SOURCE WATER DELINEATION AND ASSESSMENT REPORT

11/99

Town of Chester
Public Water System
PWSID # MT0000173

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INTRODUCTION

This Delineation and Assessment Report was prepared by Perri Phillips, Hydrogeologist and Kristine Berg in the Source Water Protection Program of the Montana Department of Environmental Quality (DEQ). The Chester Public Water Supply (PWS) is located in Liberty County, Montana. The DEQ PWS identification number, owner, and operator names for the Chester PWS evaluated in this report 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 Town of Chester 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 Chester PWS operator in the identification of potential contaminant sources in the vicinity of the Chester surface water intake at Tiber Reservoir, and the need for a source water protection plan to protect the town of Chester's drinking water source.

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 Town of Chester public water supply, and is based on published data and information obtained from local residents familiar with the community. The terms "drinking water supply" and "drinking water source" refer specifically to the sources of the Chester PWS, and not any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the area of the town of Chester are identified. Only potential sources of contamination in areas that contribute water to the identified drinking water sources are considered.

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

CHAPTER 1
BACKGROUND

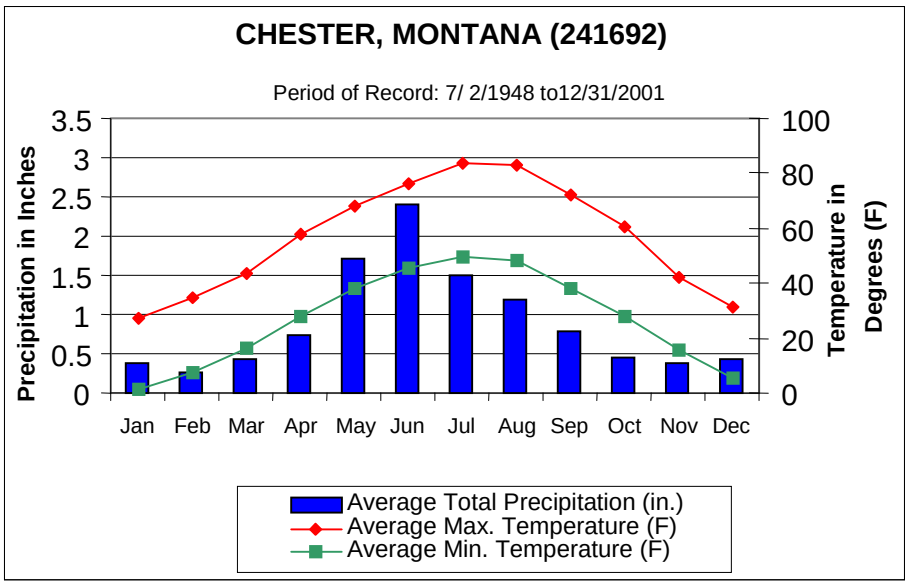
The Community

The town of Chester is located in the central area of Liberty County (Figure 1). The town is situated west of Cottonwood Creek, a tributary to the Marias River. The town is located approximately 20 miles northeast of Tiber Reservoir (Lake Elwell), which is the source water for the town's PWS. According to the 2000 U.S. Census Bureau, Liberty county, of which Chester is the County seat, has a population of 2158, 42 less than 1990. The Town of Chester has a population of 975 residents. U.S. Highway 2 connects Chester with Joplin to the East and Lothair to the West. Shelby is 42 miles West of Chester on U.S. Highway 2 and is located at the junction of U.S. 2 and Interstate 15. Interstate 15 connects Shelby with the Canadian border 35 miles to the North. In addition, the main line of the Burlington Northern Railroad runs west - east through Chester.

The largest revenue-generating industries in Liberty County in 2000 were farm, 20.6 percent of earnings; services, 19.0 percent; and state and local government, 15.7 percent. A shift in industrial activities from farm to state and local government can be seen, for in 1990, the largest industries were farm, 60.9 percent of earnings; state and local government, 13.8 percent; and retail trade, 6.0 percent (www.bea.doc.gov/bea/regional/bearfacts). Sixty-four percent of the workers in Liberty County are private wage and salary workers, and 17.2% are self-employed workers in their own, not cooperate, business. The median household income in Liberty County is $30,284. Chester has a public school system for all grades, a hospital, and an airport.

Within the Chester town limits, residents obtain their drinking water from the municipal PWS. The Chester municipal sewer district services all residents within town limits. The Sewage Lift Station has dual pumps that operate for approximately four hours daily. The station also has an emergency diesel generator that is exercised automatically weekly. A sewage treatment lagoon serves the Town of Chester. The municipal sewage discharges into Cottonwood Creek, which flows north to south and is located east of the Town of Chester.

Figure 2. Chester Average Temperatures and Precipitation



Climate

The climate in the Chester and Tiber Reservoir areas is considered semi-arid. Based on Western Regional Climatic Center data for the July 2, 1948 to December 31, 2001 period of record at the nearby Chester weather station, annual precipitation averages 10.67 inches. Monthly average precipitation ranges from 0.27 inches in February and 2.4 inches in June.

Geographic Setting

Chester and Tiber Reservoir are located in the Great Plains physiographic province of North America (Rocky Mountain Association of Geologists, 1972). The elevation of the town of Chester is approximately 3283 feet above mean sea level. Chester and the Tiber Reservoir lie in what is known as the Triangle and Hi-Line areas of Montana, where the land is greatly utilized for agricultural purposes. The Sweet Grass Hills are located approximately 35 miles north of Tiber Reservoir and the Bear Paw Mountains are approximately 65 miles east of Tiber Reservoir.

The Chester and Tiber Reservoir areas are located within the Willow and Marias watershed regions respectively. The U.S. Geological Survey hydrologic unit code for the Marias watershed is 10030203. The Marias drainage is oriented west and northwest of Tiber Reservoir, with a flow direction to the southeast. The U.S. Geological Survey hydrologic unit code for the Willow watershed is 10030204. The Willow drainage is oriented north of Tiber Reservoir, with a flow direction to the southeast. Willow Creek and Eagle Creek, located in the Willow watershed, are tributaries to the Marias River. The Marias River, a perennial stream approximately 139 miles long, flows through Tiber Reservoir, and is a major tributary to the Missouri River.

Geology

This section provides an overview of the geology and hydrology of the Tiber Reservoir and Chester areas. An understanding of hydrogeologic conditions also provides an explanation for the sensitivity of local aquifers and streams to potential contamination sources.

According to the "Liberty and Toole County conservation districts long range resource plan," a large majority of the Marias watershed is underlain by Colorado Shale, which yields highly mineralized water near the base and is generally not considered a source for ground water (Figure 3). In addition, a half-mile buffer surrounding the Marias River before and after the Tiber Reservoir consists of Alluvium, which generally yields good quality of water at shallow depths. Eagle Sandstone, Telegraph Creek Formation, Judith River Formation, and Claggett Shale out crop in the Willow Creek watershed, the majority of which are poor ground water suppliers. The "Water Quality Inventory and Management Plan, Marias River Basin, Montana" states water used in the Marias watershed region is mainly derived from surface water; however, ground water is more widespread and is also used for stock, domestic, municipal and irrigation purposes (Garvin 1975).

General Description of the Source Water

Chester obtains its water from Tiber Reservoir via intake pipes. Tiber Reservoir is an impoundment created in 1955 by the U.S. Bureau of Reclamation on the Marias River. The Reservoir covers approximately 17,800 surface acres. Maximum depth and length are 182 feet and 25 miles, respectively. The reservoir provides flood control, irrigation, recreation, and municipal water to the surrounding area. (Bennett, 1993) A U.S.G.S. gauging station (06101500) is located on the Marias River below Tiber Reservoir. Based on stream gauging data collected from 1921 through 2001, the mean monthly discharge at this station varies from 1691 cubic feet per second (cfs) in June to 405 cfs in January (U.S.G.S). The average annual streamflow recorded at this station from 1946 through 2000 varied from a low of 141 cfs in 1956 to a high of 1603 cfs in 1975.

The Public Water Supply

The Chester 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 975 residents via 470 active service connections (DEQ PWS AREV Database).

According to the most recent sanitary survey, Chester obtains its water from Tiber Reservoir via three-screened intake pipes at depths of 30, 60, and 90 feet. The raw water is pumped into two pre-sedimentation basins where it pumps to a dual train package plant. The plant consists of vertical flocculators, 60-degree tube settlers, and mixed media filtration with surface wash equipment. The filter production flows by means of gravity into a clearwell. Backwash waste and sludge accumulation is pumped to a decant basin. Decant water is pumped to the backwash ponds, then settled water is pumped to the pre-sedimentation ponds. High service pumps supply two 0.100 MG elevated tank.

Treatment processes include mechanical flocculation, tube settling, and multimedia sand filters. Alum, Chlorination, and Mangifloc 587-C flocculant are included in treatment. Copper sulfate is applied to holding ponds annually to reduce algae.

The distribution system in Chester is primarily composed of PVC. There are dead-end mains in the distribution system equipped with hydrants. Ninety-eight percent of the service lines are metered. An elevated water storage tank, constructed of steel in 1959, has a 100,000-gallon storage capacity. A drawing of the PWS distribution system configuration is located in Appendix A.

The Town of Chester PWS experiences peak production of about 1 million gallons per day (MGD) during the summer months and a low production of 0.125-MGD during the winter months.

Because Chester obtains its drinking water from Tiber Reservoir, a surface water supply, the source water sensitivity is classified as highly sensitive to contamination, in accordance with Montana Source Water Protection Program aquifer sensitivity criteria (DEQ 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.

Tiber Reservoir has been classified as B-2 water. Waters classified B-2 are 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, water fowl and furbearers; and agricultural and industrial water supply.

Total Maximum Daily Load (TMDL) streams are streams that have water quality impairments such as

numeric water quality standard exceedances or do not support specified uses such as aquatic life, fisheries, agriculture, or drinking water. The Dry Fork Marias River, from the headwaters to the mouth, is listed as a TMDL stream according to the 2000 TMDL 303(d) List. The water quality impairments and probable causes and sources of impairments for the Dry Fork Marias River have not been assessed by DEQ due to a lack of adequate data and information.

Eagle Creek, which discharges into Tiber Reservoir upstream of the Chester PWS intake, is listed on the 2000 TMDL 303 (d) List as an impaired stream (Figure 5). Eagle Creek is listed as partially supporting aquatic life and cold water fishery due to bank erosion, nutrients, habitat alterations, and riparian degradation. DEQ has identified probable sources of water quality impairment in Eagle Creek as agricultural, crop, and grazing related.

Background Tiber Reservoir Water Quality

Table 1. Dissolved constituent concentrations in the Marias River directly below the Chester PWS surface water intake were obtained from the U.S.G.S. gauging station, site number 06101500 (U.S. Geological Survey, NWIS, 2002).

Constituent	Sampling Dates (years)	Range of Dissolved Concentrations	MCL	MCLG	Secondary Standard
SO_4 (mg/l)	1981-1986	140-200	NA	NA	**250 mg/l**
NO_2 (as N)	1981-1986	0.010	**1 mg/l**	**1 mg/l**	NA
As (ug/l)	1981-1986	1.0-2.0	**0.05 mg/l**	NA	NA
Cd (ug/l)	1981-1986	1.0-4.0	**0.005 mg/l**	**0.005 mg/l**	NA
Cr (ug/l)	1981-1986	0-10.0	**0.1 mg/l**	**0.1 mg/l**	NA
Cu (ug/l)	1981-1986	1.0-5.0	NA	**1.3 mg/l**	**1.0 mg/l**
Fe (ug/l)	1981-1986	3.0-10.0	NA	NA	**0.3 mg/l**
Pb (ug/l)	1981-1986	0-6.0	**TT Action Level = 0.015 mg/l**	**zero**	NA
Se (ug/l)	1981-1986	1.0-2.0	**0.05 mg/l**	**0.05 mg/l**	NA
Ba (ug/l)	1981-1986	45.0-72.0	**0.2 mg/l**	NA	NA
Fl (ug/l)	1981-1986	0.2-0.3	**4.0mg/l**	NA	NA
Ni (ug/l)	1981-1986	0-50.0	**0.1 mg/l**	NA	NA
Hg (ug/l)	1981-1986	0-0.1	**0.002mg/l**	NA	NA
Turbidity (NTU)	1981-1986	0.4-20.0	**1 NTU not to exceed 0.3 NTU in 95% of daily samples in any month**	NA	NA
Total Dissolved Solids (tons/day)	1981-1986	222-2750	NA	NA	NA

Town of Chester PWS Water Quality

The Town of Chester's water is routinely monitored for compliance with drinking water standards. In the past five years, Chester PWS has received no violations with regards to water quality standards, nor has DEQ taken any enforcement actions against Chester PWS (DEQ PWS Database, AREV and SDWIS).

CHAPTER 2
DELINEATION

The source water protection area, the land area that contributes water to the Town of Chester public water supply, is identified in this chapter. This delineated area is subdivided into spill response and watershed regions, each with separate management goals. Potential contaminant sources are identified in Chapter 3. Relative susceptibility to significant potential contaminant sources is evaluated and management solutions are recommended in Chapter 4.

Hydrologic Conditions

The headwaters of the Marias are located approximately 20 miles southeast of Cut Bank where the Two Medicine River, Bank Creek, and other small streams meet. The Marias River flows from the northwest to the southeast, through Tiber Reservoir, and eventually combines with the Missouri River at Loma. The Marias River loses water via infiltration to the adjacent alluvium, evapotranspiration, and irrigation water withdrawals.

Using DEQ Source Water Protection Program criteria for ranking aquifer sensitivity (Table 2), Chester source water is considered highly sensitive to contamination. Sensitivity is defined as the relative ease with which contaminants can migrate to source water.

Table 2. 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

Contaminants if spilled directly into water bodies upstream or in the immediate vicinity of the Chester PWS surface water intake could potentially reach the intake before water operators could close it. Over a longer time frame, contaminants that accumulate throughout the watershed could be flushed in to the Tiber Reservoir during periods of spring run-off. Contaminants in groundwater can also enter the Tiber Reservoir in areas where it is hydraulically connected to shallow aquifers.

Methods and Criteria

DEQ's Source Water Protection Program specifies the methods and criteria used to delineate subregions of the source water protection area for Chester PWS intake. Because this is considered a surface water system, a spill response region and a watershed region have been delineated.

Delineation Results

Spill Response Region

In accordance with SWPP criteria (DEQ 1999), the spill response region for a surface water source represents an area 1/2-mile downstream and ten miles upstream from intakes and includes half-mile-wide buffers adjacent to all shorelines. An exception has been approved by the SWPP for the Chester PWS spill response region due to the size of Tiber Reservoir. Contaminants in a large reservoir experience a lesser lag time and corresponding dilution effects are greater. Therefore, the spill response region represents a one-half mile fixed radius circular area around the Chester PWS surface water intake location. The intake is located at 48.3311° latitude, -111.1272° longitude (Figure 4).

Watershed Region

The delineated watershed region extends upstream from the surface water intake to the watershed boundaries. Hydrogeologic mapping was utilized to encompass areas of surface water contribution to Tiber Reservoir, the Marias River, and Willow and Eagle Creeks. The resluts of the watershed region represent all the land within the topographic boundaries of the Lower-Missouri-Marias and Willow watersheds that contribute water to the Chester PWS intake (Figure 5).

Limiting Factors

The delineation method involves fixed-distance and watershed mapping. The spill response region represents an approximation of an area within which minimal dilution of an introduced contaminant concentration may occur within the reservoir before reaching the PWS intake. Numerous assumptions are associated with these SWPP criteria for spill response region delineations. Contaminant transport rates and concentrations will vary depending on river flow conditions, ground water flux into the river, contributions from overland flow, soil types, slope, characteristics of riparian vegetation, the extent of riparian vegetation buffer zones, the extent and duration of contamination, contaminant solution density, adsorption, mechanical dispersion, biological transformation, dilution, molecular diffusion, 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 Chester PWS to contamination, and to identify priorities for source water protection planning. These inventories were conducted within the spill response and watershed region assigned to the PWS. The inventory for the Town of Chester 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 Town of Chester PWS include metals, nitrate, pathogens, solvents, herbicides, pesticides, VOCs, SOCs, and petroleum hydrocarbons. The inventory for the Chester PWS also focuses on certain sites or land use activities in the spill response region, and 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) Agricultural lands
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

Town of Chester PWS surface water intake is located on grassland owned by the U.S. Bureau of Land Management. Land cover within the Chester spill response region consists of 60 percent water, 31 percent grasslands, and nine-percent agricultural land (row crops, small grains, and pasture/hay production). Mismanagement or over application of fertilizers and/or pesticides pose a potential threat to the Chester PWS due to the portion of land within the spill response region over which fertilizers and/or pesticides may be applied.

Low septic densities occur over the entire spill response region. No other significant potential contaminant sources listed above were noted in the Chester PWS Spill Response Region.

Table 3. Significant potential contaminant sources in the Spill Response Region for The Town of Chester PWS

Source	Address Or Map ID Number	Potential Contaminants	Hazard
Agricultural lands	See Figure 4	Nitrate, pathogens, SOC's, herbicides, and pesticides.	Spills or excessive application of Ag. Chemicals

Inventory Results/Watershed Region

Numbers on the map (Figure 5) identify the locations of potential contaminant sources in the watershed region, and correspond to Map ID numbers in Table 4. Agricultural lands occupy 53 percent of the watershed region. The other principal land covers in the watershed region are grassland (29%), and fallow ground (16%).

Low septic densities occupy 99.8 percent of the watershed region. The Chester municipal sewer, water treatment lagoon, and municipal landfill are located outside of the watershed region and therefore, do not pose any threat to the PWS (Figure 5).

Spills of fertilizers, pesticides, volatile organic compounds (VOCs), and synthetic organic compounds (SOCs) could occur along the BNSF railroad tracks, United States Highway 2, or Interstate 15 located inside the watershed region. Crude oil pipeline spills and breaks may release petroleum hydrocarbons into shallow

ground water. Numerous mines and USTs/LUSTs are located in the watershed region and may release metals and VOCs, respectively, to shallow ground water and/or surface water in the watershed region.

Two groundwater remediation sites and eight Montana Superfund sites were identified in the watershed region; petroleum hydrocarbons may be released from these sites (Figure 5). Numerous landfills may release a number of contaminants to shallow ground water hydraulically connected to surface water. Pathogens and nitrate originating from a gravel pit may infiltrate into shallow groundwater.

Permitted concentrated animal feeding operations, stormwater discharges, municipal sewage lagoons and wastewater treatment plants are located in the watershed region and may release various organic chemicals, petroleum hydrocarbons, nitrate, and pathogens (Figure 5).

Table 4. Significant potential contaminant sources in the watershed region for the Town of Chester PWS.

Source		Contaminant	Map ID Number	Hazard
Agricultural lands		SOCs, herbicides, and pesticides.	See Figure 5	Spills, excessive application of Ag. Chemicals, surface runoff
MPDES Permit Holders	Toole County Oil and Mining Stormwater Discharge	Various organic chemicals, petroleum hydrocarbons	1.a	Surface runoff discharge to Tiber Reservoir
	2 Industrial Stormwater Discharges	Various organic chemicals	1.b	Surface runoff discharge to tributaries of Tiber Reservoir
	5 Animal Feeding Operations	Nitrate, pathogens	2	Surface runoff discharge to Tiber Reservoir and/or tributaries
	2 Municipal Sewage Lagoons	Nitrate, pathogens	3	System failure system overload, untreated effluent infiltration into ground water
	3 Municipal Wastewater Treatment Plants	Nitrate, pathogens	4	System failure, system overload, untreated effluent infiltration into ground water
11 Landfills (9 closed, 2 open)		Metals, nitrate, pathogens, SOCs, VOCs	5	Infiltration of leachate into shallow ground water and subsequent discharging to Tiber Reservoir; unauthorized dumping
Burlington Northern Sante Fe Railway		Pesticides, fertilizers, VOCs, SOCs	6	Spills, stormwater runoff, infiltration into ground water
U.S. Highway 2/ Interstate 15		Pesticides, fertilizers, VOCs	7	Spills, stormwater runoff, infiltration into ground water
Crude Oil Pipeline		Petroleum hydrocarbons	8	Pipeline break, spills
8 Underground Storage Tanks		VOCs	See Figure 5	Migration of residual soil contamination into shallow ground water
25 Leaking Underground Storage Tanks		VOCs	See Figure 5	Migration of residual soil contamination into shallow ground water
Groundwater Remediation Site: Burlington Northern Derailment		Petroleum hydrocarbons	9	Poses no hazard to GW according to DEQ Groundwater Remediation Program personnel
Groundwater Remediation Site: Shelby Spill		Petroleum hydrocarbons	10	Infiltration into ground water: DEQ Groundwater Remediation Program ranks this site low priority.
Mines		Metals	See Figure 5	Spills
Gravel Pit		Nitrate, pathogens	11	Infiltration through exposed gravels into shallow ground water
8 Montana Superfund Sites		Petroleum hydrocarbons	See Figure 5	Contamination of Shallow Ground water

Inventory Update

The certified operators of the Chester 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 Chester'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 Chester and Liberty County.

The goal of source water management is to protect the source water 1) managing significant potential contaminant sources in the spill response region, and 3) ensuring 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 Chester 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 Chester's spill response region depends on whether contaminants can discharge directly to Tiber Reservoir located in the spill response region. Point source hazard is also dependent on the health affects associated with potential contaminants (Table 5). Hazard ratings for nonpoint sources are assigned based on criteria listed in Table 5 for septic systems, sanitary sewers, and cropped agricultural land. Barriers can be anything that decreases the likelihood that contaminated water will reach Chester's surface water intake. Examples of barriers include a vegetated riparian area, protective forest management practices, and dilution.

Table 5. Hazard of potential contaminant sources for the Chester public water system wells.

	High Hazard	**Moderate Hazard**	**Low Hazard**
Point Sources of Nitrate or Microbes	Potential for direct discharge to source water	Potential for discharge to groundwater hydraulically connected to source water	Potential contaminant sources in the watershed region
Point Sources of VOCs, SOCs, or Metals	Potential for direct discharge of large quantities from roads, rails, or pipelines	Potential for direct discharge of small quantities to source water	Potential for discharge to groundwater hydraulically connected to source water
Septic Systems	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
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

Table 6. 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

Susceptibility Assessment Results

The susceptibility assessment was completed for all significant potential contaminant sources in the spill response region and large significant potential contaminant sources in the watershed region. Table 7 displays the susceptibility assessment results for the Town of Chester PWS surface water intake and Figure 6 displays the location of those potential contaminant sources.

Agricultural lands – The potential hazard imposed by pathogens and nitrate originating from agricultural lands is moderate. Cropped agricultural lands constitute 53% of the watershed region, and 9% of the spill response region, falling between 20% and 50% of the region. The susceptibility of the intake to these agricultural sources of nitrate and pathogens is also moderate due to the dilution barrier.

Stormwater discharge – The Toole County oil and mining stormwater discharge is located approximately 11.5 miles upstream from the PWS intake on Tiber Reservoir; the hazard associated with this specific discharge is moderate due to its location on the surface water body. Due to dilution as a barrier, the susceptibility of the intake due to the Toole County discharge is moderate.

Active UST – An active UST is located near the shore of the reservoir and is considered a moderate hazard. This UST has the potential to contaminate Tiber Reservoir directly or by means of groundwater hydraulically connected to surface water. This active UST is required to have a leak detection system. The susceptibility due to this UST is low due to the following two barriers: the operation of a leak detection system and dilution in the reservoir.

Gravel pit – A gravel pit is located one mile from the intake point and 0.15 miles from the reservoir shore. The hazard posed by the gravel pit is moderate due to the potential for discharge of pit contaminants to underlying ground water that is hydraulically connected to reservoir surface water. The susceptibility due to the gravel pit is high because dilution does not act as a barrier for nitrate or pathogens.

Table 7. Susceptibility assessment for significant potential contaminant sources in spill response and large significant potential contaminant sources watershed regions for the Town of Chester PWS surface water intake.

Source		Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Agricultural lands		Nitrate, pathogens, SOCs, herbicides, and pesticides.	Spills, excessive application of Ag. Chemicals, surface runoff	Moderate	Dilution	Moderate	Educate landowners on the proper handling, storage, and disposal of pesticides and fertilizers; utilization of agricultural best management practices
MPDES	Toole County Oil and Mining Stormwater Discharge	Various organic chemicals, petroleum hydrocarbons	Surface runoff discharge to Tiber Reservoir	Moderate	Dilution	Moderate	Proper management of wastewater treatment system to ensure
Active Underground Storage Tanks		VOCs	Migration of residual soil contamination into shallow ground water	Moderate,	Dilution, Leak Detection System	Low	Monitor for releases to ground water
Gravel Pit		Pathogens, nitrate	Infiltration through exposed gravels into shallow ground water	Moderate	None	High	Implement stormwater best management practices

Susceptibility Assessment Limitations

The extent of the susceptibility assessment is limited to the significant contaminant sources currently inventoried within the spill response region. The introduction of new significant potential contaminant sources in the future would pose a hazard to the PWS intake. For example, if a concentrated animal feeding operation were established within the spill response region, the susceptibility of nitrate and pathogens originating from the newly established concentrated animal feeding operation would be very high due to the high sensitivity of the intake, hazard imposed by the contaminants, and lack of barriers.

Management Recommendations

The ultimate goal of SWPP and this SWDAR is to protect and benefit the Chester PWS from significant potential contaminant sources in the spill response region. Management recommendations are included in the susceptibility table for the Chester PWS (Table 7). If these management recommendations are implemented, they may be considered additional barriers that will reduce the susceptibility of Chester's surface water intake to specific sources and contaminants.

Management recommendations fall into the following categories:

- Agricultural best management practices
- Stormwater management
- Education
- Emergency Response Plan
- Sewer maintenance and leak detection
- Sewer extension

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.

Stormwater management – Stormwater planning should address source and drainage control. Source control can be accomplished through educational programs focussing 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 –Liberty County should compiled an Emergency Response Plan that incorporates the source water protection goals of the Chester PWS. 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.

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

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

Should contamination reach the Chester PWS intake, the City and County will likely need to work cooperatively to address remediation or relocation of the PWS source. Editorial contributions from the Chester PWS operator have been solicited and incorporated into this report.

Monitoring Waivers

Monitoring Waiver Requirements

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

Use Waivers

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

Susceptibility Waivers

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

Waiver Recommendation

Based on past monitoring results and the susceptibility assessment of the Chester PWS intake, the Chester PWS appears to be eligible for additional monitoring waivers. See Table 8 for the affect of identified potential contaminant sources on monitoring waiver eligibility for the Chester PWS. Currently, Chester has a monitoring waiver for Phase II and V inorganic chemicals (barium, cadmium, chromium, fluoride, mercury, and selenium; antimony, thallium, beryllium, and nickel). Chester may be eligible for a volatile organics and semivolatile organics waivers. For further monitoring waiver consideration, the Chester 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.

Table 8. The affect of identified potential contaminant sources on monitoring waiver eligibility for the Chester PWS. (Figure 6)

Source		Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Waiver Eligibility
Agricultural lands		Nitrate, pathogens, SOCs, herbicides, and pesticides.	Spills, excessive application of Ag. Chemicals, surface runoff	Moderate	Dilution	Moderate	May preclude waiver for some chemicals
MPDES	Toole County Oil and Mining Stormwater Discharge	Various organic chemicals, petroleum hydrocarbons	Surface runoff discharge to Tiber Reservoir	Moderate	Dilution	Moderate	May preclude waiver for some chemicals
Active Underground Storage Tank		VOCs	Migration of residual soil contamination into shallow ground water	Moderate,	Dilution, Leak Detection System	Low	May preclude waiver for some chemicals
Gravel Pit		Pathogens, nitrate	Infiltration through exposed gravels into shallow ground water	Moderate	None	High	No affect on waiver eligibility

REFERENCES

Bennett, David H. and Kristen M. Bennett, 1993. An Assessment of the Biological Effects of Potential Introduction of Cisco into Tiber Reservoir, Montana. Department of Fish and Wildlife Resources, College of Forestry, Wildlife and Range Sciences, University of Idaho. 2p.

Garvin, W. H. and M. K. Botz, 1975. Water Quality Inventory and Management Plan Marias River Basin, Montana. Montana Department of Health and Environmental Sciences, Environmental Sciences Division, Water Quality Bureau.

Liberty and Toole County Conservation Districts Long Range Resource Plan, 1976. Toole County and Liberty County Boards of Supervisors and U.S. Dept. of Agriculture, Soil Conservation Service. General Geology and Topography Map. Scale 1:580,000.

Montana Department of Environmental Quality, 1999. Montana Source Water Protection Program Document.

Rocky Mountain Association of Geologists, 1972. Geologic Atlas of the Rocky Mountain Region, United States of America, Denver, Colorado, 331p.

U.S. Geological Survey, 2000. National Landcover Dataset, Montana.

APPENDICES

APPENDIX A

TECHNICAL ASSISTANCE EVALUATION/FACILITY CONFIGURATION

APPENDIX B

SANITARY SURVEY

APPENDIX C

CONCURRENCE LETTER