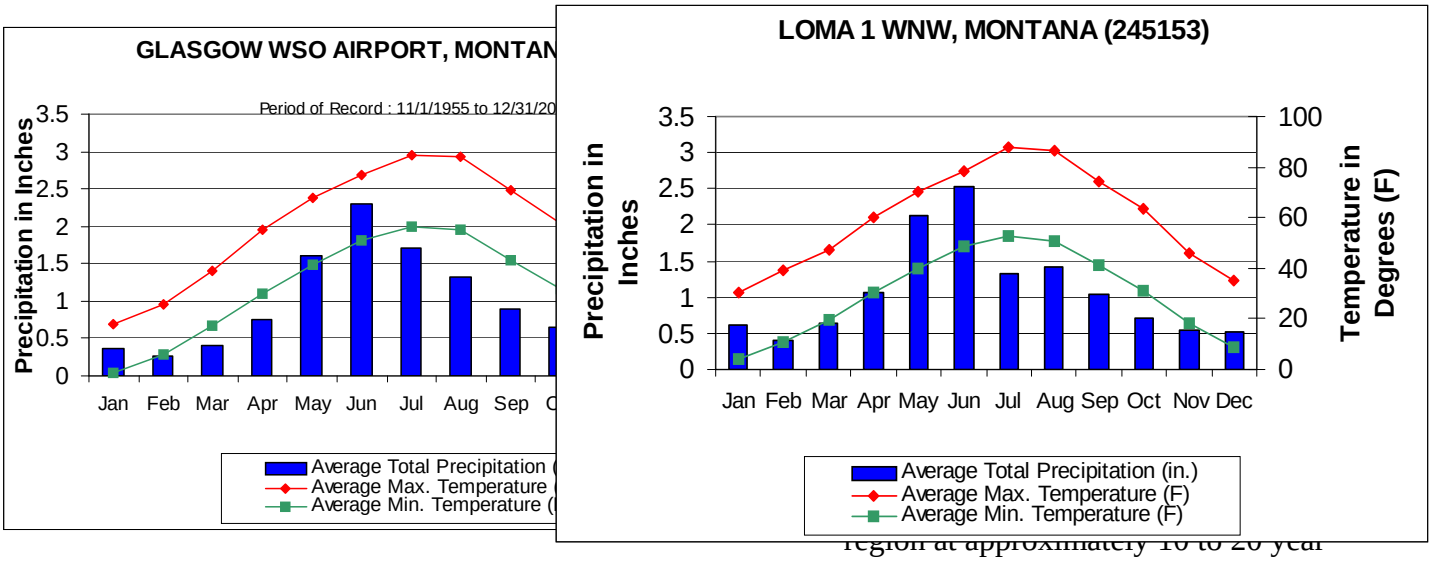
The Community

Loma is located approximately 50 miles northeast of Great Falls in Choteau County (Figure 1). The Loma County Water District PWS services an approximately 750 square mile area north of the town of Loma.

The population of Choteau County was estimated at 5,452 in 1990. The county population has increased to 5,970 in 2000, based on data collected in the U.S. Census (http://factfinder.census.gov). Loma was founded as a trading post in 1831. The town was later serviced by ferryboats traveling up the Missouri River and by the Great Northern Railroad (Cheney, 1983). The economy of the county relies on the Great Northern Railroad, agriculture, and government and social services. Natural resources extracted near Loma include gravel, oil, and natural gas. The Rocky Boy's and Fort Belknap Indian reservations cover over 700,000 acres near Loma. U.S. 87 connects Havre with Great Falls to the southwest and Havre to the northeast.

Businesses in Loma include the Burlington Northern Santa Fe Railway, agricultural implement dealers and chemical suppliers, equipment manufacturing and repair shops, and general retail. A sanitary sewer does not serve homes and businesses within the city. On-site residential septic systems are utilized both within and outside the city limits.

Figure 2. Loma Average Temperatures and Precipitation



region at approximately 10 to 20 year intervals. Evaporation rates are high, averaging 25 to 35 inches per year.

Geographic Setting

Loma is situated 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 town lies on the Marias River floodplain northeast of the confluence of the Marias and Missouri Rivers. The Loma County Water District is situated in an area of gentle plains shaped by continental glaciers. The glaciated plains are dissected by coulees occupied by intermittent streams that flow only in response to snowmelt or intense summer storms. The Marias River, the primary source of Loma's drinking water, is a tributary to the Missouri River in north central Montana.

The Marias River begins in the Rocky Mountains, located approximately 150 miles to the west of Loma, and flows into Lake Elwell behind Tiber Dam. Downstream from Tiber Dam, the Marias River flows over a thin layer of alluvium covering eastward dipping sandstone and shale layers. Glacial till consisting of sand, gravel, silt, and clay blankets the bedrock throughout much of the Loma County Water District service area.

The Loma County Water District surface water intake is located on the east bank of the Marias River, approximately 1/4 mile southwest of Loma, and just upstream of the Teton River confluence with the Marias. Here the Marias floodplain is approximately 1/2 mile wide, and bordered by glaciated ridges and benches.

The Loma County Water District surface water intake and distribution system are situated in the Marias watershed. The U.S. Geological Survey hydrologic unit code for this watershed is 10030203. The Marias River drainage is oriented north-northwest and south-southeast near Loma, with a flow direction to the southeast.

Geology

This section provides an overview of the geology and hydrology of the area in the vicinity of the Loma County Water District 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.

The following description of geologic conditions in the Marias River watershed is summarized from two reports. They are Geology of the Lower Marias River Area, Chouteau, Hill, and Liberty Counties Montana (Smith, Witkind, and Trimble, 1959) and Water Quality Inventory and Management Plan (Garvin and Botz, 1975). Bedrock in the mountainous western part of the Marias River watershed consists of sandstone, shale, and limestone rocks that were extensively faulted and folded during mountain building (Figure 3). The central and eastern part of the watershed is underlain by sandstones and shales that are deformed into the Sweetgrass Arch, a broad uplift trending generally north-south on a line from Shelby to Great Falls. The Sweet Grass Hills, in the northern part of the watershed, consist of igneous rocks that were injected as liquid masses along faults through the surrounding layers of sedimentary rocks. These liquid masses cooled and, when the overlying sedimentary layers eroded away, formed the cores of the three buttes of the Sweet Grass Hills.

Much of the central and eastern parts of the Marias River watershed is covered by up to 200 feet of clay rich glacial moraines, outwash channels, and lake sediments associated with continental glaciation. Coarse-grained alpine glacial moraine and outwash deposits extend up to 30 miles from the mountains in the western part of the watershed. Thin, modern alluvial deposits of sand, gravel, clay, and silt are found along stream channels. Terraces or remnants of similar alluvial deposits from ancient streams top benches in the western part of the watershed.

Soils on rolling plains covered by continental glacial till are predominantly deep, well-drained loam or clay loam on two to 15 percent slopes. These soils are often plastic and sticky when wet, have moderate to severe erosion hazard, and are suitable for small grains, pasture, or rangeland (Garvin and Botz, 1975). Soils on glacial meltwater areas range from clay to fine sandy loam, may be poorly drained or strongly alkaline, and, therefore, are less likely to be cultivated for crops. Shallow to deep stony soils on steep slopes characterize alpine glacial terrain. Erosion hazard is potentially severe and, therefore, these soils are not suitable for cultivation. Non-glaciated terrain in the Marias Watershed generally has thin, poorly developed soils mostly suited for rangeland.

Groundwater is used for stock, domestic, municipal, and irrigation purposes in the Marias River watershed. Glacial till produces small quantities of poor quality water (Garvin and Botz, 1975). The Eagle Sandstone, the most prolific bedrock aquifer in the region, has mostly been stripped away by erosion, and the thick shale sequence of the Colorado Formation that underlies the Eagle is not an aquifer. Alluvium of the Marias River is thin and capable of supplying small to moderate amounts of groundwater (Garvin and Botz, 1975). Approximately 19 ft of gravel alluvium was encountered in geotechnical wells drilled at the Moffat Bridge near Riverview Colony's wells by Montana Department of Highways. Logs from these wells indicate the Marias River channel is downcut 15 to 16 ft into alluvium leaving as little as a 1 to 2 feet of alluvium between the river bed and bedrock. Riverview Colony as well as Hill County Water Districts, South Chester Water Users, and Loma County Water District have infiltration galleries in this thin veneer.

General Description of the Source Water

The source water for the Loma County Water District is obtained through a surface water intake in the streambed of the Marias River. The surface water intake is located approximately one mile upstream of the Marias River confluence with the Missouri River (Figure 4). Snowmelt in the Sweet Grass Hills and Glacier National Park is an important source of water for the Marias River.

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

The Public Water Supply

The Loma County Water District 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 400 residents via 120 active service connections.

The Marias River is the primary water supply source. The latitude of the surface water intake location is 47.9336°N, and the longitude is –110.5099°W. Raw water is pumped from the river to a water treatment plant (DEQ, 1996). Marias River turbidity spikes can be as high as 4500 NTU during periods of spring runoff and rainstorms. Raw source water from the reservoir is pumped into two ponds adjacent to the treatment plant prior to treatment.

The Loma water treatment was constructed in 1980, and is typically operated for a period of six to seven hours per day (DEQ, 1996). The plant is a conventional filtration facility. Plant operation is triggered when the reservoir level drops to 8.7 feet. Alum and polymers are added to raw water in the treatment plant to induce coagulation and flocculation of suspended solids. Precipitation of solids then occurs in the clarification chamber. The water is then filtered, chlorinated with gas, and pumped into a 10,000-gallon capacity clearwell (DEQ, 1996).

The finished water is then pumped from the clearwell to a 150,000-gallon capacity storage tank and a storage reservoir. From the storage tank, finished water is pumped out to the distribution system. Finished water is also pumped out to a water fill station (DEQ, 1996).

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 Loma County Water District Surface Water Intake Water Quality

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

Concentrations of common chemical constituents in water sampled from the Marias River watershed are listed in Table 2. Water Quality of the Marias River is impacted by irrigation return flow and accelerated erosion from flow regulation. The Marias River and several tributaries and lakes in its watershed are targeted for Total Maximum Daily Load (TMDL) development. DEQ's Selection of a stream for TMDL development is based on impairment of a specified use such as aquatic life, fisheries, agriculture, or drinking water. The Marias River downstream from Tiber Dam, Pondera Coulee, and Corral Creek are included on Montana's 2002 303(d) list. The Marias River downstream of Tiber Dam is listed due to water quality related impairments to aquatic life support, impairments to the cold water and warm water fisheries in the tailwaters extending from the base of Tiber Dam to 10.8 miles downstream of the dam, and impairments to the exclusive warm water fishery in the river downstream of the Tiber Dam tailwaters to the mouth. The causes of impairment are listed as flow alteration, mercury, metals, and habitat alterations in the segment directly downstream of Tiber Dam. Flow alteration, mercury, metals and thermal modificaions are listed as impairment causes in the river from 10.8 miles downstream of the dam to the mouth. The listed sources of impairment in the segment directly downstream of the dam include: agriculture, grazing, hydrolmodification, flow regulation/modification, habitat modification, and removal of riparian vegetation. Impairment causes in the river from 10.8 miles below the dam to the mouth include: hydromodifications and flow regulation/modification. These activities also can impact drinking water quality, though drinking water use is listed as not assessed.

Table 2 Concentration of common constituents in the Marias River watershed (Garvin and Botz, 1975).

Sample Location	pH	Sc µS/cm	Ca mg/L	Mg mg/L	Na mg/L	Fe mg/L	HCO_3 mg/L	PO_4 mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L
Cut Bank Creek (4/11/1974)	8.3	611	41	21	58	0.58	204	0.08	4.5	131	0.0
Two Medicine Creek (4/11/1974)	8.2	353	42	13	6	1.30	132	0.08	0.2	68	0.0
Marias at Tiber Dam (10/18/1973)	8.0	519	53	21	27	0.12	165	0.07	2.5	138	0.22
Marias at Loma(4/17/1974)	8.5	579	57	23	31	1.20	174	<0.03	3.0	165	0.26

Loma County Water District PWS Water Quality

The Loma County Water District's water is routinely monitored for compliance with drinking water standards. Bacteriological monitoring occurs once a month. Compliance with other drinking water standards is based on additional sampling on a variety of schedules. The Department issued a boil order for the Loma County Water District on July 30, 1998 because of turbidity MCL (maximum contaminant level) exceedances. The District is no longer under the boil order, as sampling results submitted to the Department have indicated compliance with the turbidity MCL. The Department recently issued an administrative order against the District due to monitoring violations dating back to 1993. The administrative order will be in effect against the District until the water quality samples and information required for community systems under the Safe Drinking Water Act have been collected, analyzed, and submitted to the Department.

Within the past five years, the maximum contaminant level (MCL) was exceeded with the detection of fecal coliform in a sample collected on July 13, 2001 during routine contaminant monitoring. The Department issued a boil order for Loma County Water District users on July 14, 2001 following notification by the system of the detection of coliform bacteria . The system achieved compliance with the order on October 1, 2001. No maximum contaminant level (MCL) exceedances were noted for any other constituents monitored over the past five years, but detections of arsenic, barium, fluoride, nickel, nitrate, selenium, 2,4-D, bromodichloromethane, chlorodibromomethane, trihalomethanes, and chloroform were noted.

CHAPTER 2
DELINEATION

The source water protection area, or the land area that contributes water to the Loma County Water District PWS surface water intake, is delineated in this chapter. The purpose of delineation is to map the source of Loma County Water District'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 Loma County Water District surface water intake in which contaminants can be drawn with little lag time. The watershed region encompasses the Marias River watershed.

Hydrogeologic Conditions

The Marias River forms from convergence of the Two Medicine River and Cut Bank Creek that flow east from the Rocky Mountains. Other tributaries of the Marias include the Dry Fork of the Marias and Pondera Coulee, draining the plains to the south, and Eagle Creek and Willow Creek draining the Sweet Grass Hills to the north. Tiber dam impounds Lake Elwell, located approximately 50 miles upstream from Loma's surface water intake. Other significant water bodies in the Marias River watershed include Lake Francis, near Valier, and Two Medicine and Lower Two Medicine lakes at the head of the Two Medicine River. Drainage is poorly developed in a relatively large area in the north-central part of the watershed, which is underlain by glacial till (Garvin and Botz, 1975).

The average flow of the Marias River near just downstream of the Tiber Dam is 784 cubic feet per second (cfs), with a median flow of 574 cfs (Table 3). Flow is highly variable upstream from Lake Elwell, but Tiber Dam regulates flow in the Marias downstream of the reservoir. Marias River flows in the vicinity of Loma are also affected by seasonal runoff from tributaries downstream of Tiber Dam, as well as water stored and released annually for irrigation purposes. Many streams in the plains, or lower, portion of the watershed are ephemeral or intermittent, and flow primarily in response to brief storms in late spring and early summer.

Table 3. Daily stream flows in the Marias River watershed (data from U.S. Geological Survey).

Gaging Station	Area (mi^2)	Average Annual (cfs)	Peak (cfs)	Minimum (cfs)
Birch Creek near Valier	471	85.1	650	6
Dupuyer Creek near Valier	137	49.2	520	0
Two Medicine River near Browning	317	373.3	500	1.4
Cut Bank Creek at Cut Bank	1,041	163	5,000	1

Pondera Coulee near Chester	598	13	3,060	0
Willow Creek near Galata	839	11.5	1,110	0
Marias River near Shelby	3,242	787	16,700	26
Marias River near Chester	4,927	764	4,510	184

The average annual flow of the Marias River at the Marias River at Loma U.S.G.S. gaging station varied from 494 cubic feet per second (cfs) in 1963 to 1,455 cfs in 1965, based on gaging data collected from 1959 through 1971. The peak flow recorded at this station on June 16, 10,800 cfs. Flow is affected by annual and seasonal variations in runoff and water storage for irrigation.

Snowmelt, direct precipitation, surface runoff, and lateral inflow from alluvial and bedrock aquifers contribute to flow in the Marias River in the vicinity of the Loma County Water District surface water intake. The Marias loses water to infiltration through the riverbed to underlying or adjacent aquifers, evapotranspiration, and water withdrawals.

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

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

The Loma County Water District's source water is drawn into an surface water intake through a thin gravel aquifer adjacent to and beneath the Marias River. The alluvium is bounded on the north, east, and west by bedrock or glacial deposits and on the south by the fine-grained alluvium of the Missouri River. Recharge

to the aquifer is from precipitation, losses from the Marias River and its tributaries, and, to a lesser extent, recharge from bedrock and glacial deposits along its boundaries. Groundwater flow direction within the alluvium varies depending on local differences in recharge from, and discharge to, the Marias River. Facilities or activities that can release contaminants to the alluvium near the District's surface water intake or directly into the Marias River downstream from Tiber Dam are the greatest concern to the District's source water quality. The potential for releases to the lower reaches of Pondera or Basin Coulee is also a concern. Contaminants released from sources such as wastewater treatment plants and cultivated cropland upstream from Tiber Dam contribute most of the dissolved solids transported by the Marias River. However, mixing and residence in Lake Elwell reduce the concentrations of contaminants from these sources to less harmful levels downstream from the dam.

Delineation Results

Spill Response Region

Hydrogeologic mapping was utilized to delineate the spill response region ((Figure 4). The region extends from the surface water intake along the Marias River channel upstream for a distance of 10 miles, in accordance with SWP guidance (DEQ, 1999). The region also encompasses a ½ mile area extending from either side of the centerline of the Marias River channel, in accordance with SWPP guidelines.

Watershed Region

The watershed region for the Loma County Water District PWS encompasses the entire Marias River watershed, which extends from just downstream of the surface water intake upstream to the Canadian border (Figure 5). The U.S. Geological Survey hydrologic unit code for the Marias watershed is 10030203.

Limiting Factors

The delineations for the Loma County Water District 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 to reach the surface water intake with little 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 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 Loma County Water District PWS 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 Loma County Water District PWS 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 Loma County Water District PWS include nitrate, pathogens, pesticides, fertilizers, metals, VOCs, SOCs, petroleum hydrocarbons, total dissolved solids, and turbidity. The inventory for the Loma County Water District 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 Methods

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.

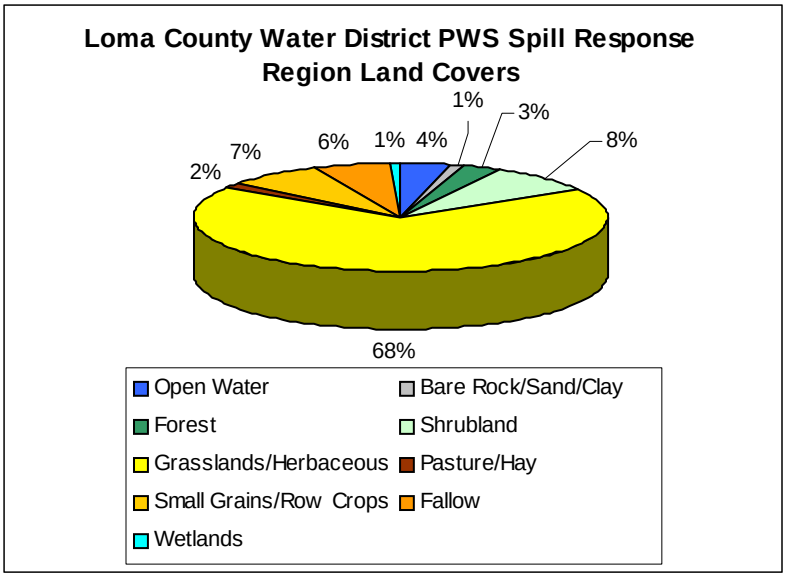
Potential contaminant sources are designated as significant if they fall into one of the following categories:

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 croplands
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 Loma County Water District PWS include open water, forest, shrubland, grassland/herbaceous, small grains/row crops, fallow ground, and wetlands (Figure 6).

Figure 6. Spill response region land cover percent of total area



Predominant land covers in the region include grasslands/ herbaceous (68%), shrubland (8%), and small grains/row crops (7%) (Figure 6). Cultivated cropland occupies 15% of the spill response region.

Low on-site septic densities cover 99.990% of the spill response region area. Loma does not have a municipal sewer system, but high and moderate on-site septic system densities occur within Loma city limits. High septic densities occupy 0.008% of the total area of the spill response region, and moderate densities occupy 0.0006% of the total area. No concentrated animal feeding operations are located in the spill response region.

One non-producing oil and gas well is located within the spill response region ((Figure 4). This well is a development well, has not been used for the production of oil and gas. As a result, brine wastewater is not generated at this well location, and is not considered a significant potential contaminant source.

Two active underground storage tanks are located at the Loma Kwik Stop in Loma ((Figure 4). In the event of line or tank leaks, this potential contaminant source may present a hazard to the Loma County source water. The Loma School, located in Loma, handles potential contaminant sources, but no known storm drains, French drains, or sumps are located in the vicinity of the school. Therefore, no readily accessible pathways for contaminant migration into the shallow ground water are present, and, as such, this potential contaminant source is not considered significant. The Loma landfill, located in Dry Fork Coulee approximately two miles northwest of Loma and ¼ mile outside of the spill response region, may present a hazard to Loma County's source water if landfill contaminants leach into the shallow ground water discharging to the Marias River ¾ mile to the south.

U.S. Highway 87 passes through the spill response region and crosses the Marias River just south of the Loma County Water District surface water intake. Herbicides are commonly sprayed along roadways such as U.S. Highway 87 for weed control purposes. There is also a potential for pesticides, fertilizers, petroleum

hydrocarbons, SOCs, and VOCs transported along this route to spill onto the roadway and adjacent soils, possibly dumping directly into the Marias River, infiltrating shallow ground water, or running off into the Marias River. The Great Northern railway parallels the U.S. Highway 87 route, and presents the same hazards to the Loma County source water.

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

Table 4. Potential contaminant sources in the spill response region for the Loma County Water District PWS.

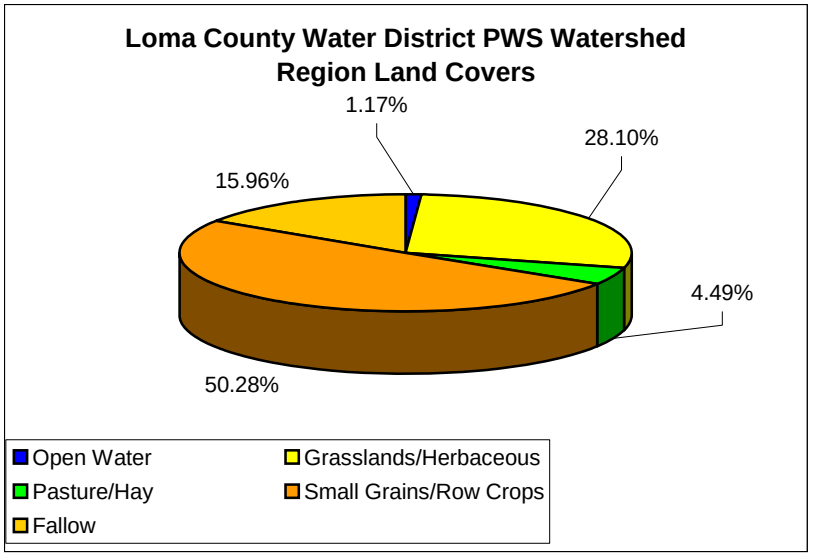
Source	Address Or Map ID Number	Potential Contaminants	Hazard
Cultivated Cropland	1	Fertilizers, pesticides, herbicides, pathogens, nitrate, turbidity	surface runoff into reservoir; infiltration to shallow ground water and subsequent discharge to reservoir
Loma Kwik Stop Active Underground Storage Tanks (USTs)	2	Petroleum hydrocarbons	Spills; leaking lines or tanks; infiltration into underlying shallow aquifer discharging to Marias River
Loma landfill	3	Solvents, metals, fertilizers, pesticides, petroleum hydrocarbons, SOCs, VOCs	Contaminant leaching to underlying shallow aquifer discharging to Marias River
US 87	4	fertilizers, pesticides, petroleum hydrocarbons, SOCs, VOCs	Spills; runoff into Marias River; infiltration into underlying shallow aquifer discharging to Marias River
Great Northern Railway	5	fertilizers, pesticides, petroleum hydrocarbons, SOCs, VOCs	Spills; runoff into Marias River; infiltration into underlying shallow aquifer discharging to Marias River
Loma School	6	Solvents, SOCs, VOCs	Spills or improper storage or disposal of contaminants; infiltration into underlying shallow aquifer discharging to Marias River
Oil & gas development well	7	Petroleum hydrocarbons, total dissolved solids (brine waste water)	Infiltration of brine water water into underlying shallow aquifer discharging to Marias River

Table 5. Significant potential contaminant sources in the spill response region for the Loma County Water District PWS.

Source	Address Or Map ID Number	Potential Contaminants	Hazard
Cultivated Cropland	1	Fertilizers, pesticides, herbicides, pathogens, nitrate, turbidity	surface runoff into reservoir; infiltration to shallow ground water and subsequent discharge to reservoir
Loma Kwik Stop Active Underground Storage Tanks (USTs)	2	Petroleum hydrocarbons	Spills; leaking lines or tanks; infiltration into underlying shallow aquifer discharging to Marias River
Loma landfill	3	Solvents, metals, fertilizers, pesticides, petroleum hydrocarbons, SOCs, VOCs	Contaminant leaching to underlying shallow aquifer discharging to Marias River
US 87	4	fertilizers, pesticides, petroleum hydrocarbons, SOCs, VOCs	Spills; runoff into Marias River; infiltration into underlying shallow aquifer discharging to Marias River
Great Northern Railway	5	fertilizers, pesticides, petroleum hydrocarbons, SOCs, VOCs	Spills; runoff into Marias River; infiltration into underlying shallow aquifer discharging to Marias River

Inventory Results/Watershed Region

Figure 7. Watershed region land cover percent of total area



The watershed region for the Loma County Water District PWS encompasses the entire Marias River watershed (Figure 5). Predominant land covers in the watershed region include small grains (51%), grasslands/ herbaceous (28%), and fallow ground (16%) (Figure 7). Cultivated cropland occupies 70 % of the watershed region.

Several DEQ-permitted Montana Pollutant Discharge Elimination System (MPDES) wastewater treatment plant, confined animal feeding operation, and stormwater discharges are located in the watershed region. There are a total of ten permitted confined animal feeding operations situated in the watershed region. However, due to the extensive distances between the discharge locations and the Loma County surface water intake, it is unlikely that contaminants from these discharges would migrate into the Marias River and reach the Loma County Water

District intake at concentrations above the detection limit, due to natural attenuation and dilution. Consequently, these permitted discharges are not considered significant potential contaminant sources.

U. S. Highways 2 and 89 and Interstate 15 pass through the watershed region (Figure 5). Herbicides are commonly sprayed along these roadways for weed control purposes. There is also a potential for pesticides, fertilizers, petroleum hydrocarbons, SOCs, and VOCs transported along this route to spill onto the roadway and adjacent soils, possibly infiltrating shallow ground water or running off into channels draining into the Marias River or its tributaries. However, due to the long distances between the roadways and the Loma County surface water intake, it is unlikely that contaminants spilled on these roads would migrate into the Marias River and reach the Loma County Water District water supply at concentrations above the detection limit, due to natural attenuation and dilution. Consequently, these roadways are not considered significant potential contaminant sources.

Several mines are located in the watershed (Figure 5). Iron, titanium, coal, gravel, fluorine, silicon, and other rare earth elements have been extracted at these sites by currently operating facilities or historical operations. Generally, the considerable distances between these sites in the watershed and the Loma County surface water intake render these mines insignificant potential contaminant sources.

Several Continental crude oil pipelines are located in the upper area of the watershed (Figure 5). Because of the considerable distance from the pipeline locations to the Loma County surface water intake, any petroleum hydrocarbons associated with pipeline spills would not likely contaminate the source water due to natural attenuation and dilution.

Several Montana Superfund (CECRA) sites and hazardous material spills are located in the watershed region (Figure 5). Hazardous materials spills include a Burlington Northern derailment and a spill near Shelby. CECRA sites include several refineries and fueling facilities near Shelby, Conrad, Kevin, and Sunburst. Only the Big West Oil Refinery site near Kevin is considered to be a high remediation priority by the Department. This site is not considered a significant potential contaminant source due to its location approximately 115 miles upstream from Loma's surface water intake.

Numerous oil and gas wells are located in the watershed region (Figure 5). A large number of these wells are currently utilized for oil and/or gas production. The production wells are depicted in red on Figure 5. Due to the high density of producing oil and gas wells in the watershed region, they are considered significant potential contaminant sources. Brine wastewater associated with these wells may infiltrate underlying shallow aquifers discharging to the Marias River. These wastewaters typically contain elevated total dissolved solids concentrations and petroleum hydrocarbons such as benzene and toluene.

Numbers on the watershed region map (Figure 5) identify the locations of potential contaminant sources, and correspond to Map ID numbers in Table 5.

Table 6. Significant potential contaminant sources in the watershed region for the Loma County Water District PWS.

Source	Address Or MapID Number	Potential Contaminants	Hazard
Cultivated Cropland	1	Fertilizers, pesticides, pathogens, nitrate, turbidity	Spills, over application, surface runoff into reservoir
Oil and Gas Production Wells	2	Total Dissolved Solids, Petroleum Hydrocarbons	Migration of brine wastewater into shallow ground water discharging to surface water; surface runoff to surface water

Inventory Update

The certified operators of the Loma County Water District PWS 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 Loma County Water District'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 Loma and Choteau 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 the Loma County Water District 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 6). The hazard presented by point sources of contaminants in Loma County Water District's spill response region depends on whether contaminants can discharge directly to the Marias River. Point source hazard is also dependent on the health affects associated with potential contaminants (Table 7). Hazard ratings for nonpoint sources are assigned based on criteria listed in Table 7 for septic systems, sanitary sewers, and cropped agricultural land. Barriers can be anything that decreases the likelihood that contaminated water will reach Loma's surface water intake. Examples of barriers include: a vegetated riparian area, protective forest management practices, and dilution.

Table 7. 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 8. Hazard rankings for various potential contaminant sources

	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 9). The susceptibility of each well to each potential contaminant source is assessed separately.

Susceptibility Assessment Results

Loma County Water District's source water is moderately susceptible to potential contamination from cultivated cropland, oil andgas production wells, and U.S. Highway 87. The source water is minimally susceptible to potential contamination from active underground storage tanks, the Great Northern railway, and the Loma landfill. Table 9 displays the susceptibility assessment results for the Loma County Water District PWS surface water intake. The intake is susceptible to number of contaminants, including pathogens, nitrates, fertilizers, pesticides, herbicides, turbidity, petroleum hydrocarbons, SOCs, total dissolved solids, and VOCs. Tables 4, 5, and 6 list all potential contaminant sources identified in the spill response and watershed regions for the Loma County Water District PWS.

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

***Cultivated cropland* –** The potential hazard imposed by fertilizers, pesticides, nitrates, pathogens, and turbidity originating from agricultural lands is moderate. Cropped agricultural lands occupy 15% of the spill response region, and 70% of the watershed region. The hazard posed by this land use is considered moderate, as the average percent occupation of cultivated croplands in both source water protection regions falls between 20% and 50% of the total area. As noted in the water quality section of chapter one, turbidity MCL exceedances have periodically posed problems for the Loma County PWS. Turbidity is naturally high in Marias River source water due to snowmelt or storm events draining fine-grained (clay and silt) Quaternary glacial deposits and glacial-derived soils predominantly exposed in the watershed. It is likely, however, that turbidity levels are increased in magnitude during these events and possibly during baseflow periods due to soil disturbance and alteration of natural flow regimes in the drainage associated with crop cultivation and irrigation. These factors, singularly or in combination, likely facilitate the flush of sediments from exposed slopes into tributaries and subsequently the Marias River. The susceptibility of the intake to these agricultural sources is also moderate due to the identification of only a single barrier: natural attenuation. The vast majority of cultivated cropland located in the watershed region is generally set back from the Marias River corridor, which is predominantly contains grasslands and shrubland (Figure 8). As a result, contaminants generated by agricultural activities generally must travel over considerable distances in surface runoff or shallow ground water within the watershed region to reach the Marias River source water. As a result, reduction of contaminant concentrations through biological processes (aerobic and anaerobic biodegradation, plant and animal uptake), physical phenomena (advection, dispersion, dilution, diffusion, volatilization, sorption/desorption), and chemical reactions (ion exchange, complexation, abiotic transformation). is likely to occur over the distance between the croplands and the river, particularly within the riparian grasslands and shrubland corridor located along some segments of the river.

***Oil and gas production wells* –** The potential hazard presented by gas production wells located in the watershed region is moderate. Brine wastewaters produced by these wells may potentially migrate into shallow ground water and eventually discharge to the Marias River upstream from Loma's surface water intake. The susceptibility of the Loma intake to this potential contaminant source is also moderate, due to the identification of only a single natural attenuation barrier. Natural attenuation of total dissolved solids and petroleum hydrocarbons associated with oil and gas brine wastewaters will likely occur over the considerable distances between the production wells in the watershed and the Loma County intake (Figure 5).

U.S. Highway 87– The potential hazard imposed by pesticides, fertilizers, VOCs and SOCs originating from U.S. Highway 87 is moderate. The road poses a moderate hazard because there is potential for a spill originating on the highway to infiltrate into shallow ground water discharging to the Marias River if a spill occurs on the highway northeast of Loma. There is also potential for a highway spill on the bridge to directly discharge to the Marias River approximately ¼ mile downstream fron Loma's intake, but it is extremely unlikely that contamination from a spill occurring at this river crossing would reach the intake upstream. The susceptibility of the PWSs to pesticides, fertilizers, VOCs and SOCs originating from this source is also moderate, due to natural attenuation processes (as described above for cultivated cropland) that would likely degrade contaminants along their travel path before reaching the Loma intake.

Great Northern Railway– The potential hazard imposed by pesticides, fertilizers, VOCs, and SOCs originating from the Great Northern railway is low. The railway poses a moderate hazard because there is limited potential for a spill originating on the railway to directly discharge into the Marias River in the vicinity of Loma's surface water intake. The susceptibility of the PWS to pesticides, fertilizers, VOCs and SOCs originating from this source is also low. The barriers identified for this source are natural attenuation and the location of the railway downstream and downgradient of the Loma County intake.

Active USTs – The potential hazard imposed by petroleum hydrocarbons originating from listed active USTs is moderate. These active USTs pose a moderate hazard because the potential exists for contaminants from these USTs to infiltrate into the underlying alluvial aquifer discharging to the Marias River in the vicinity of the PWS intake. The susceptibility of the PWS to petroleum hydrocarbons originating from these sources is low, as the barriers identified for the USTs include both natural attenuation and the operation of leak detection systems.

Loma landfill – The hazard imposed by the Loma landfill located within the inventory zone is low, because the landfill is located approximately 1/3 mile outside of the spill response region in Dry Fork Coulee (Figure 4). Natural attenuation constitutes a barrier between the potential contaminants leaching from the base of the landfill and the Loma County intake. The resultant susceptibility of the PWS to the landfill is low.

Table 9. Susceptibility assessment for significant potential contaminant sources in the spill response and watershed regions for the Loma County Water District PWS surface water intake.

Source	Contaminant	Map ID Number	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate, turbidity	See Figures 4 and 8	Spills, over application, surface runoff into Fresno Reservoir	Moderate	Natural attenuation	Moderate	Educate landowners on the proper handling, storage, and disposal of pesticides and fertilizers; utilization of agricultural best management practices
Oil and gas production wells	Total Dissolved Solids, Petroleum Hydrocarbons	8	Migration of brine wastewater into shallow ground water discharging to surface water; surface runoff to surface water	Moderate	Natural attenuation	Moderate	Proper disposal of brine wastewater
US 87	fertilizers, pesticides, petroleum hydrocarbons, SOCs, VOCs	4	Spills; runoff into Marias River; infiltration into underlying shallow aquifer discharging	Moderate	Natural attenuation	Moderate	Develop emergency response plan; Maintain preparedness of local emergency personnel through active training

			to Marias River				
Loma Kwik Stop Active Underground Storage Tanks (USTs)	Petroleum hydrocarbons	2	Spills; leaking lines or tanks; infiltration into underlying shallow aquifer discharging to Marias River	Moderate	Natural attenuation, leak detection systems in place	Low	Monitor for releases to ground water
Loma landfill	Solvents, metals, fertilizers, pesticides, petroleum hydrocarbons, SOCs, VOCs	3	Contaminant leaching to underlying shallow aquifer discharging to Marias River	Low	Natural attenuation	Low	Monitor infiltration and migration of leachate
Great Northern Railway	fertilizers, pesticides, petroleum hydrocarbons, SOCs, VOCs	5	Spills; runoff into Marias River; infiltration into underlying shallow aquifer discharging to Marias River	Low	Natural attenuation; downstream and downgradient	Low	Develop emergency response plan; Maintain preparedness of local emergency personnel through active training

Management Recommendations

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

Management recommendations fall into the following categories:

- Agricultural best management practices
- Education
- Stormwater management
- Emergency Response Plan

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.

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.

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.

Emergency Response Plan - An Emergency Response Plan should be compiled and adopted by the City of Havre and Hill 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 Loma County Water District PWS operators, the Town of Loma administration, and the Choteau County administration should consider these management recommendations. Should contamination reach the Loma intake, the District, Town, and County will likely need to work cooperatively to address remediation or relocation of the surface water intake. Editorial contributions from the Loma PWS operators, as well as the Town of Loma 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 Loma County Water District intake, the PWS appears to be eligible for additional monitoring waivers. See Table 10 for the effect of identified potential contaminant sources on monitoring waiver eligibility. Currently, Loma has a Phase II inorganic chemical monitoring waivers. The Loma PWS may be eligible for volatile organics and semivolatile organics waivers. For further monitoring waiver consideration, the Loma PWS should submit a letter to DEQ requesting additional monitoring waivers. The PWS also needs 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 10. Effect of identified potential contaminant sources on eligibility of the Loma County Water District PWS for monitoring waivers.

Source	Contaminant	Map ID Number	Susceptibility	Waiver Eligibility
Cultivated Cropland	Fertilizers, pesticides, pathogens, nitrate, turbidity	See Figures 4 and 8	Moderate	May render PWS ineligible for SOC waivers
Oil and gas Production Wells	Total dissolved solids, petroleum hydrocarbons	6	Moderate	May render PWS ineligible for VOC waivers
U.S. Highway 87	Pesticides, fertilizers, petroleum hydrocarbons, VOCs, SOCs	4	Moderate	May render PWS ineligible for VOC and SOC waivers
Great Northern railway	Pesticides, fertilizers, petroleum hydrocarbons, VOCs, SOCs	5	Low	Will not likely affect PWS eligibility for VOC and SOC waivers
Active underground storage tanks	Petroleum hydrocarbons	2	Low	Will not likely affect PWS eligibility for VOC waiver
Loma landfill	Solvents, metals, pesticides, fertilizers, petroleum hydrocarbons, VOCs, SOCs	3	Low	Will not likely affect PWS eligibility for VOC and SOC waivers

Monitoring Waiver Requirements

The 1986 Amendments to the Safe Drinking Water Act require that community and non-community PWSs sample drinking water sources for the presence of volatile organic chemicals (VOCs) and synthetic organic chemicals (SOCs). The US EPA has authorized states to issue monitoring waivers for the organic chemicals to systems that have completed an approved waiver application and review process. All PWSs in the State of Montana are eligible for consideration of monitoring waivers for several organic chemicals. The

chemicals diquat, endothall, glyphosate, dioxins, ethylene dibromide (EDB), dibromochloropropane (DBCP), and polychlorinated biphenyls are excluded from monitoring requirements by statewide waivers.

Use Waivers

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

Susceptibility Waivers

If a Use Waiver is not granted, a system may still be eligible for a Susceptibility Waiver, if through a vulnerability assessment it is demonstrated that the water source would not be susceptible to contamination. Susceptibility is based on prior analytical or vulnerability assessment results, environmental persistence, and transport of the contaminants, natural protection of the source, wellhead protection program efforts, and the level of susceptibility indicators (such as nitrate and coliform bacteria). The vulnerability assessment of a surface water source must consider the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the surface water intake. PWSs developed in unconfined aquifers should use a minimum fixed radius of 1.0 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

SANITARY SURVEYS
MASANITARYSANITARYSUSURVETSURVEY