Town of Big Sandy
Public Water System

PWS ID # MT0000150

Source Water Delineation and Assessment Report

Date of Report: 08/17/10

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Montana Department of Environmental Quality
with assistance from
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EXECUTIVE SUMMARY

Big Sandy's drinking water is currently supplied by four wells located northeast of town. A Wellhead Protection Plan was completed for Big Sandy in 1997. This Source Water Delineation and Assessment Report is intended to update and build upon the Wellhead Protection Plan to meet the requirements and guidance of the Federal Safe Drinking Water Act and the US Environmental Protection Agency, as well as a detailed Source Water Assessment Plan developed by a statewide citizen's advisory committee here in Montana. The Department of Environmental Quality (DEQ) is conducting these assessments for all public water systems in Montana. The purpose is to provide information so that the public water system staff/operator, consumers, and community citizens can implement strategies to protect your source of drinking water. The information that is provided includes the identification of the area most critical to maintaining safe drinking water, i.e., the Inventory Region, an inventory of potential sources of contamination within this area, and an assessment of the relative threat that these potential sources pose to the water system.

Based on the well logs and regional geology, sand and gravel channel material in the course of the ancestral Missouri River is providing water to the PWS's wells. In accordance with the Montana Source Water Protection Program criteria (1999), the aquifer (source water) is considered to have a moderate sensitivity to potential contaminant sources because the aquifer is semi-confined and is made up of semi-consolidated valley fill sediments. Sensitivity is defined as the relative ease that contaminants can migrate to source water through the natural materials.

Three types of source water protection management regions for the Town of Big Sandy public water system were mapped as part of this assessment. They are the control zone, inventory region and the recharge region. Potential sources of contamination were identified within each of these three regions and the results are as follows:

- The goal of management in the control zone is to avoid introducing contaminants directly into the water supply's well or immediate surrounding areas. The control zone is delineated as a 100-foot radius around each well and all sources of potential contaminants should be excluded in this region. Spills or leaks from vehicles and the occasional livestock in the pasture are potential contaminant sources identified.
- The inventory region should be managed to prevent contaminants from reaching the well before natural processes reduce their concentrations. The inventory region includes the area of land overlying the aquifer upgradient (southwest) of the wells that is expected to supply groundwater recharge to the well over the next three years. The only significant potential contaminant source identified within the inventory region is the limited area of cropland south east of the wells.
- The goal of management in the recharge region is to maintain and improve water quality over long periods of time or increased usage. The recharge region for the Town of Big Sandy wells includes the channel fill sediments upgradient (southeast) of the PWS wells. Significant potential contaminant sources identified in the recharge region include agricultural cropland, oil and gas test wells, and the septic systems, agricultural chemical use and businesses at the airport.

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. 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 flow to the public water supply well intakes. **The subsurface clay layers and aquifer depth (greater than 100 feet below surface) serve as barriers to downward migration so the overall susceptibility to the potential contaminant sources identified in the Inventory Region is ranked as very low. The water system**

and community should continue to implement the existing Wellhead Protection Plan and should consider potential risks to the protection area if future land use changes are made. Potential sources located outside the Inventory Region, but within the Recharge Region may still pose a threat over time, yet are not discussed in detail in this assessment. The susceptibility analysis provides the community and the public water system with information on where the greatest risk occurs and where to focus resources for protection of this valuable drinking water resource.

INTRODUCTION

This Source Water Delineation and Assessment Report (SWDAR) was prepared for the Town of Big Sandy Public Water Supply, PWS ID# MT0000150, located in Chouteau County. It was completed by Julie Harvey with the Source Water Protection Program at the Department of Environmental Quality and is based on the previous Wellhead Protection Plan completed by Montana Rural Water Association for the Town of Big Sandy. John Field, Big Sandy's water system operator, also provided additional assistance.

PURPOSE

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Town of Big Sandy Public Water System (PWS) as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (Public Law 104-182). The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is "delineation and assessment." Delineation is a process whereby areas that contribute water to aquifers or surface water bodies that are used to supply drinking water are identified on a map. These areas are called source water protection areas. Assessment involves identifying locations in the delineated areas where contaminants may be generated, stored, or transported, and then determining the relative potential for contamination of drinking water by these sources. The primary purpose of this source water delineation and assessment report is to provide information that helps Town of Big Sandy protect its drinking water sources.

LIMITATIONS

This report was prepared to assess threats to the Town of Big Sandy public water supply, and is based on published information and information obtained from local residents familiar with the community. The terms "drinking water supply" or "drinking water source" refer specifically to the source of the Town of Big Sandy public water supply and not to 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 Big Sandy public water supply are identified. Only potential sources of contamination in areas that contribute water to its drinking water source 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 constituents that do not have MCLs but are considered to potentially represent health threats.

CHAPTER 1
BACKGROUND

Note: The information provided in this chapter was originally provided in the Wellhead Protection Plan completed for Big Sandy by Montana Rural Water Association, Inc. (MRWS, 1997). The sections on Climate, the Public Water Supply and Water Quality; the figures; and some additional information (in italics) are provided by DEQ to update and amend the original text.

THE COMMUNITY

Big Sandy is an incorporated city located in north-central Montana, 10 miles south and west of the Bear Paw Mountains, 30 miles south of Havre and 90 miles northeast of Great Falls(*Figure 1*). The water system serves *730* people with *344* hook-ups. The major employers in Big Sandy provide services to the local agricultural community, with several grain elevators and seed distributors in Town. Highway 87 bisects the Big Sandy between Havre and Great Falls as it parallels the Burlington Northern railroad tracks.

GEOGRAPHIC SETTING

Big Sandy is located in the Glaciated Missouri River Plateau of the Great Plains Physiographic Province. The bedrock geology consists of Cretaceous shales and sandstone that were deposited when the region was part of a shallow sea. The sedimentary geology consists of alluvial and colluvial deposits. The Town sits in the abandoned Valley of the Missouri River. Nine miles south of Big Sandy the Missouri flows east through a new channel that was cut around 70,000 years ago when glaciers blocked this channel. The broad rolling plain rises over 200 feet above the Town and is covered with large wheat fields.

CLIMATE

Information on climate in the Big Sandy area is shown in Table 1 and is based on the National Oceanic and Atmospheric Administration's (NOAA) Big Sandy climate station located at an elevation of 2,700 feet above mean sea level (Western Regional Climate Station).

Table 1. Period of Record Monthly Climate Summary

BIG SANDY, MONTANA (240770) Period of Record : 9/ 1/1921 to 12/31/2003

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	28.5	34.5	44.8	59.8	70.8	77.8	88.0	86.2	74.5	62.4	43.8	32.4	58.6
Average Min. Temperature (F)	4.2	9.5	19.2	30.8	40.6	47.8	53.0	50.6	41.0	31.1	17.9	8.5	29.5
Average Total Precipitation (in.)	0.44	0.37	0.53	0.93	2.13	2.67	1.43	1.29	1.27	0.66	0.51	0.55	12.77
Average Total SnowFall (in.)	3.8	3.2	3.9	0.6	0.1	0.0	0.0	0.0	0.2	0.6	3.2	4.1	19.7
Average Snow Depth (in.)	2	2	1	0	0	0	0	0	0	0	1	2	1

GENERAL DESCRIPTION OF THE AQUIFER

Big Sandy sits in the pre-ice-age channel of the Missouri River. The channel was abandoned when glaciers prevented the Missouri River from flowing north toward Havre. The River created a new channel that flowed east around the south side of the Bear Paw Mountains. When the glaciers retreated they deposited so much debris (moraine) in the original channel that the River stayed in the new channel. Big Sandy Creek flows west off the Bear Paw Mountains and then north in the former Missouri River channel just east of Big Sandy.

The wells for Big Sandy are east of Big Sandy Creek and northeast of town. The Quaternary sedimentary materials, in which the wells are completed, were deposited by flowing water (streams) and glaciers. The wells tap a sand and gravel aquifer at about 130 feet below the surface. *The sand and gravel zone is reported to be about 27 feet thick for the North well, 18 feet thick for the South Well and 5 feet thick for the Sand Well and is located at the base of the alluvium in the former Missouri River Channel. The aquifer is underlain by the Claggett Shale at approximately 141 to 144 feet below surface.*

The aquifer is locally semi-confined. The overall groundwater flow direction in the vicinity of the wells is towards the northeast parallel to the former Missouri River channel; however, there is likely significant seasonal variation in the east/west component of groundwater flow. Recharge to the wells is likely from infiltration of precipitation and local surface water through the overlying alluvial materials in the valley. Additional detail on the geology and hydrogeology of the area is provided in Chapter 2.

THE PUBLIC WATER SUPPLY

The town of Big Sandy is classified as a community public water system (PWS) since it serves at least 25 of the same people every day. DEQ lists four active sources that supply the public water supply: The North Flats Well, South Flats Pumphouse Well, the Sand Flats Well and the Pasture Blew Top Well. The well locations are shown on Figure 1.

The water main runs south from the wells and then west into town. Water is pumped through town and then to a storage tank northwest of town. Valves are located so that each well and the storage tank can be isolated from the distribution system. The water from the North Well is currently chlorinated prior to distribution and additional chlorination facilities are planned for construction in 2004 so the water from the other wells can also be chlorinated. The Town can also add polyphosphate to the water to control the precipitation of manganese and iron.

A preliminary assessment of groundwater sources under the direct influence of surface water (GWUDISW) has not been completed for the Big Sandy PWS based on DEQ's PWS Section files. However, it is unlikely that the source water is in hydraulic connection with surface water based on the previous water quality monitoring data, depth of the wells, static water levels, and distance to surface water.

WATER QUALITY

Every PWS is required to perform monitoring for contamination to their water supply. The monitoring constituents include coliform and other signs of pathogenic organisms, nitrates, metals and multiple organic chemicals. The monitoring schedule depends on many factors such as the size and source water for a PWS, the number of sources (e.g. wells), and the population served. Each PWS has a specific monitoring program tailored to their system that follows the general protocols for operation of a PWS defined by DEQ. The monitoring schedule for Big Sandy is available at http://nris.state.mt.us/wis/swap/swapquery.asp. The Big Sandy PWS monitoring data from DEQ's PWS database for the past five years was reviewed and is summarized in this section.

Confirmed detections of total coliform have not been detected in the source water. The only compounds detected in Town of Big Sandy's source water monitoring over the past 5 years include low levels of nitrate + nitrite (0.02 to 0.17 mg/L), radium 226 (0.3 pCi/L), gross alpha (5.1 pCi/L), fluoride (0.3 mg/L), arsenic (0.011 mg/L), iron (0.29 mg/L) and manganese (0.19 mg/L), sodium (109 mg/L), and sulfate (76 to 799.8 mg/L). These detections are all below EPA primary maximum contaminant levels (MCLs) where established. (The primary MCL for arsenic will be lowered to 0.010 mg/L in 2006).

National secondary drinking water standards (SMCLs) are non-enforceable guidelines regarding contaminants that may cause cosmetic effects (such as taste, odor, or color) and are generally not a health risk. The SMCLs for sulfate and manganese were exceeded at least once and the concentration of iron detected in close to the SMCL of 0.3 mg/L. Although the sodium concentrations detected do not exceed the SMCL of 250 mg/L, water systems having greater than 20 mg/L of sodium in their drinking water source are encouraged to inform their customers of the presence of this constituent so that those individuals on a physician-prescribed low-sodium diet can inform their doctors of this source of sodium in their diet. Additional groundwater sampling data collected to characterize background groundwater quality was not identified for the Big Sandy area.

Figure 1. Vicinity Map and PWS Well Field Locations

CHAPTER 2
DELINEATION

The source water protection area, the land area that contributes water to the Town of Big Sandy PWS is identified in this chapter. Three management areas are identified within the source water protection area. These three regions, the control zone, inventory region, and recharge region, are delineated for the wells. The control zone, also known as the exclusion zone, is an area at least 100-foot radius around each well. The inventory region represents the zone of contribution of the well, which typically approximates a three-year groundwater time-of-travel. Analytical equations describing groundwater flow using estimates of pumping and aquifer characteristics and simple hydrogeologic mapping are used to calculate groundwater time-of-travel distance. The recharge region represents the area where the source aquifer for the Town of Big Sandy water system wells is replenished.

GEOLOGIC CONDITIONS AND AQUIFER CHARACTERISTICS

From the (MRWS, 1997):

> "Big Sandy uses *four* wells located northeast of town and east of Big Sandy Creek. The wells are completed in the alluvial-colluvial sediments of the pre-glacier channel of the Missouri River. The channel has been filled in with intermixed layers of clay, silt, sand and gravel deposited by reworking glacial and melt-water runoff deposits. The east side of the Big Sandy Creek Valley consists mainly of broad gently sloping alluvial fans of streams originating in the Bear Paw Mountains (Lindvall, 1956). The wells tap a sand and gravel aquifer 130 below the surface. The sediments have moderate permeability and the aquifer has a limited extent. John Fields reports that both wells cannot be run at the same time, without partially dewatering the aquifer. The aquifer recovers over time as groundwater infiltrates from the surrounding formations."

A regional geologic map is provided in Figure 2. The high static water levels indicate that the aquifer is locally semi-confined, however, for the purpose of this assessment, the aquifer is considered unconfined since the overlying clayey materials may not be laterally continuous due to the nature of alluvial deposition. The overall groundwater flow direction in the vicinity of the wells is towards the northeast parallel to the former Missouri River channel; however, there is likely significant seasonal variation in the east/west component of groundwater flow. Recharge to the wells is likely from infiltration of precipitation and local surface water through the overlying alluvial materials in the valley.

Figure 2*. *Geology of the Big Sandy Area

PWS SOURCE WELLS

The wells are located approximately 1 mile northeast of town as shown on Figure 1. The well logs are provided in Appendix A and information from the logs is provided in Table 2. Based on correspondence dated December 11, 2002 in DEQ's files from John Field, the Big Sandy PWS operator, the primary well is the north well which is rated at 250 gpm. The North Well is typically pumped 7 to 9 hours per day in the summer as additional pumping causes excessive drawdown in the well and the production of sand. The South Well is rated at 200 gpm but is used very little since it appears to be screened in the same limited aquifer as the North Well and there is interference when pumping both wells at the same time. The Blew Top Well is used from mid-April to September and pumps 70 gpm about 16 hours per day. The Sand Well is used from mid-May to September and pumps about 70 gpm for 10 to 12 hours per day.

Table 2. Summary of Well Log Information for PWS Production Wells

	North Well	South Well	Sand Well	Blew Top Well
PWS Source Code	WL006 (Pasture Blew Top)	WL007 (South Flats Pumphouse)	WL008 (Sand Flats)	WL005 (Pasture Blew Top)
Well Location	NW¼, SE¼, Sec.17, T28N, R13E	NW¼, SE¼, Sec.17, T28N, R13E	NW¼, SE¼, Sec.17, T28N, R13E	SW¼, SW¼, Sec.17, T28N, R13E
DNRC Water Right	P041781-00	P041799-00	Not listed	Not listed
Well Elevation	Approx. 2,685 feet	Approx. 2,687 feet	Approx. 2,687 feet	Approx. 2,690 feet
Date Completed	12/1980	11/29/1976	7/19/1974	
Total Depth (bgs)	144.5 feet	142 feet	240 feet	135 feet
Well Completion: Casing	12-inch steel from 0-25 feet 8" steel from –2.5 to 136 feet bgs	8" steel from –3 to 125 feet bgs	6" steel from 0 to 240 feet bgs	6" steel from –2 to 135 feet bgs
Well Completion: Screen	8" diameter 100-slot SS screen from 135.4 to 144.5 feet in gray sand with considerable amount of fine sand and large gravel and with some coarse sand and pea gravel	8" diameter slotted screen from 124 to 142 feet in gravel and sand with some clay streaks and occasional coal	1/8" slots from 128 to 133 feet in sand and gravel	No completion records available
Well Completion: Annular Seal	0-25 feet, bentonite	0-38 feet, Type V Cement	No seal records available	No seal records available
Static Water Level (at time of drilling)	31 feet bgs	-2 feet (2 feet above ground surface)	Not recorded	Not recorded
Well Pump Test Data	102 feet of drawdown after 2 hours of pumping at 300 gpm.	97 feet of drawdown after 36 hours of pumping at 225 gpm.	Pumping water level of 125 feet after 2 hours of pumping at 30 gpm	35.43 feet of drawdown after 11 hours of pumping at 770 gpm

Notes: bgs – below ground surface; gpm – gallons per minute
DNRC – Montana Department of Natural Resources and Conservation

CONCEPTUAL MODEL AND ASSUMPTIONS

The Town of Big Sandy's active production wells are located in the Big Sandy Creek watershed (USGS Hydrologic Unit Code 10050005) which is located within the Lower Missouri River Watershed Management Region for Montana. The source of Town of Big Sandy's drinking water is interpreted to be buried sand and gravel channel material that was deposited in a former channel of the Missouri River. The aquifer is locally semi-confined and may be unconfined in other areas of the channel. The overall groundwater flow direction in the vicinity of the wells is towards the northeast parallel to the former Missouri River channel; however, there is likely significant seasonal variation in the east/west component of groundwater flow. Recharge to the wells is likely from infiltration of precipitation and local surface water through the overlying alluvial materials in the valley.

Using DEQ Source Water Protection Program criteria for ranking aquifer sensitivity (Table 3), the Town of Big Sandy source water is considered as having **Moderate Source Water Sensitivity** to contamination because the aquifer is semi-confined to unconfined and is an unconsolidated alluvial aquifer. Sensitivity is defined as the relative ease that contaminants can migrate to source water.

Table 3. Source Water (Aquifer) Sensitivity Criteria

based on DEQ Source Water Protection Program Criteria (DEQ, 1999)

High Source Water Sensitivity	**Moderate Source Water Sensitivity**	**Low Source Water Sensitivity**
• Surface water and GWUDISW • Unconsolidated Alluvium (unconfined) • Fluvial-Glacial Gravel • Terrace and Pediment Gravel • Shallow Fractured or Carbonate Bedrock	• Semi-consolidated Valley Fill sediments (semi-confined) • Unconsolidated Alluvium (semi-confined)	• Consolidated Sandstone Bedrock • Deep Fractured or Carbonate Bedrock • Semi-consolidated • Confined Aquifers

DELINEATION

Methods and criteria for delineating source water protection areas are specified in the Montana Source Water Protection Program (DEQ, 1999). Source water protection areas delineated for the Big Sandy PWS include controls zones for each well and an inventory/recharge region. The delineated management zones for the wells are shown on Figure 3.

Control Zones - The control zone is *(also known as the well exclusion zone in the Wellhead Protection Plan)* is delineated as a 100-foot radius around each well. All sources of potential contaminants should be excluded in this region.

Inventory Region *- (called the "Special Protection Region" in the Wellhead Protection Plan)* - For the Big Sandy wells, the DEQ's Source Water Protection Program criteria for an unconfined aquifer system was followed. The inventory zone was delineated based on a groundwater time-of-travel (TOT) distance of three years[1]. This distance was determined using a simple ground water flow model using the uniform flow equation (EPA, 1991). Conservative estimates for aquifer properties were made using available data from published reports and the information on the well logs. The results of the calculations (Appendix B) indicate an estimated distance of approximately 4,300 feet for a three-year TOT for the North, South and Sand Wells and 3,500 feet for the Blew Top Well[1]. A summary of the time of travel calculations is included in Appendix B. All sources of potential contaminants are inventoried in this region.

Recharge Region – The recharge region *(called the "Protection Region" in the Wellhead Protection Plan)* for the Town of Big Sandy wells includes the alluvial channel material upgradient (southwest) of the PWS wells. The upgradient extent of the outwash channels mapped by Lopez (2002) (Figure 2) is shown on Figure 3 as the recharge boundary. The inventory for the recharge region focuses on general land uses and large industrial facilities. The goal of management in the recharge region is to maintain and improve the long-term quality of groundwater in the aquifer.

LIMITING FACTORS

Delineation of the source water protection areas for the Town of Big Sandy PWS wells is based on published reports and lithology indicated on the well logs. The Uniform Flow Equations used in the delineation of the inventory region assume the aquifer is infinite in extent and that flow is isotropic (horizontal only) and homogenous (uniform composition). Neither assumption exists in nature but the modeling effort merely represents the best estimate of groundwater flow conditions based on known and estimated hydrogeologic and pumping conditions. The delineation could be modified as additional information becomes available. The interaction of surface water with the alluvial channel deposits is not completely understood and the changes in the flow regime under seasonal conditions are not known. The delineation was completed using conservative assumptions to help ensure that the inventory zone reflects the actual area where contamination to the system may occur.

Figure 3. Inventory and Recharge Regions

[1] The special protection region calculated in the Wellhead Protection Plan included a zone of contribution to the North and South wells for a distance of 3,017 feet upgradient, which approximated a time of travel of five years. There was an error in the calculation so the distance was recalculated for this Source Water Delineation and Assessment Report resulting in a larger Inventory Region/Special Protection Region. For this assessment, the delinieation area was reduced to approximate a 3-year time-of-travel area which is in accordance with the Montana SWPP (1999) and the area was expanded to include the Blew Top Well. The original calculation and the new calculations are provided in Appendix B.

CHAPTER 3
INVENTORY

INVENTORY METHOD

An inventory of significant potential contaminant sources was conducted to assess the susceptibility of Town of Big Sandy's wells to contamination and to provide a foundation for source water protection planning. The inventory for Town of Big Sandy focuses on facilities that generate, use, or store potential contaminants and certain land uses in the inventory region delineated in the previous section. Sources of all primary drinking water contaminants and pathogens are identified, although only potential sources of contaminants that are the greatest threat to human health were selected for detailed inventory.

It is important to remember that the sites and areas identified in this section are only potential sources of contamination to the drinking water. Contamination of the drinking water is not likely to occur when potential contaminants are properly used and managed. Not all of these inventoried activities pose actual high risks to your public water supply. The day-to-day operating practices and contamination awareness varies considerably from one facility or land use activity to another.

The inventory for the Town of Big Sandy PWS focuses on all activities in the control zones for the wells; certain types of municipal and private facilities or land uses in the inventory region; potential sources of nitrates and pathogens in the surface water buffer; and general land uses and large facilities in the Recharge Region. Databases were searched to identify businesses and land uses that are potential sources of regulated contaminants. The process for completing the inventory included several steps, which are summarized as follows:

Step 1: Urban and agricultural land uses were identified from the U.S. Geological Survey's Geographic Information Retrieval and Analysis System (http://nris.state.mt.us/gis/datalist.html). Sewered and unsewered residential land uses were identified from boundaries of sewer coverage obtained from municipal wastewater utilities.

Step 2: EPA's Envirofacts System (http://www.epa.gov/enviro/) was queried to identify EPA regulated facilities located in the inventory region. This system accesses facilities listed in the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) and the Permit Compliance System (PCS - for Concentrated Animal Feeding Operations with MPDES permits). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility should be classified as a significant potential contaminant source.

Step 3: Databases were queried to identify the following in the inventory region:

- Underground Storage Tanks (UST) (http://www.deq.state.mt.us/UST/USTDownloads.asp)
- Hazardous waste contaminated sites (DEQ hazardous waste site cleanup bureau),
- Landfills (http://nris.state.mt.us/gis/datalist.html), and
- Abandoned and active mines including gravel pits (http://nris.state.mt.us/gis/datalist.html)

Any information on past releases and present compliance status was noted.

Step 4: A business phone directory was queried 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 Classification (SIC) code.

Step 5: Major road and rail transportation routes were identified throughout the inventory region (http://nris.state.mt.us/gis/datalist.html).

Step 6: A windshield survey was conducted to identify potential contaminant sources as part of the Wellhead Protection Plan due to the isolated nature of the area around the wells. In addition, public water system officials, or someone they designated as knowledgeable of the area, were interviewed to identify potential sources that are not listed in databases or on maps elsewhere (such as animal feeding operations that are not required to obtain a permit) and to assist in locating potential sources listed in the state and federal databases.

Step 7. Significant potential contaminant sources were identified in the control zone and inventory region and land uses and facilities that generate, store, or use 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. Underground storage tanks.
4. Known groundwater contamination (including open or closed hazardous waste sites, state or federal superfund sites, and UST leak sites).
5. Underground injection wells.
6. Major roads or rail transportation routes.
7. Cultivated cropland greater than 20 % of the inventory region.
8. Animal feeding operations.
9. Wastewater treatment facilities, sludge handling sites, or land application areas.
10. Septic systems.
11. Sewer mains.
12. Storm sewer outflows.
13. Abandoned or active mines

CONTROL ZONE INVENTORY RESULTS

The area surrounding the wells is a combination of pasture and marsh. Big Sandy Creek runs between the wells and town and there is no development east of the Creek. The wells are sited on a road/dike several feet above the surrounding marsh/pasture (Wellhead Protection Plan, MRWS, 1997). The North, South and Sand wells have fencing around them. The PWS has easements for the 100-foot control zone for the wells which consists of primarily open field/grassland. The Control Zone includes the road that is used to access the wells and the marsh/pasture. Spills or leaks from vehicles and the occasional livestock in the pasture (especially around the Blew Top Well) are potential contaminant sources identified in the Wellhead Protection Plan (MRWS, 1997).

INVENTORY REGION RESULTS

The inventory results for Town of Big Sandy's source water are summarized in Table 4 and are shown on Figure 4 and Figure 5. Land cover in the inventory region for the Town of Big Sandy PWS primarily grasslands (87%) and agricultural croplands (12%) The low percentage of agricultural land poses a low hazard to the water supply based on the Montana Source Water Protection Guidance Manual (1999).

The only other potential source of contaminants identified in the inventory region is an oil/gas test well that is located near the Blew Top Well. This test well is listed as a "development well with no production" and is likely a low risk to the water supply.

Table 4. Summary of Potential Contaminant Sources in the Control/Inventory Region

Source Type	*Potential Contaminants*	*Description/Concern*
Land Use Cover (Step 1)		
Agricultural Crop Land (12%)	Nitrate and SOCs from fertilizer, pesticides and herbicides. Pathogens (if grazing occurs)	Over-application or improper handling of pesticides or fertilizers on agricultural lands could result in these compounds entering groundwater and impacting the drinking water supply. Excessive irrigation may cause increased transport of contaminants to groundwater. Improper storage and management of animal wastes may impact drinking water supply.
EPA Envirofacts Sites (Step 2)		
None identified		
DEQ Databases (Step 3)		
None identified		
Business – SIC Code Sites (Step 4)		
None identified		
Miscellaneous Others, including Step 5 and 6		
Occasional vehicle traffic and livestock in the control zone	Petroleum products, nitrates and pathogens.	Spills or leaks of automotive fluids and improper management of animal wastes may impact drinking water supply.
Oil and Gas test well	Total dissolved solids, petroleum products.	Improperly sealed or abandoned wells may facilitate contaminant transport to shallow or deeper aquifers.

Notes: Individual sites identified are evaluated in Chapter 4.

Figure 4. Land Use in the Protection Areas

Figure 5. Potential Contaminant Sources in the Protection Areas

RECHARGE REGION RESULTS

Land use in the recharge region is reported in the 1992 National Land Cover dataset (Figure 4) to be primarily grasslands and pasture land (approximately 60%) and agricultural croplands (33%) with the remaining 7% of the land use being residential/commercial/ transportation, pasture/hay, open water/wetlands, and mixed forest. Grasslands/pasture are not considered potential sources of contamination unless there are significant grazing operations in the area. The agricultural land is considered a moderate potential risk to the drinking water supply.

Other potential sources of contamination are shown in Figure 5 and include septic systems and businesses at and near the airport. Improper location, operation and maintenance of septic systems can be a source of pathogens and nitrate to the groundwater.

The airport or other businesses within the recharge region may be potential contaminant sources based on their potential to use or generate hazardous chemicals in the area. The facilities with a Big Sandy address (based on Standard Industrial Codes (SICs)) are summarized in Appendix C. Businesses associated with the airport and Ezzie's Wholesale (gas station) appear to be the only businesses identified in the recharge region. The airport is used by crop spraying planes. Significant agricultural chemical usage, handling and storage occurs at the airfield, which can pose a high hazard to groundwater.

Several facilities with a Big Sandy address were identified on DEQ's underground storage tank (UST) and Leaking UST lists (Appendix C). The sites with active USTs do not appear to be located in the recharge region. There were 65 facilities with a Big Sandy address that were listed on DEQ's UST list as having inactive USTs. Based on the addresses given, only a couple of these facilities appear to be located within the recharge region (Big Sandy Airport, Triangle Aviation and Robertson Oil Co./Ezzie's Wholesale):

- Ezzie's Wholesale is listed as an active UST location. Spills or improper handling during tank filling or product distribution at active facilities may impact the drinking water supply.
- Big Sandy Airport, Triangle Aviation, and Robertson Oil Co. are listed as having inactive USTs. DEQ classifies inactive USTs as temporarily out of service and requires that the product in the tank be removed. However, testing of the tanks, distribution lines or soils around the tank is not required to evaluate the potential for historic leaks or spills that may impact subsurface soils and groundwater.
- Robertson Oil and Triangle Aviation are also on DEQ's Leaking UST list. The Robertson site is still active in the Leaking UST program but the Triangle Aviation site is listed as "closed" which indicates no further action is being undertaken at this time. Existing contamination from spills, leaks, or improper handling of stored materials may impact the drinking water supply.

Additional point sources of potential pollutions (such as businesses or facilities listed on regulatory databases) were not identified in the recharge region.

INVENTORY UPDATE

To make this SWDAR a useful document for the years to come, the certified water system operators should update the inventory for their records every year. Changes in

land uses or potential contaminant sources should be noted and additions made as needed. The complete inventory should be submitted to DEQ every five years to ensure the source water delineation and assessment remains current.

INVENTORY LIMITATIONS

The potential contaminant sources described above are identified from readily available information. Consequently, unregulated activities or unreported contaminant releases may have been overlooked. The use of multiple sources of information, however, should ensure that the major threats to the source water for Big Sandy's public water supply have been identified. The lack of identification of a potential contaminant source in the inventory or susceptibility assessment of this report does not mean that the potential for contamination does not exist or there is not a threat. It is highly recommended that the PWS and community "enhance" or refine the identification of the potential contamination sources through further research and local input.

CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

GENERAL DISCUSSION

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose a concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case the Town of Big Sandy PWS managers and operators. The goal of Source Water Management is to protect the source water by 1) controlling activities in the control zone, 2) managing significant potential contaminant sources in the inventory region, and 3) ensuring that major land use activities or other significant activities in the recharge region pose minimal threat to the source water. Management priorities in the inventory 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 PWS managers and operators to reduce susceptibility are recommended in this chapter.

HAZARD DETERMINATION

The proximity of a potential contaminant source to a spring or well intake, potential contaminant migration pathways, or the density of potential non-point contaminant sources determines the threat of contamination, referred to here as hazard (Table 5). Hazard and the existence of barriers to contamination determine susceptibility, which is described in Table 6. Table 5 below describes the criteria to determine hazard within the inventory region as it was delineated in this SWDAR. Note that this table is specific to PWSs that draw their water from unconfined aquifers. The determination of hazard is somewhat different for other types of water sources.

Table 5. Hazard of Potential Contaminant Sources for Wells Drawing Water from Unconfined Aquifers

Type of Potential Contaminant Source	High Hazard	Moderate Hazard	Low Hazard
Septic System Density (# per square mile)	More than 300 septic systems per sq. mile	Between 50 and 300 septic systems per sq. mile	Less than 50 septic systems per sq. mile
Municipal or Community Sanitary Sewer (% land use)	More than 50 percent of the inventory region	Between 20 and 50 percent of the inventory region	Less than 20 percent of the inventory region
Cropland (% land use)	More than 50 percent of the inventory region	Between 20 and 50 percent of the inventory region	Less than 20 percent of the inventory region
Point sources of all contaminants	Within 1-year TOT	1-3 years TOT	Over 3-year TOT

DISCUSSION OF SUSCEPTIBILITY

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 flow to the Town of Big Sandy PWS well intakes (Table 6).

Table 6. Susceptibility Based on Hazard and Barriers

Presence Of Barriers	Hazard		
	High	**Moderate**	**Low**
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

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

The low permeability clay layers that were identified in the well logs serve as a natural barrier to potential contaminant sources for the Big Sandy source water. In addition, the aquifer depth of over 100 feet serves as a barrier to potential contaminant sources. A summary of the susceptibility assessment for Town of Big Sandy PWS production wells is located in Table 7.

Because a contaminant source has not been identified in the inventory or susceptibility assessment of this report, it doesn't mean that the potential for contamination does not exist or is not a threat. Table 7 only includes the potential contaminant sources identified in Chapter 3 that were determined to present a <u>significant</u> potential risk to the drinking water supply. Low risk potential sources such as the oil and gas test well in the inventory region or the grazed grasslands were not included. It is highly recommended that the PWS operator and community members familiar with the nature of businesses and land use in the area enhance the inventory through further research and local input.

Table 7. Susceptibility Assessment of Significant Potential Contaminant Sources

Potential Contaminant Source	Potential Contaminants	Hazard	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Inventory Region						
Agricultural Crop Land (12%)	Nitrate and SOCs from fertilizer, pesticides and herbicides. Pathogens (if grazing occurs)	Contaminants leaching into groundwater	***Low***	- Clay layers overly the aquifer near the wells - Aquifer depth >100 feet	***Very Low Susceptibility***	Encourage use of agricultural best management practices (BMPs) in the inventory and recharge region
Occasional vehicle traffic and livestock in the control zone	Petroleum products, nitrates and pathogens.	Contaminants leaching into groundwater	***Low***	- Clay layers overly the aquifer near the wells - Aquifer depth >100 feet	***Very Low Susceptibility***	Ensure that potential sources of contamination are excluded from the control zone and that positive drainage away from each well casing is maintained.
Recharge Region						
Agricultural Crop Land (33%)	Nitrate and SOCs. Pathogens (if grazing occurs)	Contaminants leaching into groundwater	***Moderate***	- Clay layers overly the aquifer near the wells - Aquifer depth >100 feet	***Not Rated –*** *outside the inventory region*	Encourage use of best management practices (BMPs)
Oil and Gas Test Wells	Total dissolved solids and petroleum hydrocarbons	Improperly sealed or abandoned wells may facilitate contaminant transport to aquifers	***Low***	- Drilling locations appear to be test holes with no production. - Number of oil and gas test holes does not appear to be large. - Aquifer depth >100 feet	***Not Rated –*** *outside the inventory region*	Encourage monitoring of drilling activities and oil field development.
Big Sandy Airport area septic systems	VOCs, SOCs, metals, pathogens, nitrates, others	Ongoing or catastrophic leakage of sewage into groundwater	***Low***	- Distance from the PWS well(s) - Clay layers overly the aquifer near the wells - Aquifer depth >100 feet	***Not Rated –*** *outside the inventory region*	Maintenance, rehabilitation, or replacement of existing sewer mains, use of sewer main liners, rapid response planning for leaks or ruptures.
Big Sandy Airport Triangle Aviation Robertson Oil Ezzie's Wholesale (active and non-active USTs, leaking UST, agricultural chemical and other chemical use, storage, and handling)	Pesticides, herbicides, VOCs, petroleum products	Leaks, spills and improper handling of pesticides, fertilizers and petroleum products may impact drinking water source.	***Low***	- Most handle only small volumes of potential contaminants - Clay layers overly the aquifer - Aquifer depth >100 feet	***Not Rated –*** *outside the inventory region*	**For USTs:** Review permit status for USTs and ensure proper operation and maintenance. Tank and line integrity testing, soil testing to evaluate potential impact from historic spills or leaks. Encourage proper removal USTs if out-of-service. **For agricultural chemical and other chemical use areas:** Pollution prevention education; training in waste reduction, handling and recycling; regulatory oversight; promotion of good housekeeping. Emergency planning, training of local emergency response personnel.

Notes: VOCs - Volatile organic compounds (i.e. solvents, fuel components)
SOCs - Synthetic Organic Compounds (i.e. pesticides, herbicides, plasticizers)
UST – Underground Storage Tank

The susceptibility assessment results for each significant potential contaminant source identified within the Inventory Region are described below. Sources located outside the Inventory Region, but within the Recharge Region may still pose a threat over time, but are not discussed in detail.

Agricultural cropland – The potential hazard imposed by nitrates, pesticides and pathogens originating from agricultural lands is low based on the percent of the total land use in the inventory region. The clay layers and aquifer depth serve as barriers to downward migration so the overall susceptibility is ranked as very low.

Occasional vehicles and livestock in the control zone - The potential hazard imposed by fuels, nitrates, and pathogens originating from vehicles or livestock is low based on the infrequent occurrence. The clay layers and aquifer depth serve as barriers to downward migration so the overall susceptibility is ranked as very low.

MANAGEMENT RECOMMENDATIONS

It should be noted that even small releases of some chemicals in close proximity to a public water supply well can have significant negative impact on water quality, and therefore are a significant threat to the public water supply. Steps can be taken to reduce the likelihood of releases in the source water for the PWS or in the vicinity of the sources. Some of these management recommendations are detailed in the susceptibility table for the Town of Big Sandy PWS (Table 7). If these, and other, management recommendations are implemented; they may be considered additional barriers that will reduce the susceptibility of the intake to specific sources and contaminants.

Continue to Implement the Existing Wellhead Protection Plan. Big Sandy should continue to implement the recommendations in the existing Wellhead Protection Plan (the Management and Contingency Plan sections of this report are provided for reference in Appendix D). At a minimum, the water system operator and other parties interested and/or knowledgeable of the area should meet annually to verify the existing conditions and update the management and emergency response plan if warranted.

Continue to Restrict Chemical Handling, Use and Storage in Control Zones– Big Sandy should restrict chemical handling, use and storage within the control zones for the production wells (including pesticides and herbicides). Ongoing training to promote safe handling and proper storage, transport, use, and disposal of hazardous materials should be provided if these materials are used in the control zone.

Agricultural Best Management Practices (BMPs) – The water system should encourage local land users to utilize BMPs that (1) address application and mixing of fertilizer and pesticides and (2) keep the concentration of cattle low in the inventory region. Fencing should be maintained to keep livestock away from the control zone for the wells. BMPs are generally voluntary but their implementation can be encouraged through education and technical assistance.

Education - Educational information or workshops provided to the businesses at the airport 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 would promote the efficiency and effectiveness of emergency responses to hazardous material spills. The EPA and the State of Montana can provide educational materials on these topics.

Future Development: The water system and community should consider potential risks to the protection area if future land use changes are made, especially in the airport area where commercial and industrial development may occur.

CHAPTER 5
MONITORING WAIVERS

WAIVER RECOMMENDATION

The Town of Big Sandy PWS has a waiver for Phase 2 inorganics (which includes barium, cadmium, chromium, fluoride, mercury and selenium). The waiver allows Big Sandy to collect one sample round for these constituents every 9-year cycle (the standard is one sample round per 3-year cycle). In addition, Big Sandy was grandfathered under the radionuclide rule and is only required to sample once every 9-years. Based on past monitoring results and the susceptibility assessment, the Town of Big Sandy PWS may be eligible for other waivers as well. Information on susceptibility and use waivers is provided in this section to give the PWS operators an opportunity to consider if waivers may be feasible.

Before a susceptibility or use wavier is requested, the PWS Operators are encouraged to carefully review the following section on Monitoring Waiver Requirements. If after reviewing this section it is determined that an additional waivers are feasible, the PWS should submit a letter to DEQ requesting the specific monitoring waivers. If requested by DEQ, the PWS may also need to provide additional information regarding chemical use in the area within the Inventory Region. Table 8 shows how identified potential contaminant sources affect the eligibility for monitoring waivers.

Table 8. Susceptibility Assessment as it relates to Waiver Eligibility for Significant Potential Contaminant Sources in the Inventory Region

Source	Contaminant	Susceptibility	Waiver Eligibility
Agricultural /Grazing Lands	Nitrate and SOCs from fertilizer, pesticides and herbicides. Pathogens (if grazing occurs)	**Very Low**	Waivers are not available for pathogens and nitrate. Chemical use may preclude waivers for some chemicals. The PWS should confirm chemical use/storage history by land parcel.

MONITORING WAIVER REQUIREMENTS

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

Use Waivers

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

Susceptibility Waivers

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

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

Susceptibility Waiver for Unconfined Aquifers

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

Unconfined aquifers are usually locally recharged from surface water or precipitation. In general, groundwater flow gradients in unconfined aquifers reflect surface topography, and the residence time of water in the aquifer is comparatively shorter than for water in confined aquifers. Similar water chemistry often exists between unconfined groundwater and area surface water, and physical parameters and dissolved constituents can be an

indicator of the hydraulic connection between groundwater and surface water. Consequently, unconfined aquifers can be susceptible to contamination by organic chemicals migrating from the ground surface to groundwater.

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

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GLOSSARY*

Acute Health Effect. A negative health effect in which symptoms develop rapidly.

Alkalinity. The capacity of water to neutralize acids.

Aquifer. A water-bearing layer of rock or sediment that will yield water in usable quantity to a well or spring.

Barrier. A physical feature or management plan that reduces the likelihood of contamination of a water source from a potential contaminant source

Best Management Practices (BMPs). Methods for various activities that have been determined to be the most effective, practical means of preventing or reducing non-point source pollution.

Biennial Reporting System (BRS). An EPA database that contains information on hazardous waste sites. The data can be accessed through the EPA Envirofacts website.

Chronic Health Effect. A negative health effect in which symptoms develop over an extended period of time.

Class V Injection Well. Any pit or conduit into the subsurface for disposal of waste waters. The receiving unit for an injection well typically represents the aquifer, or water-bearing interval.

Coliform Bacteria. A general type of bacteria found in the intestinal tracts of animals and humans, and also in soils, vegetation and water. Their presence in water is used as an indicator of pollution and possible contamination by pathogens.

Comprehensive Environmental Cleanup and Responsibility Act (CECRA). Passed in 1989 by the Montana State Legislature, CECRA provides the mechanism and responsibility to clean up hazardous waste sites in Montana.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Enacted in 1980. CERCLA provides a Federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. Through the Act, EPA was given power to seek out those parties responsible for any release and assure their cooperation in the cleanup.

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS). A database that provides information about specific sites through the EPA Envirofacts website.

Confined Animal Feeding Operation (CAFO). Any agricultural operation that feeds animals within specific areas, not on rangeland. Certain CAFOs require permits for operation.

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

Confining Unit. A geologic formation present above a confined aquifer that inhibits the flow of water and maintains the pressure of the groundwater in the aquifer. The physical properties of a confining unit may range from a five-foot thick clay layer to shale that is hundreds of feet thick.

Delineation. The process of determining and mapping source water protection areas.

Glacial. Of or relating to the presence and activities of ice or glaciers. Also, pertaining to distinctive features and materials produced by or derived from glaciers.

Geographic Information Systems (GIS). A computerized database management and mapping system that allows for analysis and presentation of geographic data.

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

Hazard. A relative measure of the potential of a contaminant from a facility or associated with a land use to reach the water source for a public water supply. The location, quantity and toxicity of significant potential contaminant sources determine hazard.

Hydraulic Conductivity. A constant number or coefficient of proportionality that describes the rate water can move through an aquifer material.

Hydrology. The study of water and how it flows in the ground and on the surface.

Hydrogeology. The study of geologic formations and how they effect groundwater flow systems.

Inventory Region. A source water management area for groundwater systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified three-year groundwater travel time.

Lacustrine. Pertaining to, produced by, or formed in a lake or lakes.

Large Capacity Septic System. Defined by Underground Injection Control regulations as an on-site septic system serving 20 or more persons.

Leaking Underground Storage Tank (LUST). A release from a UST and/or associated piping into the subsurface.

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

Montana Bureau of Mines and Geology – Groundwater Information Center (MBMG/GWIC). The database of information on all wells drilled in Montana, including stratigraphic data and well construction data, when available.

Montana Pollutant Discharge Elimination System (MPDES). A permitting system that utilizes a database to track entities that discharge wastewater of any type into waters of the State of Montana.

National Pollutant Discharge Elimination System (NPDES). A national permitting system that utilizes a database to track entities that discharge wastewater into waters of the United States.

Nitrate. An important plant nutrient and type of inorganic fertilizer that can be a potential contaminant in water at high concentrations. In water the major sources of nitrates are wastewater treatment effluent, septic tanks, feed lots and fertilizers.

Nonpoint-Source Pollution. Pollution sources that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. Examples of nonpoint- source pollution include agriculture, forestry, and run-off from city streets. Nonpoint sources of pollution, such as the use of herbicides, can concentrate low levels of these chemicals into surface and/or groundwaters at increased levels that may exceed MCLs.

Pathogens. A microorganism typically found in the intestinal tracts of mammals, capable of producing disease.

Phase II (and IIb) Rules. EPA updated or created legal limits on 38 contaminants. The rules became effective July 30, 1992 and January 1, 1993. Some of these contaminants are frequently-applied agricultural chemicals such as nitrate and others are industrial solvents.

Phase V Rule. EPA set standards for 23 contaminants in addition to those addressed by the Phase II Rules. The Phase V Rule became effective January 17, 1994. Some of these contaminants include inorganic chemicals such as cyanide and other Phase V contaminants are pesticides that enter water supplies through run-off from fields where farmers have applied them or by leaching through the soil into groundwater. Six are probable cancer-causing agents. Others can cause liver and kidney damage, or problems of the nervous system and brain.

Point Source. A stationary location or a fixed facility from which pollutants are discharged. This includes any single identifiable source of pollution, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fracture, container, rolling stock (tanker truck), or vessel or other floating craft, from which pollutants are or may be discharged.

Pollutant. Generally, any substance introduced into the environment that adversely affects the usefulness of a resource (e.g. groundwater used for drinking water).

Permit Compliance System (PCS). An EPA database that provides information on the status of required permits for specific activities for specific facilities. The data can be accessed through the EPA Envirofacts website.

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

Pumping Water Level. Water level elevation in a well when the pump is operating.

Recharge Region. An area in which water is absorbed that eventually reaches the zone of saturation in one or more aquifers. As a source water management region, the term generally describes the entire area that could contribute water to an aquifer used by a public water supply. Includes areas that could contribute water over long time periods or under different water usage patterns.

Resource Conservation and Recovery Act (RCRA). Enacted by Congress in 1976. RCRA's primary goals are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner.

Resource Conservation and Recovery Information System (RCRIS). Is a database that provides information about specific sites through the EPA Envirofacts website.

Secondary Maximum Contaminant Levels (SMCL). The maximum concentration of a substance in water that is recommended to be delivered to users of a public water supply based on aesthetic qualities. SMCLs are non-enforceable guidelines for public water supplies, set by EPA under authority of the Safe Drinking Water Act. Compounds with SMCLs may occur naturally in certain areas, limiting the ability of the public water supply to treat for them.

Section Seven Tracking System (SSTS). SSTS is an automated system EPA uses to track pesticide producing establishments and the amount of pesticides they produce.

Source Water. Any surface water, spring, or groundwater source that provides water to a public water supply.

Source Water Delineation and Assessment Report (SWDAR). A report for a public water supply that delineates source water protection areas, provides an inventory of potential contaminant sources within the delineated areas, and evaluates the relative susceptibility of the source water to contamination from the potential contaminant sources under “worst-case” conditions.

Source Water Protection Areas. For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply. For groundwater sources, the area within a fixed radius or three-year travel time from a well, and the land area where the aquifer is recharged.

Spill Response Region. A source water management area for surface water systems that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified four-hour water travel time in a stream or river.

Standard Industrial Classification (SIC) Code. A method of grouping industries with similar products or services and assigning codes to these groups.

Static Water Level (SWL). Water level elevation in a well when the pump is not operating.

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

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

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

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

Toxicity. The quality or degree of being poisonous or harmful to plants, animals, or humans.

Toxicity Characteristic Leachate Procedure. A test designed to determine whether a waste is hazardous or requires treatment to become less hazardous.

Toxic Release Inventory (TRI). An EPA database that compiles information about permitted industrial releases of chemicals to air and water. Information about specific sites can be obtained through the EPA Envirofacts website.

Transmissivity. A number that describes the ability of an aquifer to transmit water. The transmissivity is determined by multiplying the hydraulic conductivity time the aquifer thickness.

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

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

Underground Storage Tanks (UST). A tank located at least partially underground and designed to hold gasoline or other petroleum products or chemicals, and the associated plumbing system.

Volatile Organic Compounds (VOC). Chemicals such as petroleum hydrocarbons and solvents or other organic chemicals that evaporate readily to the atmosphere.

Watershed. The region drained by, or contributing water to, a stream, lake, or other water body of water.

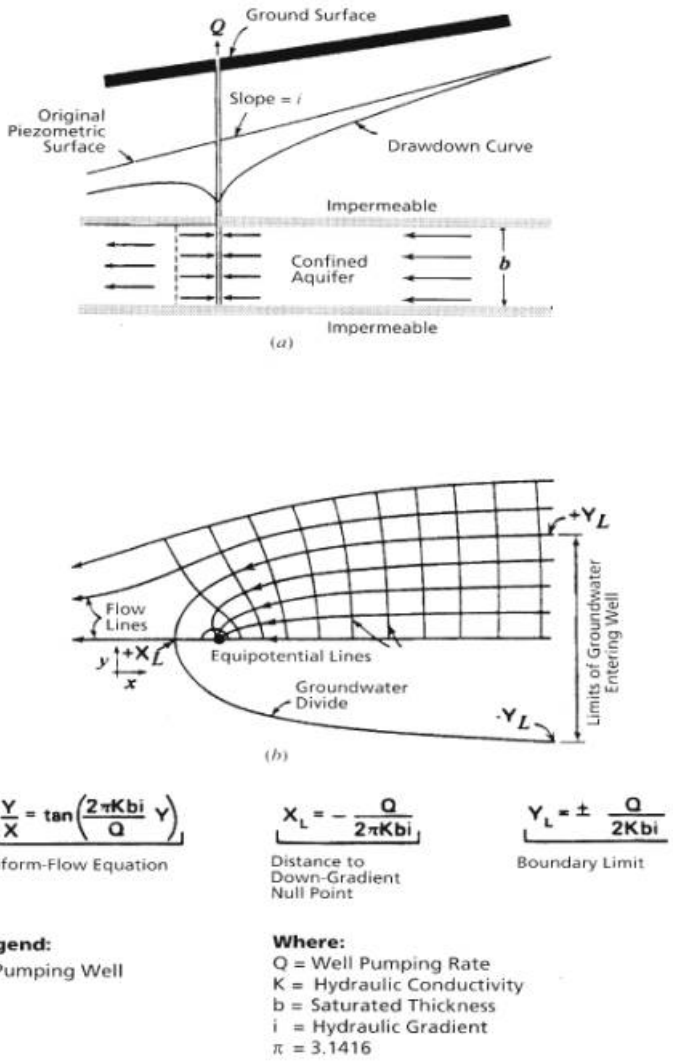
* With the exception of the definitions for Lacustrine, Phase II and Phase V Rules, and Standard Industrial Classification Code, definitions were adapted from EPA's Term References System (formerly known as Glossary of Selected Terms and Abbreviations) which can be found at: http://www.epa.gov/trs/index.htm . The definitions of glacial and lacustrine were taken from the Glossary of Geology by Robert L. Bates and Julia A. Jackson.

The definitions for Phase II and Phase V Rules were adapted from:
http://www.epa.gov/OGWDW/source/therule.html#PhaseII
http://www.epa.gov/OGWDW/source/therule.html#PhaseV

The definition for Standard Industrial Classification Code was adapted from:
EPA/Office of Enforcement and Compliance Assurance: Guide to Environmental Issues: Glossary of Terms & Acronyms *Term Detail*

Appendix A
PWS Well Logs

Appendix B
Groundwater Time-of-Travel Calculations



Model Input

The values selected for the calculation of time of travel represent conservative assumptions made to identify areas that may potentially impact the Town of Big Sandy PWS. The criteria for selection of each value used for this delineation are as follows:

- ***Thickness (b)***: The value for the thickness of the aquifer is estimated at 17 feet which is the average of the aquifer thickness in the North, South and Sand well logs (27 feet, 18 feet, and 5 feet respectively).
- ***Transmissivity (T) –*** Transmissivity is based on the specific capacity of the well and is estimated using the formula $T= 33.6(Q/s)^{.67}$ where Q=the pumping rate (in ft^3/day) and s = the drawdown (in feet) during a pump test. Information from the well logs was used to estimate a transmissivity as follows:
  North Well T= 2349 ft^2/day (Q=300 gpm = 57754 ft^3/day and s=102 ft)
  South Well T= 2429 ft^2/day (Q=225 gpm = 43315 ft^3/day and s=97 ft)
  Average T= 2389 ft^2/day
- ***Hydraulic Conductivity (K)***: A value for hydraulic conductivity (K) is estimated by the formula K=T/b =2389 ft^2/day/17 feet = 140.5 ft/day. This is within the standard range of hydraulic conductivities for unconsolidated well-sorted sands and gravel (per Fetter).
- ***Hydraulic Gradient (i)***: The hydraulic gradient was estimated based on local topography. The estimated gradient is 0.0038 feet/feet from the Wellhead Protection Plan was used.
- ***Flow Direction***: The flow direction is to the northeast along the former Missouri channel as shown in Figure 2 of the report.
- ***Porosity (n)***: The value for effective porosity is estimated from (Todd, 1980) at 20% which is typical for sand and gravel.
- ***Pumping Rate (Q)***: The pumping rate was estimated based on operator notes attached to the inventory update (12/11/02) which indicated the following:
  North Well – 9 hrs/day @ 250 gpm = avg of 94 gpm = 18048 ft^3/day
  South Well – 4 hrs/day @ 200 gpm = avg of 33 gpm = 6417 ft^3/day
  Sand Well – 12 hrs/day @ 70 gpm = avg of 35 gpm = 6738 ft^3/day
  Total for North/South/Sand Wells = 31,203 ft^3/day x 1.25 (as a conservative factor to account for future growth) = 39000 ft^3/day
  Blew Top Well – 16 hrs/day @ 70 gpm = avg of 47 gpm = 8983 ft^3/day x 1.25 (as a conservative factor to account for future growth) = 11230 ft^3/day

Delineation Results

The results of the calculations are shown below.

Time of Travel Calculation-3 yr TOT			for North/South/Sand Wells		
User supplies K, b, I, Q, n, and X (distance estimate) to calculate travel time and other parameters.					
Input Values			**TOT and Capture Zone Results**		
K=	140.5	ft/day			
b=	17	ft	Tx	1095	Days
I=	0.0038	ft/ft	Tx (years)	3.00	Years
Q=	39000	ft3/day	Null Point	-683.87	ft
n=	0.20	%	Boundary Limit	2148.45	ft
X=	4278	ft	Flow Rate	3.91	ft/day

Time of Travel Calculation-3 yr TOT			for Blew Top Well		
User supplies K, b, I, Q, n, and X (distance estimate) to calculate travel time and other parameters.					
Input Values			**TOT and Capture Zone Results**		
K=	140.5	ft/day			
b=	17	ft	Tx	1095	Days
I=	0.00	ft/ft	Tx (years)	3.00	Years
Q=	11230	ft3/day	Null Point	-196.92	ft
n=	0.20	%	Boundary Limit	618.64	ft
X=	3501	ft	Flow Rate	3.20	ft/day

Tx = travel time from point x to a pumping well (days)

K = hydraulic conductivity (ft/day)

B = aquifer thickness (ft)

I = hydraulic gradient (ft/ft)

Q = average production rate (ft3/day)

N = effective porosity (%)

X = distance from pumping well over which groundwater travels in Tx (ft)

Null Point = distance to downgradient null point (ft)

Boundary Limit = maximum distance from the center line to the boundary of the capture zone (ft) (i.e. half the maximum width of zone

Time-of-travel Calculation Method: The Time of Travel for water to move along a line parallel to the hydraulic gradient form a point to a pumping well (EPA, 1991) is

$$T_X = \frac{n}{Ki}\left[X_L - \frac{Q}{2\pi Kbi}\ln\left(1 + \frac{2\pi kbi}{Q}X_L\right)\right]$$

Wellhead Protection Plan - Delineation Method/Model Input Parameters
(Montana Rural Water Systems, Inc., 1997).

The special protection region was delineated using the analytical method based on the Uniform Flow Equations. The parameters needed are described below.
Q= pumping rate in cubic feet per day
T= transmissivity of the aquifer and is measured in square feet per day
s.= drawdown and is measured in feet

The empirical equation used to calculate transmissivity is from Huntley and Raznic.
$T= 33.6(Q/s)^{.67}$
K=T/b =57,754/17= 878 ft/day
i.= 5ft/1300ft= .0038

DOWN GRADIENT STAGNATION POINT; $-X_L=Q/(2piKbi)=$
LATERIAL LIMITS; $Y_L=Q/2Kbi=$
UPGRADIENT LIMIT; Kit/n=

Kb=T=2348.7 ft^2/day should have been inserted here

$Q=(300gpm/7.48gal/ft^3)(1440min/day)=57,754\ ft^3/day$
$T= 33.6(Q/s)^{.67}= 33.6(57,754ft^3/102ft)^{.67}= 2348.7ft^2/day$
$-X_L=Q/(2piKbi)= 57,754/((2)(3.14)(57754)(.0038))= 3235.5$ ft
Kit/n= ((878 ft/day)(.0038)(1825 days))/.2= 3017 ft

Assumptions

The Uniform Flow Equations assume the aquifer is infinite in extent and that flow is isotropic (horizontal only) and homogenous (uniform composition). Neither assumption exists in nature but because of the small amount of water withdrawn by the well in relation to the amount of groundwater in the aquifer, the assumptions are valid to the level of accuracy required for this program.

Limiting Factors

Major assumptions used in the application of many groundwater flow models are; 1) flow in the aquifer is uniform, and 2) flow in the aquifer is horizontal. A groundwater flow model for any specific set of conditions should be considered within these limitations as groundwater flow is generally not uniform nor strictly horizontal. Any particular modeling effort merely represents the best estimate of groundwater flow conditions based on known and estimated hydrogeologic and pumping conditions and should be modified as additional information becomes available.

Specific limitations to this delineation include the limited amount of water available in the sand and gravel layer in which the wells are completed. The wells cannot be pumped at the same time without dewatering the aquifer at one of the pumps (personal conversation with John Field). The result is that the equations will overestimate the capture zone.

The delineation shown on the base map represents the estimated capture zone which assumes the flow direction is valid within 45 degrees and is based on a maximum daily pumping rate. This should yield a capture zone that will still be safe as the water demand increases.

Appendix C
Listing of Potential Contaminant Sources

DEQ Underground Storage Tank (UST) List

http://www.deq.state.mt.us/UST/USTDownloads.asp

Notes:
Active USTs have usually been upgraded to 1998 standards (which includes leak detection and monitoring) Spills or improper handling during tank filling or product distribution at these facilities may impact the drinking water supply.

DEQ classifies inactive USTs as temporarily out of service and requires that the product in the tank be removed. However, testing of the tanks, distribution lines or soils around the tank is not required to evaluate the potential for historic leaks or spills that may impact subsurface soils and groundwater.

AltFacilityID	Facility Name	Facility_Location_Address	City	County	Active Tanks	Nonactive Tanks
08-00855	Ezzie's Wholesale (Big Sandy)	Hwy 236	Big Sandy	Chouteau	5	7
08-05363	Nepil Bros Partnership	HC 77 Box 809	Big Sandy	Chouteau	2	2
08-03317	Albert Bold & Sons Farm	Sec 18-29-10	Big Sandy	Chouteau		2
08-07400	Bahnmiller, Ernest	Route 1, Box 733	Big Sandy	Chouteau		1
08-09322	Bahnmiller, Paul	Rte 1 PO Box 723	Big Sandy	Chouteau		3
08-13334	Bank of Montana	Johanes Ave	Big Sandy	Chouteau		2
08-00444	Big Sandy Airport	Address Unknown	Big Sandy	Chouteau		1
08-13444	Big Sandy Medical Center	PO Box 530	Big Sandy	Chouteau		2
08-06818	Big Sandy Public Schools	Pioneer Trail	Big Sandy	Chouteau		2
08-08760	Big Sandy Radio	Address Unknown	Big Sandy	Chouteau		1
08-02203	Bley Farm	Hwy 432	Big Sandy	Chouteau		1
08-09518	BN Big Sandy - Depot	1st Ave	Big Sandy	Chouteau		1
08-09519	BN Big Sandy - Microwave	8.3 Mi At 255 Degrees From	Big Sandy	Chouteau		1
08-02570	Boyce Ranch	Warrick Rte	Big Sandy	Chouteau		2
08-02363	Chouteau County District #1	PO Box 459	Big Sandy	Chouteau		2
08-04157	Chouvet, Kenneth	PO Box 69	Big Sandy	Chouteau		3
08-07993	Christofferson Land and Cattle Co.	Sec 16, T29N, Rge11E (Farm)	Big Sandy	Chouteau		3
08-08367	Clawiter, Max	PO Box 550	Big Sandy	Chouteau		1
08-01799	Cline, Floyd	RR 1 Box 704	Big Sandy	Chouteau		1
08-00158	Darlington, Robert	Address Unknown	Big Sandy	Chouteau		1
08-05134	Eagle Creek Ranch	Address Unknown	Big Sandy	Chouteau		1
08-07992	Edventures Inc. (At Farm Bld)	Sec 18, T29N, R11E	Big Sandy	Chouteau		1
08-12347	Eve Place	RR 1, Box 649	Big Sandy	Chouteau		2
08-06222	Finke, Robert	PO Box 679	Big Sandy	Chouteau		1
08-04021	Four Way Fuel	Junction Hwys 87, 236, 432	Big Sandy	Chouteau		5
08-02656	Gasvoda, Arland W.	PO Box 882	Big Sandy	Chouteau		1
08-00923	Gasvoda, Francis	Ferry Star Route Box 880	Big Sandy	Chouteau		1
08-05350	Geyer, Ernest	Johannes & 3rd St	Big Sandy	Chouteau		1
08-08003	Glen A Kulbeck	RR 1 PO Box 692	Big Sandy	Chouteau		1
08-13614	H & R Building	Hwy 87	Big Sandy	Chouteau		2
08-00287	James & Marla Drga	30+ Miles SEon Route 236	Big Sandy	Chouteau		1
08-05197	Jurenka, William	PO Box 461	Big Sandy	Chouteau		1
08-01279	K & K Farms Inc.	RR 1 Box 734	Big Sandy	Chouteau		1

AltFacilityID	Facility Name	Facility_Location_Address	City	County	Active Tanks	Nonactive Tanks
08-07331	Kidd Bros	PO Box 662	Big Sandy	Chouteau		1
08-04517	Kulbeck Bros	PO Box 703	Big Sandy	Chouteau		2
08-10952	Larson, Alan W.	Route 1, Box 672	Big Sandy	Chouteau		1
08-06025	Main Post Office	Johannes Ave	Big Sandy	Chouteau		1
08-04652	Matt Gasvoda & Sons Incorporated	21 Miles SE of Big Sandy	Big Sandy	Chouteau		2
08-02726	Midway Ranch Inc.	Unknown	Big Sandy	Chouteau		1
08-10062	Moes, Edward W Family Trust	PO Box 449	Big Sandy	Chouteau		1
08-03332	Moes, Gordon	Ferry Rt Box 865	Big Sandy	Chouteau		2
08-13030	Montana Hotel	2nd Block Johannes Ave	Big Sandy	Chouteau		1
08-05136	Nl Ranch	Address Unknown	Big Sandy	Chouteau		1
08-08048	Osterman, Henry	Ferry Route Box 823	Big Sandy	Chouteau		1
08-04750	Pearson, Alandra K.	Lot 6 Block 19 of Elderman's 2nd	Big Sandy	Chouteau		1
08-10169	Pegar, Roy F.	PO Box 156	Big Sandy	Chouteau		2
08-07238	Pribyl Bros Farm Inc.	PO Box 22	Big Sandy	Chouteau		1
08-06223	Quinn Farm & Ranch	Ferry Rt PO Box 803	Big Sandy	Chouteau		1
08-08368	Ray, James C.	PO Box 575	Big Sandy	Chouteau		1
08-01583	Ray, Ronald E.	Warrick Route	Big Sandy	Chouteau		1
08-04018	Robertson Oil Co	Lot 4 Block 24	Big Sandy	Chouteau		1
08-04017	Robertson Oil Co	Johannes Ave Block 35	Big Sandy	Chouteau		7
08-08002	Russell Dixon	PO Box 714	Big Sandy	Chouteau		2
08-12588	Scooter's Sinclair	US Hwy 87	Big Sandy	Chouteau		3
08-05135	Seifert Ranch	Address Unknown	Big Sandy	Chouteau		1
08-03676	Skaalure Farm Inc.	Ferry Rt PO Box 813	Big Sandy	Chouteau		1
08-07330	Tester, R Jon	PO Box 709	Big Sandy	Chouteau		1
08-07252	Tim Godfrey Home	300 Mcnamara Ave	Big Sandy	Chouteau		1
08-09324	Town Pump Inc. (Big Sandy)	Hwy 87 & McNamara	Big Sandy	Chouteau		3
08-08880	Triangle Aviation	Big Sandy Airport	Big Sandy	Chouteau		5
08-13315	Turner, Wayne C.	PO Box 126	Big Sandy	Chouteau		1
08-10076	Underdal, Selmer O.	PO Box 329	Big Sandy	Chouteau		1
08-05133	Whitcraft Ranch	PO Box 489	Big Sandy	Chouteau		1
08-00286	Works, Marvin	Address Unknown	Big Sandy	Chouteau		2

DEQ Leaking Underground Storage Tank (LUST) List

http://www.deq.state.mt.us/UST/USTDownloads.asp

City	SiteName	Location	AltEventID	Date	Confirmed Release Date	Project Officer	Active
Big Sandy	Big Sandy Public Schools		0806818*859	16-Aug-91	16-Aug-91		No
Big Sandy	Bn Big Sandy - Depot	1st Ave	0809518*747	18-Jun-88	18-Jun-88		No
Big Sandy	Chouteau County District #1		0802363*2032	13-Dec-93	13-Dec-93	Lust Pool	Yes
Big Sandy	Four Way Fuel	Junction Hwys 87, 236, 432	0804021*3780	05-Aug-99	05-Aug-99	Lust Pool	Yes
Big Sandy	H & R Block Building	Hwy 87	0813614*2542	16-Mar-95	16-Mar-95		No
Big Sandy	Nepil Bros Partnership	Hc 77 Box 809	0805363*2473	06-Dec-94	06-Dec-94		No
Big Sandy	Quinn Farm & Ranch	Ferry Rt	0806223*1819	06-Aug-93	06-Aug-93		No
Big Sandy	Robertson Oil Co	Hwy 236 Sec 19; T 28n; R13e	0800855*1233	16-Jun-92	16-Jun-92	Lust Pool	Yes
Big Sandy	Robertson Oil Co	Johannes Ave Block 35	0804017*499	03-Dec-90	03-Dec-90	William Hammer	Yes
Big Sandy	Scooter's Sinclair	US Hwy 87	0812588*3806	15-Oct-90	15-Oct-90	William Hammer	Yes
Big Sandy	Triangle Aviation	Unknown	0808880*1143	25-Mar-92	25-Mar-92		No

Businesses that may use Hazardous Materials identified by SIC Code

NAME	ADDRESS	CITY	SIC1	SIC2	SIC3	SIC4	LATITUDE	LONGITUDE	Precision
Adm/Chs	79365 Highway 87	Big Sandy	422101				47.952360	-109.88298	4
Big Sandy Auto Parts Inc	29 Mcnamara Ave	Big Sandy	553111				47.952360	-109.88298	4
Big Sandy Auto Parts Inc	Highway 87	Big Sandy	553111				47.952360	-109.88298	4
Big Sandy City Hall	Hopp Rd & Iliad Rd	Big Sandy	911104				47.952360	-109.88298	4
Big Sandy Fire Dept		Big Sandy	922404				47.952360	-109.88298	4
Big Sandy High School	398 1st Ave	Big Sandy	821103				47.952360	-109.88298	4
Big Sandy Medical Ctr	166 Montana Ave E	Big Sandy	806202	805101			47.952360	-109.88298	4
Big Sandy Superintendent Ofc	Pioneer Trl	Big Sandy	821103				47.952360	-109.88298	4
Big Sky Rifle Ranch	Highway 87 S	Big Sandy	594129				47.952360	-109.88298	4
Courtnage & Sons Inc	146 Johannes Ave	Big Sandy	171102				47.952360	-109.88298	4
Easy Hitch Inc	PO BOX 126	Big Sandy	553122				47.952360	-109.88298	4
Edventures Inc	2906 Edwards Rd	Big Sandy	152103				48.219360	-110.32620	3
Ezzie's Wholesale	418 Judith Landing Rd	Big Sandy	554101				47.952360	-109.88298	4
F E Miley Elementary School	342 Vernon Ave	Big Sandy	821103				47.952360	-109.88298	4
General Mills Inc	Highway 2	Big Sandy	422101				47.952360	-109.88298	4
Golden Harvest Seeds Inc	1582 Golden Rd	Big Sandy	072301	355909	519102	519112	48.219360	-110.32620	3
Grocery Store	135 Johannes Ave	Big Sandy	541105				47.952360	-109.88298	4
Hartland Public Schools		Big Sandy	821103				47.952360	-109.88298	4
Highway Dept		Big Sandy	161102				47.952360	-109.88298	4
Judith Landing	40841 Judith Landing Rd	Big Sandy	541103				47.741520	-109.62492	1
Kemdata	915 Raarick Rd	Big Sandy	138905	873402			47.952360	-109.88298	4
Little Shaps Rifle Mfg	159 2nd Ave	Big Sandy	594129				47.952360	-109.88298	4
Little Sharpe Rifle Mfg	1st & Jefferson St	Big Sandy	594129				47.952360	-109.88298	4
Mountain View Coal Co	Hwy 87	Big Sandy	519114	519102			47.952360	-109.88298	4
Ophus Auction Svc	149 Lehfeldt Ave	Big Sandy	738901				47.952360	-109.88298	4

NAME	ADDRESS	CITY	SIC1	SIC2	SIC3	SIC4	LATITUDE	LONGITUDE	Precision
Otto's Repair	132 Judith Landing Rd	Big Sandy	508310				47.952360	-109.88298	4
Prairie Design		Big Sandy	738940				47.952360	-109.88298	4
Tumble Weed Gallery	79286 US Highway 87	Big Sandy	599969				47.952360	-109.88298	4
United Agri Products Co	Highway 87 & Main St	Big Sandy	519114				47.952360	-109.88298	4
United Argi Products Inc	1st & Main St	Big Sandy	516916	519105	519114		47.952360	-109.88298	4
Warrick School District 26	29200 Warrick Rd	Big Sandy	821103				47.943660	-109.87710	3

Notes:

SIC- Standard Industrial Classification Code

Data Source: 1= address matched to location (most accurate), 2= located at centroid of Zip+4, 3= located at centroid of Zip+2, and 4= Zip Code Centroid (least accurate)

Reference: Select Phone Version 3.3 Phone Directory by Info USA

The U.S. Standard Industrial Classification (SIC) Codes classify categories of businesses. SIC Codes cover the entire range of business categories that exist within the economy. U.S. industries are categorized into the following divisions as represented by the first two digits of the SIC code:

- Agriculture, Forestry, and Fishing (01-09)
- Mining (10-14)
- Construction (15-19)
- Manufacturing (20-39)
- Transportation and Public Utilities (40-49)
- Wholesale Trade (50-51)
- Retail Trade (52-59)
- Finance, Insurance, and Real Estate (60-69)
- Services (70-89)
- Public Administration (90-98)
- Nonclassifiable Establishments (99)

Each SIC Code division contains a series of subcategories that cover all areas within that specific division. Detailed descriptions of each code are provided at http://www.census.gov/epcd/www/naicstab.htm.

Appendix D
Big Sandy Wellhead Protection Plan

BIG SANDY
PWS
WELLHEAD PROTECTION PLAN

PWSID # *00150*

JOHN FIELD,
Certified Operator

JOHN FIELD,
WHP contact

phone:(406) *378-2646*

DEQ Note: Big Sandy's management plan as provided in the original 1997 Wellhead Protection Plan is provided below. Additional management recommendations that could be implemented are provided by DEQ in Chapter 4 of the Source Water Delineation and Assessment Report. If these, and other, management recommendations are implemented; they may be considered additional barriers that will reduce the susceptibility of the PWS to specific sources and contaminants. It should be noted that even small releases of some chemicals in close proximity to a public water supply well can have significant negative impact on water quality, and therefore are a significant threat to the public water supply.

CHAPTER 4
MANAGEMENT

The goal of the Wellhead Protection Plan is to, 1) protect the source water by keeping potentially polluting materials and activities out of the control zone, and, 2) to manage the special protection region to ensure land use activities pose minimal threat to the source water.

WHP Management

John Fields the town's operator will oversee the Wellhead Protection Plan. The Town Council approved the program in January 1998.

Control Zone Management

Access to the Control Zone is restricted and several private gates need to be opened by the landowner. The wellheads need to be maintained and mounded to ensure surface water runs off. Should a leak or spill occur to a vehicle at the wells the operator will ensure it is cleaned up.

Special Protection Region Management

The Region is all pasture and/or marsh, livestock are the only potential contaminant source and are fenced off from the wells. An accident or spill on SR 2700 would require cleanup in accordance with state regulations. The city would monitor the situation and make the cleanup crews aware of the wells. A leak in the water main could allow contaminated water to enter the distribution system. Routine water quality testing will ensure the water quality. Because the area is not populated the Region can be squared off for easier land use planning.

Protection Region Management

The Protection Region is sparsely populated rangeland and does not require active management.

Management Implementation

The management activities described above are in use at this time. The city already works with the landowners to ensure Best Management Practices are used to maintain the quality and quantity of the drinking water.

DEQ Note: Contingency planning is highly recommended as part of voluntary protection measures by each PWS. DEQ has not reviewed this chapter to confirm that the emergency plan identifies the potential threats to the drinking water supply and provides the detail necessary to implement a response to contamination or disruption of the public water system. The water system operator and other parties interested and/or knowledgeable of the area should meet annually to verify the existing conditions and update this emergency plan if warranted. The PWS should verify that the existing county Emergency Response Plan contains a clear listing of all emergency contacts, emergency numbers, and resources available within the county to respond to an emergency situation, such as a hazardous material spill.

CHAPTER 5
EMERGENCY PLANNING

The emergency plan identifies the principal threats to the source water, designates an emergency coordinator, and then describes a series of potential responses planned in the event of a problem arises. Another important aspect of the plan is an estimate of the equipment and materials that would be needed in the event of an emergency, a description of how a short-term replacement water supply would be handled, and a description of the funding available to deal with an emergency response.

Identification of possible disruption threats

The principal threat to the PWS has been identified as a spill, leak, or discharge in the control zone which could contaminate the source water by entering through the well bore or perhaps along with contaminated shallow groundwater through a failed casing. Included are spills from vehicles, spills from mobile liquid holding tanks, leaks from above or underground tanks, leaks from waste carrying pipes, and livestock waste.

Designation of an emergency coordinator

The emergency coordinator for Big Sandy is John Field and his phone number is 386-2467.

The emergency coordinator is familiar with the county and state DES procedures and is responsible for contacting the appropriate officials should a spill or other threat to the source water occur. The Chouteau County DES coordinator 24 hour phone number is Ed Gierke at 450-1998. The State of Montana 24 hour Spill Hotline phone number is (406) 841-3911.

Equipment and material resources

The principal identified threats to the well are generally limited to spills in the control zone. Resources that may be needed to respond to a spill are heavy equipment for berm and excavation work and absorbent materials.

Should additional resources be needed due to the magnitude or chemical nature of a spill the Big Sandy Department of Public Works will contract with an emergency response firm properly trained and equipped. A list of possible contractors is maintained and updated by the DEQ Enforcement Division (406) 444-0379.

A catastrophic loss of water will require the contracted services of a water hauler, a design engineer, and a well driller.

Procedures to shut down the well

The well can be turned off and isolated from the water supply system. Important valves are located as shown on appendix 1. Under ideal conditions the system can operate without the well by using water in the water storage tank can for approximately ___days. Well shut down is the responsibility of the certified operator or backup.

Coordination Procedures

The *Big Sandy* WHP Plan will be made available to Chouteau County DES coordinator Ed Gierke at 450-1998. Additionally, reportable spills will be handled as per the mandated reporting requirements as follows:

- Agricultural chemical or fertilizer spills will be reported to the MT Department of Agriculture (406)444-5400
- Any refined petroleum product such as gasoline, diesel, asphalt, road oil, kerosene, fuel oil, and derivatives of mineral, animal, or vegetable oil spills in excess of 25 gallons will be reported to the DES hotline (406) 841-3911.

Procedures to communicate with water users

The nature of the PWS should allow the well to be isolated from the distribution system in the event of a spill in the control zone which threatens source water quality. If it is determined that the source water was exposed to a contaminant the well will remain off line until sampling proves the water to be safe, an evaluation done in cooperation with the MT DEQ, PWS Section.

Should the distribution system become contaminated, the public would be notified city officials and emergency services personnel going door to door. In addition radio and television stations in Great Falls and Havre would be asked to broadcast warnings.

Source of emergency water

If both wells are out of service for more than _4_days, an emergency supply of water may need to be arranged. The short-term plan is to haul water using a DEQ approved water hauler from a DEQ approved water source. Should this be necessary, a hauler will be contracted and a short-term plan relating to the source water and disinfection requirements will be submitted to DEQ-PWS Section for approval. Prairie Water provides water hauling services in this area.

Should a total loss of water occur, the services of a design engineer and well driller will be retained to assess the options. Plans and specifications for any new well will require DEQ-PWS Section review and approval prior to construction.

Disinfection and resumption of water service

The well and storage tank can be disinfected for bacteriological contamination as per the city's standard disinfection and tank cleaning procedures under the direction of the certified operator.

Normal water service resumption will occur after sample results indicate the supply is safe as approved by DEQ-PWS Section and the certified operator.

Funds

Big Sandy is an incorporated community and maintains an emergency fund.

Important emergency contacts and phone

CONTACT NAME	TITLE	PHONE	RESPONSIBILITY
John Field	*Director of Public Works*	*386-2467*	*All PWS*
	Emergency Contractors	*444-0379*	*Equipment and Materials*
Ed Gierke	*District 2 Representative*	*450-1998*	*Disasters and Emergency Services (DES)*
Montana Spill Hotline		*(406) 841-3911*	
	Department of Agriculture	*444-5400*	*Agricultural chemicals*

CHAPTER 6
ALTERNATE WATER SOURCES

Big Sandy is working with an engineering firm to find alternate and additional water sources. To date several test wells have been drilled but an adequate water source has not been found.

Appendix E
Concurrence Letter