SOURCE WATER DELINEATION AND ASSESSMENT REPORT

11/99

Kinsey School
Public Water System
Custer County, Montana

PWSID #
MT0001191

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TABLE OF CONTENTS

INTRODUCTION

This report is intended to meet the technical requirements for the completion of the Source Water Delineation and Assessment for the Kinsey School Public Water Supply System (PWSID# MT0001191) as required by the Montana Source Water Protection Program and the federal Safe Drinking Water Act (SDWA). The Delineation and Assessment Report (SWDAR) for the Kinsey School was completed by MSU students Chad Walby and Karen LaClair under the supervision of Dr. Steve Custer, at Montana State University.

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protecting public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is termed delineation and assessment. The emphasis of this delineation and assessment report is identifying significant potential contaminant threats to public drinking water sources and providing the information needed to develop a source water protection plan for Kinsey School.

Delineation is a process whereby areas that contribute water to aquifers or surface waters used for drinking water, called source water protection areas, are identified on a map. Geologic and hydrologic conditions are evaluated in order to delineate source water protection areas. Assessment involves identification of locations or regions in source water protection areas where contaminants may be generated, stored, or transported and then determination of the potential for contamination of drinking water by these sources.

Delineation and assessment is the foundation of source water protection plans, the mechanism Kinsey School can use to protect their drinking water source. Although voluntary, source water protection plans are the ultimate focus of source water delineation and assessment. This delineation and assessment report is written to encourage and facilitate the Kinsey School water operator and the community to complete a source water protection plan that meets their specific needs.

CHAPTER 1
BACKGROUND

THE COMMUNITY

Kinsey school is considered a non-transient non-community public water supply system because regularly serves at least 25 of the same persons over six months per year (McNenny, Sanitary Survey, 1995, Appendix D). Kinsey school is located in Custer County about 11 miles Northeast of Miles City, North of the Yellowstone River and North of I-90, on Kinsey Road. The location of the Kinsey school well is 46.5702, 105.6472 (McNenny, 1995; Appendix A, Figures 1 and 2).

The population of Custer County according to Census 2000, was 11,696. Approximately 50 residents live in Kinsey, a rural community (Montana State Library NRIS, 2002). Management and professional, service, and sales and office occupations make up the economic base of Custer County (census bureau).

Kinsey is not served by a sanitary sewer system. Each residence is served by an on-site septic system and drainage field.

GEOGRAPHIC SETTING

Kinsey school is in the Unglaciated Missouri Plateau section of the Northern Great Plains physiographic province of North America (Zelt, et. al., 1999) and the non-glaciated central ground-water region of the United States (Heath, 1984). The elevation of Kinsey is 710 feet above sea level. Kinsey resides in the Lower Yellowstone-Sunday watershed, hydrologic unit code 10100001 (United States EPA).

Climate data comes from the NRCS National Water and Climate Center online database, from the nearest weather station at the Miles City airport to the Southwest. The average low and high temperatures for the Miles City airport are 6.3 and 26.8 degrees Fahrenheit in January, and 60 and 88.6 degrees Fahrenheit in July. The Miles City airport receives 13.52 inches of precipitation and 30 inches of snowfall annually (NRCS).

Soil at Kinsey is classified as Chanta loam. Chanta loam is more than 60 inches deep with a dark colored surface layer and slopes of 0-2 percent. Chanta loam is suitable for cropland and rangeland (NRIS, 2001).

GENERAL SOURCE WATER DESCRIPTION

Groundwater is the source of water for Kinsey school. There is one well on the Kinsey school grounds. The well from which the school receives water was drilled on May 1, 1961. The well was drilled to a depth of 519 feet and cemented with 39 bags of cement (GWIC, Ground-Water Information Center, well log in Appendix C). The depth of cementation is uncertain. Completion information states that the well is perforated from 415 feet to 519 feet of depth. The well log states that the well was completed in gumbo, a term used for a fine-grained, clay-rich, smectite-bearing soil that is sticky and impermeable when wet. The well is artesian with a pressure of 13 pounds per square inch (McNenny, 1995).

PUBLIC WATER SUPPLY

There is one well supplying the Kinsey school. The well (PWS ID 01191, source 002) serves approximately 2 people in the summer and 52 people the rest of the year on two active service connections (McNenny, 1995, Appendix D). The approximate volume of water used during the year is 1300 gallons per day during the year, and 50 gallons per day during the summer (EPA, 1991). Water from the well is delivered to the basement of the school by artesian pressure. In the basement, a one horsepower centrifugal pump delivers the water to a captive air pressure tank. The water is then sent through the school water system via two service connections (McNenny, 1995, Appendix D). According to the Sanitary Survey, there is no water treatment system

WATER QUALITY

Available regional background water quality for wells drilled into the Fort Union and Hell Creek formations in the area of Kinsey school is presented in Table 1. Data were acquired from the GWIC database. A search was made for all wells drilled in Township 09N, Range 48E. Specific electrical conductivity at 25 °C had a mean value of 394 micromhos, with a low of 13 micromhos and a high of 1303 micromhos. Data indicates that the water is a sodium bicarbonate water (Table 1).

The Kinsey school PWS is routinely monitored for compliance with drinking water standards. Bacteriological monitoring occurs monthly. Compliance with other drinking water standards is based on additional sampling on a variety of schedules depending on system classification and population served. Nitrate can come from human or animal wastes and can also occur naturally. Nitrate levels for Kinsey school have not been reported in the last five years. The Kinsey school well has tested free of bacteria for the last 5 years.

Table 1a. Regional water quality for Fort Union and Hell Creek deposits in the Kinsey area.

Gwic Id	Aquifer	Latitude	Longitude	Town, Range, Section	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Cl (mg/l)	HCO3 (mg/l)	CO3 (mg/l)	SO4 (mg/l)	NO3 (mg/l)	F (mg/l)	SiO2 (mg/l)
1728	125FRUN, 211HLCK	46.558	-105.673	09N,48E,3CD	6	0.3	313	2.4	43	670	53	3.2	0	1.5	15
1729	125FRUN, 211HLCK	46.5688	-105.699	09N,48E,4,BB	3.2	0.1	328	1.2	53	708	49	5.6	0.113	1.6	13
1730	211FHHC	46.5708	-105.698	09N,48E,4BBBA	1	0.2	340	0.6	61.4	709	40.8	0.4	0.038	1.7	10
1731	125FRUN, 211HLCK	46.5327	-105.73	09N,48E,18DB	3	0.5	343	2.8	44	795	30	4	0.113	2.4	11
				MAX	6	0.5	343	2.8	61.4	795	53	5.6	0.113	2.4	15
				MIN	1	0.1	328	0.6	44	708	30	0.4	0.038	1.6	10
				MEAN	3.3	0.275	331	1.75	50.35	720.5	43.2	3.3	0.066	1.8	12.25

Table 1b. Regional water quality for Fort Union and Hell Creek deposits in the Kinsey area, continued.

GWIC ID	B (µg/l)	Fe (mg/l)	TDS	Cations	Anions	Lab pH	Lab SC (µmhos @ 25°C)
1728	680	0.1	767.55	14.00909	14.113	8.9	129
1729	780	0.1	803.68	14.47291	14.935	8.8	13
1730	674	0.03	805.43	14.87936	14.812	9.03	1303
1731	480	0.02	832.46	15.18185	15.491	8.5	131
MAX	780	0.1	832.46	15.18185	15.491	9.03	1303
MIN	480	0.02	803.28	14.47291	14.812	8.5	13
MEAN	653.5	0.0625	802.28	14.6358	14.83775	8.8075	394

CHAPTER 2
DELINEATION

All source water protection areas for the Kinsey school well were delineated as required for non-transient, non-community public water supplies under the Montana Source Water Protection Program (DEQ, 1999). A 100-ft radius control zone was delineated for the Kinsey school. The control zone is the most critical area within which direct introduction of contaminants into the well or immediate area can occur. An inventory region using a 1 mile fixed radius was delineated for the Kinsey school well, according to the criteria for a non-transient, non-community well. The Inventory Region represents an area from which water or contaminants can flow to the well over a period of months to years. The recharge region is delineated using hydrogeologic mapping and analysis. This region represents the entire area contributing recharge water to groundwater that may flow to a drinking water supply over long time periods.

HYDROGEOLOGIC CONDITIONS

Land surface elevation in the area of Kinsey school decreases going Southeast toward the Yellowstone River. Groundwater flow direction in the region is not documented in any studies of the area. Geologic maps available for the area are listed in Table 2. Geologic maps are found in Appendix A, Figures 7a, 7b, 7c, 7d, and 7e.

There are four aquifers in the Kinsey area, Quaternary alluvium, Tertiary Fort Union formation, upper Cretaceous Hell Creek formation, and the upper Cretaceous Fox Hills formation (GWIC). The Kinsey school well log does not list the source aquifer. The depth to which the well is drilled coincides with wells listed in GWIC as 125FRUN/211HLCK, which is either the Fort Union and/or the Hell Creek formation. The dual listing occurs because the drillers were unsure which formation the well reached.

Table 1. List of geologic or hydrogeologic investigations near Kinsey.

Title of Project	Period of Project	Area Covered	Project Purpose
Potentiometric surface map of the Fox-Hills-lower Hell Creek Aquifer, Lower Yellowstone River Area	1993-1997	Portions of Dawson, Fallon, Prairie, Richland, and Wibaux Counties, Montana	Determine direction of flow and water table altitudes in the Fox-Hills-lower Hell Creek aquifer.

Table 2. List of geologic maps available for Kinsey school area.

Title or Description	Date	Area Covered	Reference
Preliminary Geologic Map of the Terry 30' x 60' quadrangle, Montana	1989	Lat 46° 30' to 47° Long 105° to 106°	Vuke, S.M., et. al.
Geologic Map of Montana	1955	State of Montana	Ross, Clyde P., et. al.
Geologic Map of Montana	1944	Eastern Montana	Andrews, D.A., et. al.

CONCEPTUAL MODEL AND ASSUMPTIONS

Quaternary terrace deposits are at the surface in Kinsey (Appendix A, Figure 7c). Quaternary alluvium lies at the surface along Sand, Spring, and Muster Creeks and the Yellowstone River. The terrace deposits are interpreted by Colton to be older than the stream and river alluvium and overly the Fort Union formation.

Members of the Fort Union are the only other outcropping geologic units in the area of Kinsey school (Colton, et.al., 1989). The Tongue River, Lebo, and Tullock are members of the Fort Union. The Tullock member is the only member present near Kinsey and is interpreted to underly the Quaternary terrace deposits. Thickness of the Tullock member is not possible to estimate without additional structural geologic data in the preliminary geologic map of the Terry quadrangle. No explanation exists yet for the map. The next geologic quadrangle to the south, the Miles City 30' x 60' quadrangle, estimates the thickness of the Tullock member to be 150 feet (Vuke, et. al., 2001).

The Hell Creek formation is the next lower stratigraphic unit. There is no estimated thickness given for the Hell Creek on the Terry quadrangle. The Miles City and Wibaux quadrangles are the quadrangles to the south and east, respectively. Estimated thickness of the Hell Creek in the Miles City quadrangle is 150 feet (Vuke, et. al., 2001). Estimated thickness of the Hell Creek in the Wibaux quadrangle is from 260 to 390 feet (Vuke, et. al., 1986).

The Kinsey school well is drilled to a depth of 519 feet and draws water from the interval between 415 and 490 feet (GWIC, Well Log, Appendix C). Given the depth of the Kinsey school well, erosion down to the Tullock member and an estimated thickness of 150 feet for the Tullock member, the Kinsey school well is likely finished in the Hell Creek formation. Table 3 lists wells, the listed aquifer each well is completed in, and the depth of the wells in the area surrounding Kinsey. Depths of wells known to be drilled in the Fort Union and Hell Creek formations range from 420 to 612 feet deep (GWIC).

The hydrogeologic relationship within the Hell Creek and between the Hell Creek and Fort Union formations is not directly known for the study area. Layers of clay and gumbo are reported in the subsurface in the area surrounding Kinsey. The well is likely confined to the Hell Creek formation due to the depth of the well and the thickness of the existing layers of gumbo and clay (Appendix C, Well Log). Nine wells in the Kinsey area (9N 48E, 10N 49E) known to be drilled in either the Fort Union/Hell Creek or Fox Hills-Hell Creek do not have well seal information. The lack of a seal on any number of these wells could pose a threat to the Kinsey PWS. The wells may be naturally sealed due to compression of sediments around the well pipe.

Due to the great distance between the Kinsey school well and outcrops of the Hell Creek formation, about 38 miles to the southeast and 40 miles to the west, a formal recharge area has not been delineated. Recharge to the Hell Creek beneath Kinsey likely comes from outcrops of the Hell Creek to the west of Kinsey, in Yellowstone and Mussellshell counties, along the east flank of the Porcupine Dome uplift. See Appendix A, Figure 7a for the location of outcropping Hell Creek formation, and Appendix A, Figure 7b for the location of the Porcupine Dome uplift. The structure contour map of basement rocks shown in Figure 7b accompanied by the general knowledge that groundwater within the Fox Hills-lower Hell Creek aquifer flows toward the Yellowstone River suggests that recharge to the aquifer in the area of the PWS is primarily from the west (Patton, et. al., 1997).

Table 3. Wells, associated aquifers, and depth of wells. Kinsey area.

Mnumber/GWIC ID	Aquifer listing	Depth of well (in feet)
22865	Tullock	160
1728	Fort Union/Hell Creek	543
1729	Fort Union/Hell Creek	612
1731	Fort Union/Hell Creek	420
22829	Fox Hills/Hell Creek	850
1730	Fox Hills/Hell Creek	850

WELL INFORMATION

The well from which Kinsey school gets water (source 002) is South of the old teacher's house, which is now a computer classroom, and about 55 feet East of the school (McNenny, 1995, Appendix D). This well was completed on May 1, 1961, drilled to a depth of 519 feet (GWIC, see well log in Appendix C). Four inch casing was installed to a depth of 42 feet. Two inch casing was installed from 42 feet to 519 feet, perforated from 415 feet to 519 feet. Annular seal information states that 39 bags of cement were used to seal the well, though a depth to which the well was sealed is not suggested in the well log. Based on this information, the aquifer used by the school's well is interpreted as a deep confined aquifer and is assigned a low sensitivity to potential sources of contamination in accordance with the Montana Source Water Protection Program (DEQ, 1999).

LIMITING FACTORS

No hydrogeologic investigations have been done around the Kinsey school area, so direct knowledge of hydrogeologic conditions does not exist. Exact thicknesses of formations in the Kinsey area are also unknown given available information. The aquifer is being treated as confined because it is drilled to a depth of 519 feet and is flowing artesian. Lithologic information in the well log states that two layers of gumbo (a fine-grained, smectite-rich, soil or clay that is impervious when wet) were drilled through, which likely seals the well from surface water, shallow groundwater, and interaquifer contamination via adjacent wells.

Table 4. Source well information for Kinsey School

Information	Well #1	Sources of Information
PWS Source Code	002	Sanitary Survey
MBMG #	22819	GWIC
Water Right #	N/A	GWIC
Legal Location	9N, 48E, 02BBAB	GWIC
Latitude/Longitude	45.5703°/ 105.6561°	GWIC
Date Completed	1961	GWIC
Well Depth	519	GWIC
Perforated Interval	415 to 519 feet	GWIC
Static Water Level Depth	Artesian, 13 psi	Sanitary Survey
Pumping Water Level Depth	Unknown	Sanitary Survey
Drawdown	Unknown	Sanitary Survey
Test Pumping Rate	Unknown	Sanitary Survey
Specific Capacity	Unknown	Sanitary Survey
Source Type	Fort Union (125FRUN)	Terry 30’x60’ Geologic Quadrangle

CHAPTER 3
INVENTORY

Montana Source Water Protection Program (DEQ, 1999) requires that land uses and all potential contaminant sources be identified within the control zone and inventory region of non-transient non-community public water supplies. Inventory of potential sources of contamination was conducted for Kinsey school within the control and inventory regions. The significant potential contaminants in the Kinsey School inventory region are nitrate, pathogens, fuels, solvents, and agricultural chemicals.

The inventory for Kinsey School focuses on all activities in the control zone and certain sites or land use activities in the inventory region.

INVENTORY METHOD

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

Step 1: 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 use 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). 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: The Permit Compliance System (PCS) was queried using Envirofacts (http://www.epa.gov/enviro/) to identify Concentrated Animal Feeding Operations with MPDES permits. The water system operator or other local official familiar with the area included in the inventory region identified animal feeding operations that are not required to obtain a permit.

Step 4: Databases were queried to identify the following in the inventory region: Underground Storage Tanks (UST) (http://webdev.deq.state.mt.us/UST/), hazardous waste contaminated sites (DEQ hazardous waste site cleanup bureau), landfills (http://nris.state.mt.us/gis/datalist.html), abandoned mines (http://nris.state.mt.us/gis/datalist.html) and active mines including gravel pits. Any information on past releases and present compliance status was noted.

Step 5: A business phone directory was queried to identify businesses that generate, use, or store chemicals in the inventory region (infoUSA, Inc., 2002). Equipment manufacturing and/or repair facilities, printing or photographic shops, dry cleaners, farm chemical suppliers, and wholesale fuel suppliers were targeted by SIC code.

Step 6: Major road and rail transportation routes were identified throughout the inventory region (http://nris.state.mt.us/gis/datalist.html).

Step 7: All wells located within the inventory region were identified and well logs were obtained when available.

Step 8: The 1929 Sanborn Insurance Co. fire maps were reviewed to identify historic sources of potential contaminants.

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.

A list of significant potential contaminant sources for the Kinsey school is given in Table 5. In addition, known underground storage tanks (UST's) and leaking underground storage tanks (LUST's) are listed in Tables 6 and 7, respectively. The LUST's and UST's may not show up in writing in this report or in the diagrams in Appendix A due to inaccurate or unknown location information.

INVENTORY RESULTS/CONTROL ZONE

Kinsey School owns most of the land within the 100-foot control zone. This was determined by the ortho photo of the vicinity (Appendix A, Figures 3 and 4). The lone hazard within the control zone of the Kinsey school PWS is a septic tank owned by the school. The septic tank lies 25 feet to the east of the Kinsey school well (verbal communication, Duaine Bundy, PWS operator, Appendix A, Figure 4). Normally, the close proximity of a septic tank to a well would be a concern, however, the well appears to be sealed from surface contaminants and is artesian.

INVENTORY RESULTS/INVENTORY REGION

Land cover information for the Kinsey School inventory region (Appendix A, Figure 8) was summarized from the National Landcover Dataset, Montana (USGS, 2000). In addition, a pie chart showing land use breakdown is included (Appendix A, Figure 9). Land cover within the 1-mile inventory zone of the Kinsey school includes 43% small grains, 29% Pasture/Hay, 14% Row Crops, 9% Fallow, 3% Grassland/Herbaceous, and 2% Commercial/Industrial/Transportation, Deciduous Forest, Evergreen Forest, Shrubland, and Open Water. Agricultural land is considered a significant contaminant source, and at 95% is given a high hazard rating. The hazard posed by agriculture is attenuated by the depth of the well, the fact that the well is artesian, and the two thick layers of gumbo seen in the lithologic log for the well (Appendix C, Well Log).

Two main roads lie in the inventory region, Kinsey road (east-west trending) and Lower road (southwest-northeast trending) (Appendix A, Figure 5). Both roads are secondary roads, so the hazard posed by both is considered low.

Table 5. Significant potential contaminant sources for the Kinsey School.

Source	Contaminants	Description
LUST/UST	VOC's, SOC's, inorganics	Contaminants leaching to groundwater
Highways	All	Contaminants leaching to groundwater
Railways	All	Contaminants leaching to groundwater
Cultivated cropland	Pathogens, nitrates, agchemicals	Nitrates, pathogens, and agchemicals leaching to groundwater
Septic Systems	Pathogens and Nitrates	Nitrates and pathogens leaching to groundwater

ADDITIONAL INVENTORY RESULTS

No formal recharge region was delineated for the Kinsey school PWS because the aquifer is confined, the well is artesian, and the distance between the well and the nearest outcrop of the Hell Creek formation is about 40 miles to the west and 38 miles to the souteast

(Ross, et. al., 1955).

The septic density in the area of Kinsey is low, so the hazard associated with septic density is low (Appendix A, Figure 2).

There are two pipelines southwest of the Kinsey school running southwest to northeast (Appendix A, Figure 6). Both pipelines are outside the inventory region. One is an oil pipeline and the other is a Federal Montana Interstate pipeline. The Federal Interstate pipeline is a pipeline owned by the state of Montana that is used by a number of companies to transport crude oil. It is not known if the pipeline is used for the transfer of any other product. The portions of the pipelines that would be of concern for the Kinsey school are down gradient of the school well and thus are given low hazard ratings. Again, the already low hazard of the pipelines is further attenuated by the artesian well, the confining layers of gumbo.

A hazardous spill site is also shown in Appendix A, Figure 6. The spill site is over two miles east of Kinsey on the south banks of the Yellowstone River, down gradient from the Kinsey school well. Given the location of the site, the spill site is given a low hazard rating.

Table 6. Underground Storage Tanks Listed with the Montana DEQ.

AltFacilityID	Facility Name	Street Address	City	County	ActiveTanks	NonactiveTanks
09-03213	Cenex	Kinsey Road	Kinsey	Custer		2
09-04459	Meidinger Farms Incorperated	Address Unknown	Kinsey	Custer		2
09-03809	Miller, Charlotte	Tract #58	Kinsey	Custer		1
09-05675	Viall, Jerome D	Kinsey Rt	Kinsey	Custer		1
09-08372	Ziebarth, Bill	Address Unknown	Kinsey	Custer		1

Table 7. Leaking Underground Storage Tanks listed with Montana Department of Environmental Quality.

City	SiteName	Location	AltEventID	Date	Confirmed Release Date	Project Officer	Active
Kinsey	MEIDINGER FARMS INCORPERATED	Address Unknown	0904459*1639	30-Apr-93	30-Apr-93		No

INVENTORY UPDATE

The certified operator will update the inventory for his or her records every year. Changes in land uses or potential contaminant sources will be noted and additions made as needed. The complete inventory will be submitted to DEQ every five years to ensure re-certification of the source water delineation and assessment report.

INVENTORY LIMITATIONS

The potential sources of contamination for the Kinsey School have been identified using readily available data and reports. Unregulated activities or unreported contaminant releases may have been missed. The use of multiple sources of data, however, should ensure that the major potential contaminant threats to the Kinsey School are known.

CHAPTER 4

SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case Kinsey School.

The goal of Source Water Management is to protect the source water by controlling activities in the control zone and managing significant potential contaminant sources in the Inventory Region. 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 Kinsey School to reduce susceptibility are recommended.

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers (Table 8) that decrease the likelihood that contaminated water will flow to the Kinsey School well. Hazard for confined aquifers is low if all wells in the inventory region are constructed to current state standards. Hazard is high if the PWS well is not sealed into the confining layer and moderate if only other wells are not properly constructed.

Table 8. Relative susceptibility to specific contaminant sources as determined by hazard and the presence of 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

Susceptibility ratings are presented in Table 9 for each significant potential contaminant source and each associated contaminant. The well itself is located in the Hell Creek formation at a depth of 519 feet. The well appears to be sealed from the surface due to depth and the presence of a number of impermeable layers shown in area well logs (GWIC). The PWS well is flowing artesian, so the aquifer is confined from the surface. Thus, the overall susceptibility of the Kinsey School well to potential contaminant sources is rated low.

Table 9. Susceptibility assessment for significant potential contaminant sources in the Inventory Region**.**

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management
School Septic Tank	Nitrates, Pathogens, agchemicals	Nitrates, pathogens, & agchemicals leaching to groundwater	High	Depth to Water, confined aquifer, well is sealed	Low	Monitor groundwater to ensure contaminants do not impact PWS
Cultivated cropland	Nitrates, pathogens, agchemicals	Nitrates, pathogens, & agchemicals leaching to groundwater	High	Depth to Water, confined aquifer, well is sealed	Low	Use best management practices & apply agchemicals according to labels
Oil Pipeline	Oil, Gasoline, VOC's	Spills and VOC's dissolving in groundwater	High	Depth to Water, down gradient, outside inventory region	Low	Active System Integrity Inspection program to isolate leaks.
Federal Montana Interstate Pipeline	Oil, Gasoline, VOC's	Spills and VOC's dissolving in groundwater	High	Depth to Water, down gradient, outside inventory region	Low	Active System Integrity Inspection program to isolate leaks.
Spill Site	Unknown	Unknown	Low	Depth to Water, down gradient, outside inventory region	Very Low	Investigate area around site to determine if further threat exists
Abandoned and active septic systems	Nitrates and pathogens	Nitrates and Pathogens leaching into groundwater	Low	Depth to Water, confined aquifer	Very Low	Monitor groundwater to ensure contaminants do not impact PWS
Kinsey Road	All	VOC's, SOC's leaching into groundwater, etc.	Low	Depth to Water, confined aquifer	Very Low	I mplement an emergency response plan
Lower Road	All	VOC's, SOC's leaching into groundwater, etc.	Low	Depth to Water, confined aquifer	Very Low	Implement an emergency response plan

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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.

Community. A town, neighborhood or area where people live and prosper.

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 ground water 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.

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.

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

Hydrologic Unit Codes (HUC). Uniform, nationally consistent map codes for river basins.

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

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

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 – Ground Water 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 ground waters 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 ground water. 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. 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. A source water management region that is generally 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 ground water 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 ground water 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.

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 which evaporate readily to the atmosphere.

Watershed. The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common delivery point.

* With the exception of the definitions for Phase II and Phase V Rules, definitions were adapted from EPA's Glossary of Selected Terms and Abbreviations which can be found at:
http://www.epa.gov/ceisweb1/ceishome/ceisdocs/glossary/glossary.html

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

APPENDICES

APPENDIX A

FIGURES

APPENDIX B

SITE PLAN

APPENDIX C

WELL LOG(s)

APPENDIX D

SANITARY SURVEY

APPENDIX E

HAZARD AND BARRIER WORK SHEETS

APPENDIX A

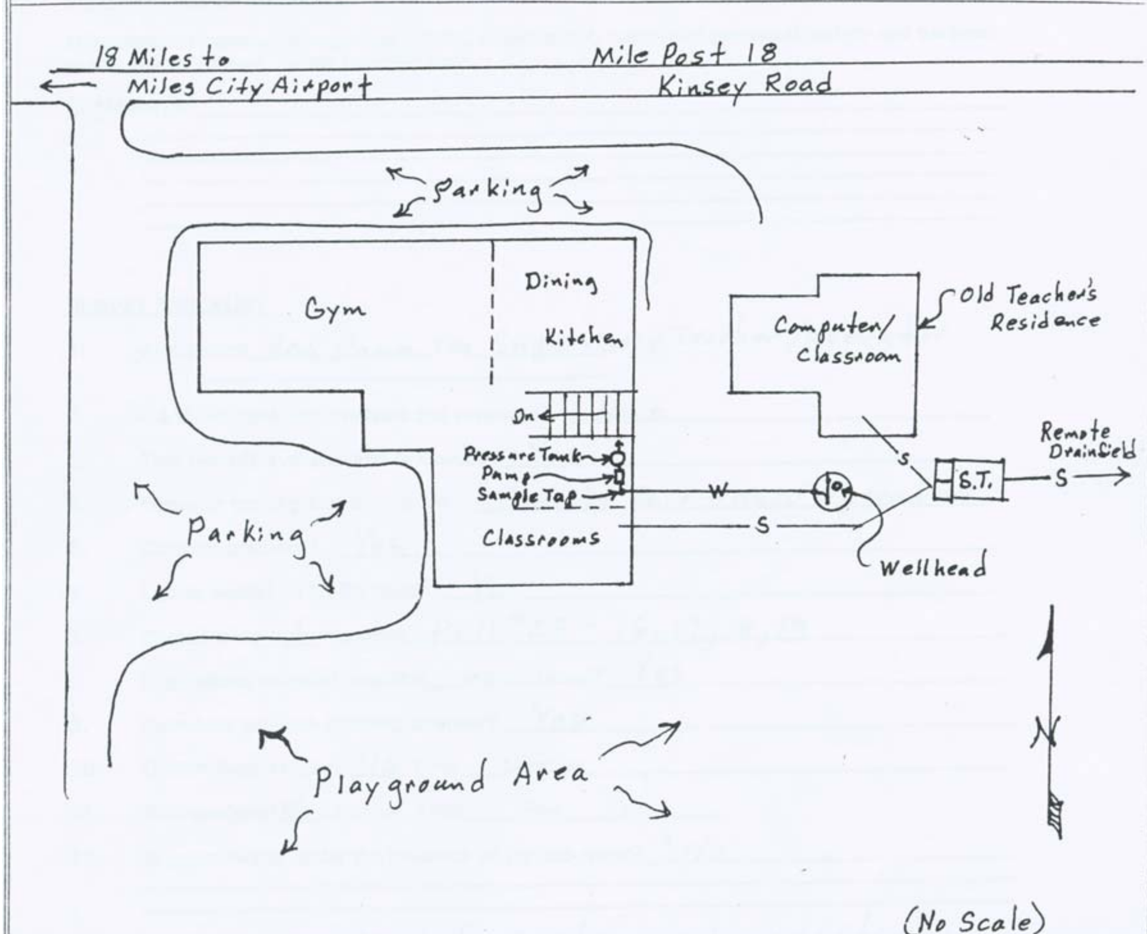
FIGURES

APPENDIX B

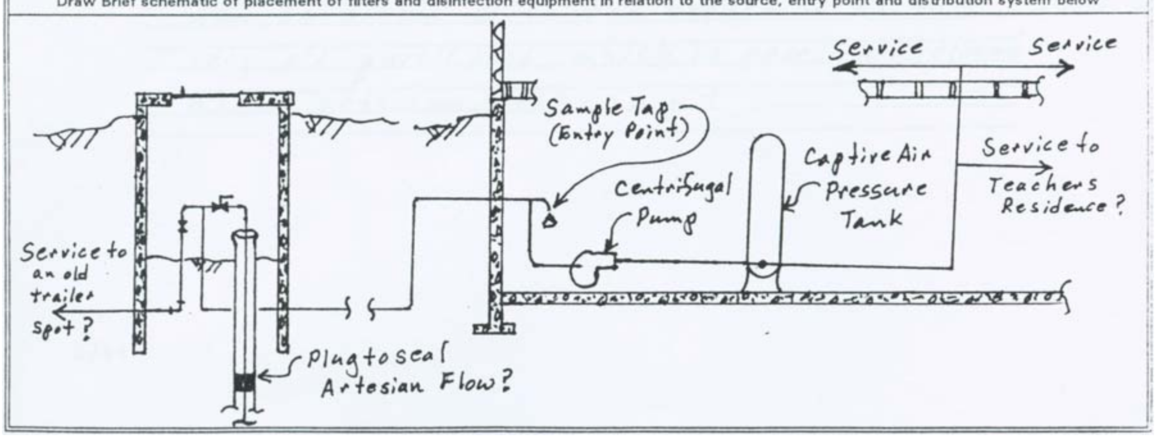
SITE PLAN

SANITARY SURVEY FORM - DIAGRAMS

Draw brief schematic showing location of well(s), springs(s), water storage, distribution system, pumphouse(s), entry point(s), etc.



Draw Brief schematic of placement of filters and disinfection equipment in relation to the source, entry point and distribution system below



APPENDIX C

WELL LOG

Montana Bureau of Mines and Geology
Ground-water Information Center Site Report
KINSEY SCHOOL DISTRICT #63

Plot this site on a topographic map

Location Information

GWIC Id:	22819	Source of Data:	LOG
Location (TRS):	09N 48E 02 BBAB	Latitude (dd):	46.5703
County (MT):	CUSTER	Longitude (dd):	-105.6561
DNRC Water Right:	Not Reported	Geomethod:	MAP
PWS Id:	01191002	Datum:	1927
Block:	Not Reported	Addition:	Not Reported
Lot:	Not Reported	Type of Site:	WELL
Certificate of Survey:	Not Reported		

Well Construction and Performance Data (measurements are reported below land surface)

Total Depth (ft):	519.00	How Drilled:	Not Reported
Static Water Level (ft):		Driller's Name:	Not Reported
Pumping Water Level (ft):		Driller License:	Not Reported
Yield (gpm):	8.00	Completion Date:	May 01, 1961
Test Type:	Not Reported	Special Conditions:	None Reported
Test Duration:		Is Well Flowing?:	YES
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	Not Reported
Recovery Time (hrs):		Well/Water Use:	PUBLIC WATER SUPPLY

Hole Diameter Information

No hole diameter records were found.

Casing Information

From (ft)	To (ft)	Dia (in)	Description
0.0	42.0	4.0	
42.0	519.0	2.0	

Annular Seal Information

From (ft)	To (ft)	Description
0.0	0.0	39 BAGS OF CEMENT

Completion Information

From (ft)	To (ft)	Dia (in)	Description
415.0	519.0	2.0	104 FT OF PERFORATIONS

Lithology Information

From (ft)	To (ft)	Description
0.0	34.0	SANDY CLAY
34.0	45.0	GRAVEL
45.0	320.0	GUMBO
320.0	350.0	SAND SMALL FLOW
350.0	400.0	GUMBO
400.0	490.0	WATER SAND
490.0	519.0	GUMBO

Site Notes

TRACT LOCATION BASED ON LAT\LONG FROM DEQ.

APPENDIX D

SANITARY SURVEYS

APPENDIX E

HAZARD AND BARRIER WORKSHEETS

Hazard Determination - Significant Potential Contaminant Sources for Wells

PWSID 01191
Well ID 002

Hazard *Time-of-Travel (years):*	*High* <1	*Moderate* 1-3	*Low* >3
A. Animal Feeding Operations			
A1.			
A2.			
B. Wastewater Treatment, Spray Irrigation, Lagoons			
B1.			
B2.			
C. Spill Threat: Highway, Railway, or Pipeline			
C1. Oil Pipeline	●		
C2. Federal MT interstate Pipeline			
D. Underground Storage Tanks			
D1.			
D2.			
D3.			
E. Known Groundwater Contamination Sites			
E1.			
E2.			
E3.			
E4.			
E5.			
F. Other Significant Point Contaminant Sources			
F1. School Septic Tank			
F2. Kinsey Road			
F3. Lower Road			
F4. Spill Site			
F5.			
G. Injection Wells			
H. Sanitary Sewer Mains			
I. Storm Sewer Outflows			
Number / Sq. Mile:	*>300*	*50 - 300*	*<50*
J. Septic Systems (unsewered residential)			X
Percent:	*>50*	*20-50*	*<20*
K. Cropped Agricultural Land	95%		

Natural Barriers – Significant Potential Contaminant Sources

PWSID 01191
Source 002

Wells: A – Continuous Clay Layer; B – Depth to Water > 100 ft.; C – Upward Gradient; D – Dilution; E - Natural Attenuation

Surface Water: A - Dilution; B – Forested Riparian Zone > 50 ft.

ID#	Facility Name	Barrier Type	Description
Significant Point Sources Including Underground Storage Tanks			
1	School Septic Tank	B, A	Well is sealed
2	Kinsey Road	B, A	
3	Lower Road	B, A	
4	Spill Site	B, C	Located Remotely
Ground Water Remediation Sites			
Animal Feeding Operations			
Wastewater Treatment, Spray Irrigation, Lagoons			
Spill Threat: Highway, Pipeline, or Railway			
5	Oil Pipeline	B, C	Located Remotely
6	Federal MT Interstate Pipeline	B, C	"
MPDES Wastewater Discharges			
Injection Wells			
Sanitary Sewer Main			
Storm Sewer Outfall			
Septic Systems			
7	Low Density	B, A	
Cropped Agricultural Land			
8	95% High Hazard	B, A	Well is Sealed

Susceptibility Assessment – Significant Potential Contaminant Sources

PWSID 01191
Source 002

Contaminant Source ID #	Hazard	Hazard Rating	Barriers	Susceptibility
1	Nitrates / Pathogens	High	Depth to water, confined, well sealed	Low
2	VOC's, SOC's etc.	Low	Depth to Water, confined aquifer	Very Low
3	VOC's, SOC's, etc.	Low	Depth to water, confined aquifer	Very Low
4	Unknown	Low	Depth to water, down gradient, remote locale	Very Low
5	Oil, Gas, VOC's	High	"	Low
6	Oil, Gas, VOC's	High	"	Low
7	Nitrates / Pathogens	Low	Depth to water, confined aquifer	Very Low
8	Nitrates / Pathogens Ag chemicals	High	Depth to water, confined, well sealed	Low