Libby Dam Project
Public Water Supply

PWS ID # MT0002582

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Date of Report: 01 May 2006

Report Prepared For:
Libby Dam Project
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INTRODUCTION

Jeffrey Frank Herrick, a hydrogeologist with Montana Department of Environmental Quality (DEQ) – Source Water Protection Program (SWPP) completed this Delineation and Assessment Report. This report was prepared for:

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Purpose

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Libby Dam Project PWS as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182).

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to 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 of mapping source water protection areas, which contribute water used for drinking. Assessment involves identifying locations or regions in source water protection 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 twofold, to provide information that helps the Libby Dam Project PWS protect its drinking water source and to lay the groundwork for the development of source water protection planning.

Limitations

This report was prepared to assess threats to the Libby Dam Project PWS public water supply, and is based on published information and information obtained from persons familiar with the community. The terms “drinking water supply” or “drinking water source” refer specifically to the source of the Libby Dam Project public water supply and not any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the area of the PWS are identified. Only potential sources of contamination in areas estimated to 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 be significant health threats.

CHAPTER 1
BACKGROUND

The Community and Setting

The Libby Dam and Lake Koocanusa are located in northwestern Montana's Lincoln County. The Libby Dam Project PWS facility is found on the north shore of the Kootenai River near the substation at Libby Dam and east from the incorporated City of Libby. It is situated at about 2,080 feet above mean sea level. The nearby City of Libby is found at the intersection of Montana Highway 37 and U.S. Highway 2 (Figure 1). Libby is approximately 97 miles west of Kalispell. According to 2000 United States Census data, Libby has a population of 2,626 people. According to U.S. Census data, major industries in Lincoln County include educational, health, and social services, retail trade, and manufacturing. Median household income for the county is around $26,754. Evergreen forest covers most of the area, as is common in western Montana (Figure 2 and 3).

The climate in the area is typical of other lower elevation intermontane basins in the northern Rocky Mountains west of the continental divide. As is shown in Table 1, high and low temperatures average 31.5° and 15.6° F in January and 87.9° and 46.2° F in July. The area receives 17.8 inches of precipitation annually, and the average snowfall is 54.9 inches yearly. Snow falls mostly in December, January, and February.

Table 1. Climatic Data

Libby Ranger Station, Montana (245015)
Period of Record: 6/ 9/1895 to 9/30/2005 (from wrcc@dri.edu)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	31.5	40.1	50.1	61.7	71.1	78.4	87.9	86.8	75.0	59.0	40.5	32.1	59.5
Average Min. Temperature (F)	15.6	19.1	24.4	30.2	36.9	43.3	46.2	44.5	38.4	32.3	25.5	18.9	31.3
Average Total Precipitation (in.)	2.01	1.39	1.32	1.01	1.39	1.59	0.87	0.94	1.18	1.55	2.26	2.31	17.82
Average Total Snowfall (in.)	17.6	7.8	4.0	0.3	0.0	0.0	0.0	0.0	0.0	0.5	6.6	18.1	54.9
Average Snow Depth (in.)	9	9	4	0	0	0	0	0	0	0	2	5	2

General Description of the Source Water

The one (1) Libby Dam Project public water supply (PWS) well is located approximately as seen on Figure 3. It draw water from the sand and gravel deposits that lay directly on top of the fractured bedrock and from the upper portion of the fractured bedrock within the bottom of the Kootenai River valley. An examination of well logs for the PWS well and other wells found in the neighborhood confirm the presence of a laterally extensive confining unit above water-bearing fractures in the upper part of the bedrock. For the purposes of this report, the local fractured bedrock aquifer beneath the PWS is considered confined. Groundwater flow is described as moving southwest and subparallel to the surface flow in the Kootenai River. Recharge to the local aquifer probably occurs from recharge out of the nearby spillway and from upward migration of water moving through fractures in the deeper bedrock.

Figure 1. Libby Dam Area

Figure 2. Vicinity Map

Figure 3. Location Map

It appears that there is a community sewer collection system servicing the various facilities associated with the Libby Dam with a wastewater treatment plant (the specific location isn't known). The treatment plant appears to discharge the treated effluent into the Kootenai River and a summary of the discharge permit is included in Appendix B.

The Public Water Supply

Based on DEQ records, the Libby Dam Project public water supply serves a total population of 95, which is made up of 50 transients (visitors) and 45 non-transients (day workers). The number of users will vary somewhat from season to season. The water is delivered through 5 active residential service connections and it appears that none of the connections are metered. According to the most recent Sanitary Survey (1999), 1 well is on the system and is designated Well #1 Powerhouse. Details of the well are summarized on Table 2. The system provides water to the entire dam facility as well as the visitor's center, campground, and picnic area at Souse Gulch.

PWS Well Information

Included in Appendix B are the well logs for several wells found in proximity to the PWS wells. Information regarding the wells at the Libby Dam Project PWS is summarized in Table 2 below. The original PWS well log and the MBMG GWIC well logs are found in Appendix B.

Table 2. PWS Source/Well Information

Libby Dam Project PWS (#MT0002582)

Source Name	**Well 1 - Powerhouse**
Location	Located Near the Powerhouse
Source Code	WL002
Status	Active
MBMG GWIC #	88201
Water Right #	Unknown
Date completed	23 November 1966
Total Depth (feet bgs)	65
Depth of Casing (feet bgs)	58
Depth of Grout Seal (feet bgs)	No record on the log
Perforated Interval (ft bgs)	48-58
Static Water Level (ft bgs)	19
Pumping Water Level (ft bgs)	28
Draw Down (ft)	9
Test Pumping Rate (gpm)	120
Yield (gpm)	120

PWS Facilities Information

Well #1 – the Powerhouse Well supplies water to the system. The information on the facilities associated with this PWS is summarized on Table 3 below. This table is derived from the most recent Sanitary Surveys (in Appendix B) and a printout of the DEQ PWS database (Appendix A).

Table 3. PWS Facilities and Well Information

Libby Dam Project Public Water Supply (#MT0002582)

PWS Class	Non-Community Non-Transient
Well/Intake Source Code	WL002
Well/Intake Name	Well 1 – Powerhouse
Status	Active
Treatment Facility	TP002 With EPGWCL EP for GW CL, sample point
Treatment System	Chlorination for Well 1, in the chlorine room at the treatment building prior to entering the reservoir. Sodium Hypochlorite – WASCLOR
Pressure Control Assembly	PC001 Pressure Control Assembly Active
Pump Facility	PF001 With EP502, EP ST Tank, sample point This is a 900 gallon tank is located in the chlorine room below the reservoir, regulates pressure to the bathrooms at the visitors center
Storage Facility	33,000 gallon reservoir, concrete, enclosed
Distribution System	DS001 Distribution System Active With SP001, SP for DS, sample point With DBPMAX1

Water Quality

Over the past 10 years coliform bacteria have never been detected during routine samplings of water from the system. It appears that all disinfection byproducts measured in the distribution system have been present only in trace amounts and always below the EPA’s maximum contaminant level (MCL). Nitrate levels have ranged between 0.59-1.33 mg/L, which is below the EPA’s MCL of 10 mg/L. No other analyses have indicated the presence of any of the remaining regulated contaminants in noteworthy levels over the past 10 years. A printout of the analytical data of water samples over the last 10 years is found in the form of a DEQ PWS database printout, which is contained in Appendix A.

CHAPTER 2
DELINEATION

Delineation Process

The source water protection regions are identified in this chapter. They are the delineated land areas that contribute water to the wells at the Libby Dam Project PWS. Three management or source water protection regions are usually identified. These three regions are the Control Zone, Inventory Region, and Recharge Region. The Control Zone, also known as the exclusion zone, is an area at least 100-foot radius around the PWS wellhead, spring collection box, or surface water intake. Human activity in this area can have an immediate impact on water quality by introducing contaminants into the area directly above a well screen or other intake structure. As such, management of this Control Zone is critical to protect a PWS. For groundwater sources the Inventory Region usually represents the zone of contribution of the well, which can approximate a three-year groundwater time-of-travel distance or a 1-mile radius around a wellhead. The Inventory Region comprising a 1-mile radius circle around a well is often a conservative value that is used either for convenience or when insufficient geologic or hydrogeologic information is available about an area or details are lacking on the construction of a production well. In certain circumstances where a PWS well taps into an aquifer that has been characterized as being confined, the Inventory Region can be limited to an approximate 1,000-foot radius around the wellhead, and the inventory of potential contaminant sources is only completed for those sources within 1,000-feet of the well. Activities or contaminant releases within the Inventory Region have the potential to reach a PWS well in a period approximating less than 3 years. The Recharge Region represents the entire portion of the aquifer or an area that contributes water to the local aquifer and over time supplies water to a well. This extended region of groundwater recharge is often, but not always, inclusive of the limits of a watershed. At times an entire watershed is too large to be realistically manageable by a PWS or community, so a subsection of that watershed is delineated as the Recharge Region. Long-term water quality at a PWS can be affected by contaminant releases or certain land use activities in the Recharge Region. Table 4 summarizes how these source water protection regions are determined.

Table 4. Criteria for Delineating Source Water Protection Regions

If Your Source of Water Is	Delineate These Water Protection Regions	Method For Each Region	Minimum Distance Values & Type of Inventory Required
Ground Water that is: • Unconfined or Semi-confined*	Control Zone Inventory Region Recharge Region	Fixed radius Fixed radius Topography	Distance - 100 feet Distance - 1 mile or 3 year groundwater TOT Limits of the watershed
• **Confined**	Control Zone Inventory Region Recharge Region	Fixed radius Fixed radius Topography	Distance - 100 feet Distance - 1000 feet Limits of the watershed
*Ground Water that is hydraulically Connected to Surface Water also needs the following ------------------->>	Surface Water Buffer Zone	Fixed Distance	In addition to the Inventory Region, a one-half mile surface water buffer will extend upstream a distance corresponding to a 4-hour TOT but not to exceed ten miles or the nearest intake. The buffer will not exceed the extent of the watershed. Inventory is limited to pathogens and nitrate sources.
Surface water*	Spill Response Region Watershed Region	Fixed Distance Topography	One-half mile buffer extending upstream a distance corresponding to a 4-hour TOT but not to exceed ten miles or the nearest intake. Buffer will not exceed the extent of the watershed. Inventory is for all regulated contaminants for that PWS. Limits of the watershed

Note: TOT is the groundwater time-of-travel. This is the calculated distance groundwater will travel in a 1-year or 3-year time.

Hydrogeologic Conditions

The following is a description of the sediments, bedrock, and groundwater in the Libby valley and along the Kootenai River valley. This information is relevant because the rock units and sediments comprise the aquifer(s) (the water bearing formations) into which the Libby Dam Project PWS wells are installed. The hydrogeology is a description of the presence and movement of groundwater in the bedrock and within the valley fill materials. This discussion is intended to help the reader understand where the PWS wells are obtaining their groundwater and the vulnerability of that source of water to potential contamination. See Figure 4 for a surficial geologic map of the area. Much of the following discussion of geology and hydrogeology is taken from the USGS Report 96-4025 (Kendy and Tresch, 1996).

Geology

The Libby Creek Valley formed by extension along normal faults on the east and west basin margins. The mountains to the east and west are up-thrown blocks relative to the valley floor. It appears that the Kootenai River has exploited and moves through similarly formed valleys and faults that have broken perpendicular to the bedding in the native rock. The depth of the bedrock floor (and hence the thickness of valley fill) is unknown in the Libby Valley. The deepest well in the center of the Libby valley is 576 feet deep and did not penetrate bedrock. The dept to bedrock in much of the Kootenai River valley east of Libby is probably consistently less than 100 feet. The bedrock and mountains of the region are Middle Proterozoic rock of the Belt Supergroup. The argillite, quartzite, and siltite rocks are folded, faulted, and fractured in a generally north-northwestern trend (Figure 4). Tertiary sediments overlie the bedrock in most of the deeper intermontane basins of the Northern Rocky Mountains. The Tertiary is a period that occurred between the Mesozoic Era (>65 m.y. before present) and the Quaternary Period (<1.8 m.y. before present), which is prior to the recent glaciations. Tertiary sediments do not crop out in the area and drillers or geologists are not able to recognize these older sediments during well drilling. Quaternary (<1.8 m.y. old) deposits in the area include glacial till, glacial lakebed deposits, and alluvial deposits. More than 500 feet of glacial till are thought to be present in some of the larger valleys around Libby. Glacial till deposits are chaotic mixtures of boulders, gravel, sand, silt, and clay. Glacial till can often be seen as large clasts (cobbles and boulders) suspended in a finer-grained matrix (sand, silt, or clay). It should be noted that this area both north and south of the Libby Dam was subjected to intense glacial action. This area was the avenue of the repeated southward advance of the central lobe of the Kootenai Glacier, a major portion of the Cordilleran Ice Sheet. Smaller discontinuous fluvial deposits can be intermixed within the glacial till, are probably representative of paleo stream and river channels. The glacial till deposits form most of the higher lateral terraces seen around the Libby Creek and along most of the valleys scattered along the Kootenai River. Pleistocene glacial Lake Kootenai (and numerous recessional lakes (that were always present at the terminus of the receding glacier) repeatedly occupied the Kootenai River valleys and the Libby Valley. Glacial lakebed deposits (fine-grained and well sorted) generally underlie many of the terraces adjacent to lower elevation floodplains. Some of the lakebed deposits are believed to be up to 500 feet thick in the deeper valleys. They will be considerably thinner in the narrower and shallower valleys along the river. These lakebed units consist of clay, silt, and fine sand and are usually in very tabular flat-lying formations. The Holocene is the part of the Quaternary that is more recent than 10,000 years ago (since the Pleistocene glaciation). It appears that along the Kootenai River and Libby Creek there can be up to 100 feet of alluvial deposits consisting of well-sorted silt, sand, gravel, and cobbles. These alluvial deposits cut into and are deposited on top of both glacial till and glacial lakebed deposits. Well logs in the vicinity of the Libby Dam Project PWS well suggest that along this part of the river, bedrock is at around 45-55 feet below ground surface (bgs) and is covered by relatively well sorted fine sand and silt. During drilling of the PWS well, an enormous boulder was encountered within the fine-grained well-sorted sediment. This sediment appears to be lakebed sediments that contain a large ice-rafted dropstone that fell to the bottom of the lake and was buried by further sedimentation. The lithologic log for the Bonneville Power Assoc. well indicated that it was drilled to 90 feet bgs and did not hit bedrock. The locations of wells as provided by the Montana Bureau of Mines and Geology are rough approximations due to the inaccurate locations provided by the drillers. It's not clear to the author if the Bonneville Power Assoc. well was drilled up on a lateral terrace (which may account for its depth of sediment) or if it was drilled right along the river. The depth of bedrock beneath the actual riverbed is unknown, but is probably very shallow. A figure depicting the location of area wells was developed for this report and is found with their well logs in Appendix B.

<u>Hydrogeology</u>

Wells completed in Quaternary alluvial deposits can produce up to 500 gpm (gallons/minute). Beneath the flood plain near Libby, a 20 foot thick clayey layer locally separates the shallow alluvial aquifer (<40 feet bgs) from the deep (>60 feet bgs) alluvial aquifer. Both appear to be unconfined aquifers. Although more isolated from the surface, it appears that the deeper aquifer has been impacted by area contaminant sources. As such, the clayey layer does not prevent communication (groundwater flow) between the 2 aquifers. Interbedded Pleistocene glacial till and glacial lakebed deposits yield water to wells from discontinuous, possibly perched, water-bearing units. Some wells installed into these fluvial formations can produce up to 45 gpm, whereas wells installed into glacial lakebed deposits provide much smaller yields. Scattered sand and/or gravel lenses within the glacial till or lakebed deposits can provide adequate water for domestic use, but are generally not laterally extensive. This means that their ability to store groundwater and supply it to a well is not great. This results in low specific capacities for wells, with less than 1.0 gallon/minute/foot of drawdown in the wells. The Proterozoic bedrock that surrounds and underlies the basin and the river valleys is generally not a very good aquifer in its ability to hold and produce water to wells (dependant on the number of fractures in the rock). Well yields tend to be relatively low at <10 gpm. Yields will be greater if the bedrock contains more and laterally extensive fractures that can carry water to the well. Bedrock wells are usually located on the valley margins where alluvium is thin or absent. In some situations these bedrock wells are found in the center of one of the Kootenai River valleys, they can penetrate less productive glacial deposits and tap into the top of the underlying fractured bedrock.

Groundwater generally flows from the uplands toward the valley centers, then turns to follow surface streams toward the Kootenai River. It appears that near the streams and the river, groundwater will turn and it flows subparallel to the surface water flow. Precipitation and snowmelt, surplus irrigation water, subsurface flow upward from the underlying bedrock, and infiltration from surface streams all actively recharge the basin fill aquifers. Discharge is generally to the Kootenai River as well as to some of the larger tributary streams.

The sediments beneath the Libby Dam Project PWS were mapped as glacial till and/or glacial outwash (Qgl) (see Figure 4). The well log for the PWS Well #1 indicates a pretty simple stratigraphy is present and made up of finer-grained layers. These are silt and fine sand units that probably represent glacial lakebed sediments and do not appear to be productive water-bearing formations. These fine-grained units appear to rest directly on top of the bedrock. As such, the fractures present in the bedrock must collect, hold, and transmit groundwater to the PWS well. The static water levels in some of the wells along the river valley in this area were measured at between 19-30 feet bgs (mostly right around 20 feet bgs). The presence of a thick confining unit above the bedrock and shallow water level in the PWS well suggest that the water entering the well is rising up the well casing under pressure. This hydrostatic pressure (called head) is one of the ways that a confined aquifer is defined. So, for this SWDAR the local conditions indicate that the aquifer beneath the Libby Dam Project PWS is a confined aquifer. It is unknown to what extent the local aquifer beneath this area is influenced by the river, meaning that it's unknown how much water the river loses to the aquifer. It is probable that along this stretch at least some river water is entering the alluvial materials (or the fractured bedrock) beneath and along the river and at least some groundwater is discharged out of the alluvium back into the river. But if the sediments along the river are as fine-grained as seen in the well log for the Libby Dam Project PWS, then the exchange of water is not great. This has never been studied along this reach of the Kootenai River. The Kootenai River is around 300 feet south of the well. For the sake of this delineation, the author is assuming that the pumping well is not able to pull water from the river. This really says that any contamination found in the river may not be able to reach the well.

Figure 4. Geologic Map

Water entering the confined bedrock aquifer beneath the Libby Dam Project PWS comes from one or more primary sources. Recharge to the fractured bedrock aquifer in the mountains comes from direct precipitation and vertical infiltration in the highlands (the mountains) that may enter the area of the PWS from the north side migrating along the sediment-bedrock interface. If the aquifer is recharged from the north, it undoubtedly is recharged from beneath as groundwater flows upward out of the deeper bedrock fractures and collects beneath the fine-grained glacial lake sediments. This recharge from beneath is called a vertically upward groundwater gradient and is evidenced by the elevated water level in the well casing (there's upward pressure on the groundwater. Groundwater may also enter the area beneath the PWS well from drainage downward into the bedrock beneath the river channel and spillway. For this delineation and assessment, the author is assuming that a majority of the groundwater is entering the shallow fractured bedrock aquifer originates from the uplands to the north and comes from vertically upward flow of groundwater moving within the fractured bedrock. Groundwater flow beneath the well at the Libby Dam Project PWS is probably to the southwest.

Source Water Sensitivity

Based upon the hydrogeologic setting, the wells for this system are classified as having low source water sensitivity to contamination, as shown by highlighting below.

Table 5. Source Water (Aquifer) Sensitivity

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 Results

A 100-foot radius Control Zone is delineated around the wellhead. This is done in order to ensure that the area immediately surrounding PWS wells remains free of contamination. Thus 100-foot radius Control Zones have been delineated and inventoried around the well at the Libby Dam Project.

An Inventory Region was delineated around the Libby Dam Project PWS wells based upon the belief that the well is drawing its water from a confined aquifer. As such, a 1000-foot fixed radius circle Inventory Region is believed to be an appropriate estimate of the area that could contribute water to the aquifer beneath the Libby Dam Project and should be protective of public health (Figure 5). The Recharge Region for PWS well captures the area north of the dam and surrounds Lake Koocanusa. It should be noted that this area encloses the town of Rexford. Few noteworthy potential contaminant sources were found surrounding the lake during the inventory process (discussed in the next chapter), so a figure of the Recharge Region was not prepared for this SWDAR.

Limiting Factors

Groundwater behavior in general terms is reasonably well understood in the Libby valley, but is not easily predictable beneath specific locations in some of the surrounding valleys. Groundwater behavior is even more difficult to predict around a certain well that is drawing water from a specific depth. Groundwater flow direction fluctuates seasonally and from year to year. Here, several conservative assumptions were made in the delineation of the source water protection areas and the development of this report. Also, reliance on some basic hydrogeologic principals to define the aquifer boundaries and groundwater movement was employed. The SWDAR, however, can and should be revised if more data becomes available that alters the assumed groundwater confinement and its flow direction(s).

Figure 5. Inventory Region

CHAPTER 3
INVENTORY

Inventory Method

An inventory of potential sources of contamination was conducted for the Libby Dam Project PWS within the Control Zones, Inventory Region, and Recharge Region. Potential sources of all primary drinking water contaminants and *Cryptosporidium* were also identified and noted, however, only significant potential contaminant sources were selected for detailed inventory and the susceptibility evaluation that occurs in Chapter 4 of this SWDAR. It should be noted that the inventory emphasizes potential contaminant sources. Inclusion of a facility or business in the inventory does not indicate that it is an actual polluter, with the exceptions of known hazardous waste sites where past releases have occurred, areas with known onsite contamination, locations with leaking underground storage tanks (LUSTs), or wastewater dischargers.

The inventory for the Libby Dam Project PWS focuses on all activities in the Control Zone around the well, certain types of municipal and private facilities in the Inventory Region, and general land uses and large facilities in the Recharge Region. The following databases have been searched in an effort to identify generators, storage facilities, and land uses that could be potential generators of contamination in the Inventory Region.

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). Additionally, county tax records were examined to get a handle on the predominant agricultural land use in an area. Sewered and unsewered residential land uses were identified from boundaries of sewer coverage obtained from municipal wastewater utilities. Septic density (the density of private onsite septic systems) was determined based on the 2000 US Census and obtained from the Montana State Library's Natural Resource Information System (NRIS) Thematic Mapper (http://nris.state.mt.us/mapper/) and (http://nris.state.mt.us/wis/swap/swapquery.asp).

Step 2: As appropriate, 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 PWS system operator and/or system managers are familiar with the area included in the Inventory Region will have 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: Major road and rail transportation routes were identified throughout the Inventory Region (http://nris.state.mt.us/gis/datalist.html).

Step 6:. All land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the Recharge Region and identified on the base map.

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.

Inventory Results

Results of inventory for each of the three protection regions are presented below. A tabular summary is presented in Table 6 on the following page. A key piece of needed information is a better plot of the location of Well 1, the PWS well for the Libby Dam Project. If this well is actually located a little bit further north, then the Inventory Region encloses the power plant, a former UST/LUST site, and probably the wastewater treatment plan for sewerage. The author is counting on the site specific knowledge of the operators to plot the well and wastewater treatment plant accurately for this report.

Control Zone

The area around the wells is best seen on Figure 3 and Figure 5. From the maps presented along with Sanitary Surveys, the location of sewer lines or other facilities could not be determined.

Inventory Region

The Inventory Region is depicted on Figure 5. DEQ Permitting and Compliance records indicate that a wastewater treatment plant with a discharge to surface water is owned and operated by the US Army Corps of Engineers at the Libby Dam. This discharge is for treated sewerage and the treatment plant and discharge appear to be located at or very near to the powerhouse. The plant is probably a small package plant. A record of this sewage treatment facility is found in Appendix B, but the precise location of the plant was never determined. For the purposes of this report, it will be conservatively assumed that the sewage treatment plant is located within the Inventory Region. Sewer lines probably run between the various buildings and the wastewater treatment plant. The location of these lines is unknown, but it is assumed that at least a few may cross through the Inventory Region. A former UST (underground fuel storage tank) was also located at or very near the powerhouse. When it was removed, it was found to have leaked and is identified in DEQ records as a LUST (leaking underground fuel storage tank) site. No further information was found regarding the former UST or the status of any contamination at the site.

Table 6. Potential Contaminant Sources
Libby Dam Project PWS

Source	**Contaminants**	**Description**
Sewer Treatment Plant And Wastewater Discharge to Surface Water	Pathogens, nitrates, other organic and inorganic chemicals	If this system fails, it may not completely eliminate nitrate and pathogens from the effluent. If a failure occurs, effluent may reach shallow groundwater and migrate southwest toward the PWS well.
Sewer Lines between various facilities that cross the Inventory Region.	Pathogens, nitrates, other organic and inorganic chemicals	Sewer lines can chronically leak untreated effluent to the subsurface. In some cases large volumes of effluent can leak from failed joints or pipes. If these leaks are located upgradient from a well, the threat of contamination can be considerable.
Former UST, LUST Site	VOCs, petroleum hydrocarbons	If any petroleum impacted soil/sediment remains in-place, this contamination could leach further downward to reach groundwater. If impacted, groundwater could migrate toward the PWS well.

For the purposes of this report, the Libby Dam powerhouse and the power substation are not considered potential sources of contamination. This is because there is no record that they have currently or in the past, contained large volumes of PCB enhanced transformer oils or that any PCB transformer oil has been released at the site.

Inventory Update

To make this SWDAR a useful document in the years to come, the owners, managers, or the water system operators for the Libby Dam Project public water supply should update the inventory for their records every year. Changes in land uses or the presence of new potential contaminant sources should be noted and additions made as needed. This updated inventory should be submitted to DEQ at least every 5 years to ensure that this report/plan stays current in the public record.

Inventory Limitations

The extent of the potential contaminant source inventory is limited in several respects. The inventory is based on data that is readily available through state documents, published maps and reports, GIS data, and discussions with people that are familiar with the area. Also, documentation may not be readily available on some potential sources. This is the case with the sewage treatment plant and sewer lines that are present within or nearby the Inventory Region. This SWDAR assumed that these facilities are located within or nearby the PWS. The location of the PWS well is also an estimate. This estimated location dictates the boundaries of the 1,000-foot radius Inventory Region boundary. In any event, all potential contaminant sources may not have been identified or recognized as being significant potential contaminant sources. The author of this SWDAR is depending on local PWS owners and/or operators for site-specific knowledge. Their initial review of this document is sought and their comments will be incorporated.

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 concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case the Libby Dam Project PWS owners and the operator. 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 owners and the operator to reduce susceptibility are recommended in this chapter.

Hazard Determination

The Susceptibility of the Libby Dam Project PWS production well to various types of contamination is assessed in the following paragraphs. 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 7). Hazard and the existence of barriers to contamination determine susceptibility, which is described in Table 8. Table 7 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 confined aquifers. The determination of hazard is somewhat different for other types of water sources. Records on the well log do not indicate that the casing was adequately grouted (sealed). Sealing of a well is the placement of clay or cement grout between the outside of the casing and the wall of the drill hole. This is done to reduce the likelihood that contamination can migrate up or down that annulus and impact groundwater. As such, the column titled "The PWS well is not sealed through the confining layer" is used to determine hazard. Any point sources within the Inventory Region is assigned a high hazard.

Table 7. Hazard of Potential Contaminant Sources
For wells drawing water from confined aquifers

Potential Contaminant Source	The PWS well is not sealed through the confining layer	Other wells in the inventory region are not sealed through the confining layer	All wells in the inventory region are sealed through the confining layer
Point Sources	**High Hazard**	**Moderate Hazard**	**Low Hazard**
Septic Systems (# per square mile)	High: >300 Moderate: 50 to 300 Low: <50	Moderate: >300 Low: 50 to 300	Low
Sanitary Sewer (% land use)	High: >50 Moderate: 20 to 50 Low: <20	Moderate: >50 Low: <50	Low
Cropland (% land use)	High: >50 Moderate: 20 to 50 Low: <20	Moderate: >50 Low: <50	Low

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 PWS well intake. First, hazard is rated by the proximity of a potential contaminant source to the PWS well or by a percentage of the area it occupies. Susceptibility ratings are then determined individually for each significant potential contaminant source and/or contaminant based on Table 8. These susceptibility ratings are the evaluation of the vulnerability of well to the potential contaminant sources and are presented on Table 9.

Table 8. 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

Discussion of Susceptibility

A summary of the susceptibility assessment for the Libby Dam Project PWS well is located in Table 9. Of the three (3) potential contaminant sources that were identified within the Inventory Region, all were assigned a high hazard. This hazard was based on the lack of information on the seal around the annulus of the well casing. Multiple barriers were identified as present between the well and the potential contaminant sources, so the PWS well is considered to be moderately susceptible to contamination that originates with these sources.

Table 9. Susceptibility Assessment

Libby Dam Project – Inventory Region (only)

Source	Contaminants	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Sewer Treatment Plant And Wastewater Discharge to Surface Water	Pathogens, nitrates, other organic and inorganic chemicals	If this system fails, it may not completely eliminate nitrate and pathogens from the effluent. If a failure occurs, effluent may reach shallow groundwater and migrate southwest toward the PWS well.	**High Hazard**	o Vertically upward groundwater gradient (evidenced by head pressure in the well) o This is a small-scale sewage treatment plant that does not appear to hold large volumes of untreated effluent (such as in a lagoon) o This facility is regulated and overseen by DEQ Permitting and Compliance Division, and meets NPDES requirements for discharge into the Kootenai River.	**Moderate Susceptibility**	o Consider an education program concerning the proper waste disposal of routine chemicals used in shops and/or other site facilities. This is to encourage collection and recycling of all chemicals. o Survey the facilities connected to the treatment system to ensure that none of the shops have floor drains. Floor drains tend to promote improper disposal of waste chemicals (such as cleaning agents, petroleum hydrocarbons, and solvents).
Sewer Lines between various facilities that cross the Inventory Region.	Pathogens, nitrates, other organic and inorganic chemicals	Sewer lines can chronically leak untreated effluent to the subsurface. In some cases large volumes of effluent can leak from failed joints or pipes. If these leaks are located upgradient from a well, the threat of contamination can be considerable.	**High Hazard**	o Vertically upward groundwater gradient (evidenced by head pressure in the well) o This is a small-scale sewage treatment plant and the number of sewer lines running to the plant (across the Inventory Region will be small. o Any rupture in the sewer main would occur near the surface. Surface runoff would head downhill toward the river, and so would effluent from a near surface rupture of a sewer main.	**Moderate Susceptibility**	o Consider an education program concerning the proper waste disposal of routine chemicals used in shops and/or other site facilities. This is to encourage collection and recycling of all chemicals. o Survey the facilities connected to the treatment system to ensure that none of the shops have floor drains. Floor drains tend to promote improper disposal of waste chemicals (such as cleaning agents, petroleum hydrocarbons, and solvents). o Monitor the sewer line for signs of leakage with replacement of line as needed with modern glue jointed pipe.
Former UST, LUST Site	VOCs, petroleum hydrocarbons	If any petroleum impacted soil/sediment remains in-place, this contamination could leach further downward to reach groundwater. If impacted, groundwater could migrate toward the PWS well.	**High Hazard**	o UST(s) was removed o LUST site is not active, meaning that DEQ is not actively working the site to ensure the removal of any remaining contamination (it assumes there is little or no contamination remaining) o Site is managed / monitored by DEQ	**Moderate Susceptibility**	o Ensure that the UST was removed or appropriately abandoned. o Determine if there is residual contamination at the LUST site. Promote cleanup as needed. o Determine the plans for future work at the LUST site. Promote cleanup as needed.

Waiver Recommendation

This section addresses the Libby Dam Project PWS that DEQ has classified as Non-Community Non-Transient. The author's recommendation is based upon the determination of susceptibility as described above.

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 purpose of the vulnerability assessment procedures 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. Review of an organic chemical monitoring waiver application will be conducted by DEQ's PWS Section and DEQ's Source Water Protection Program. Other state agencies may be asked for assistance.

Susceptibility Waiver for Confined Aquifers

Confined groundwater is isolated from overlying material by relatively impermeable geologic formations. A confined aquifer is subject to pressures higher than atmospheric pressure that would exist at the top of the aquifer if the aquifer were not geologically confined. A well that is drilled through the impervious layer into a confined aquifer will enable the water to rise in the borehole to a level that is proportional to the water pressure (hydrostatic head) that exists at the top of a confined aquifer. The susceptibility of a confined aquifer relates to the probability of an introduced contaminant to travel from the source of contamination to the aquifer. Susceptibility of an aquifer to contamination will be influenced by the hydrogeologic characteristics of the soil, vadose zone (the unsaturated geologic materials between the ground surface and the aquifer), and confining layers. Important hydrogeologic controls include the thickness of the soil, the depth of the aquifer, the permeability of the soil and vadose zones, the thickness and uniformity of low permeability and confining layers between the surface and the aquifer, and hydrostatic head of the aquifer. These factors will control how readily a contaminant will infiltrate and percolate toward the groundwater.

The Susceptibility Waiver has the objective of assessing the potential of contaminants reaching the groundwater used by the PWS. The extent of confinement of an aquifer is critical to limiting susceptibility to organic chemical contamination.

Waiver Recommendation of this SWDAR

Based on past monitoring results and the susceptibility assessment of the Libby Dam Project PWS (as it is now configured, using 1 deep aquifer well), the PWS appears to be eligible for several monitoring waivers. DEQ records suggest that the PWS currently has no waivers. Based on the monitoring history for the well, the results of the inventory, the susceptibility assessment of this SWDAR, the geology of the area, the nature of the aquifer from which the well draws water, the PWS production well may be eligible for waivers from select inorganic chemicals (IOCs), volatile organic chemicals (VOCs) and synthetic organic chemicals (SOCs). For monitoring waiver consideration, 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.

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GLOSSARY

Acute Health Effect. An adverse health effect in which symptoms develop rapidly.

Alkalinity. The capacity of water to neutralize acids.

Best Management Practices (BMPs). Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.

Coliform Bacteria. Bacteria found in the intestinal tracts of animals. Their presence in water is an indicator of pollution and possible contamination by pathogens.

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 that inhibits the flow of water.

Delineation. A process of mapping source water management areas.

Effective Porosity. The percent of soil, sediment, or rock through which fluids, such as air or water, can pass. Effective porosity is always less than total porosity because fluids cannot pass through all openings.

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

Hazard. A measure of the potential of a contaminant leaked from a facility to reach a public water supply source. Proximity or density of significant potential contaminant sources determines hazard.

Hydraulic Conductivity. A coefficient of proportionality describing the rate at which water can move through an aquifer.

Inventory Region. A source water management area that encompasses an area expected to contribute water to a public water supply well within a fixed distance or a specified groundwater time-of-travel distance.

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.

Nitrate. An important plant nutrient and type of inorganic fertilizer. In water the major sources of nitrates are 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.

Pathogens. A bacterial organism or virus typically found in the intestinal tracts of mammals, capable of producing disease.

Point-Source. A stationary location or fixed facility from which pollutants are discharged.

Porosity. The percent of soil, sediment, or rock filled by air, water, or other fluid.

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

SIC Code. 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.

Source Water Protection Area. For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply.

Susceptibility (of a PWS). The 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. 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, non-point, and natural sources. The TMDL program was established by section 303(d) of the Clean Water Act to help states implement water quality standards.

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

Transmissivity. The ability of an aquifer to transmit water.

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

Volatile Organic Compounds (VOC). Any organic compound that evaporates readily to the atmosphere (e.g. fuels and solvents).

Recharge Region / 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.

**Definitions taken from EPA's Glossary of Selected Terms and Abbreviations and other sources.

APPENDICES

Appendix A

DEQ PWS's Database

Facilities Summary

Water Quality Data

Appendix B

Sanitary Surveys

Well Log Information

Other Relevant Well Information

Map of Area Wells

Lithologic Logs for Other Area Wells

Potential Contaminant Sources Summary

Appendix C

Concurrence Letter