

**CASCADE COLONY  
PUBLIC WATER SUPPLY**

**PWS ID No. MT0001738**

**SOURCE WATER DELINEATION & ASSESSMENT  
REPORT**

PREPARED BY:

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY  
SOURCE WATER PROTECTION PROGRAM

PREPARED FOR:

Paul Wurz and Peter Entz  
*Certified Operators*

508 Birdtail Creek Road  
Sun River, Montana, 59483

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## EXECUTIVE SUMMARY

This Source Water Delineation and Assessment Report (SWDAR) was prepared as required by the Federal Safe Drinking Water Act, according to a detailed Source Water Assessment Plan developed by a statewide Montana citizens' advisory committee, and approved by the US Environmental Protection Agency. The Department of Environmental Quality (DEQ) is completing assessment and delineation reports for all public water systems in Montana. These reports are intended to provide information so that the public water system staff/operator, consumers, and community citizens can develop strategies to protect drinking water sources. The information provided includes the delineation of the area most critical to maintaining safe drinking water (the inventory region), an inventory of significant potential sources of contamination within this area, and an assessment of the relative threat that these sources pose to the water system.

Cascade Colony's drinking water is supplied by one infiltration system. An inactive well is present on the property, but is not connected to the system. The water source is groundwater. According to the Source Water Protection Program (DEQ, 1999) the source aquifer is considered to have **high sensitivity** to potential contamination, since the aquifer is unconfined shallow sandstone.

Three source water protection management areas were mapped for the Cascade Colony public water system. They are: the control zone, the inventory region, and the recharge region. The control zone (sometimes called the exclusion zone) is a 100-foot radius circle around the infiltration gallery. The goal of management in the control zone is to avoid introducing contaminants directly into the water supply. The inventory region is generally the region expected to contribute groundwater to the spring over the next three years. The recharge region represents the area that will contribute water to the spring over long periods of time. Helium-tritium age dating of water from the spring yielded an age of approximately 4 years. For this reason, the inventory region and the recharge region are coincident, and extend over approximately half of Shaw Butte. An inventory of potential contaminant sources was completed for the control zone and inventory region, and the results are as follows:

- No potential contaminant sources were identified within the control zone.
- No conventional contaminant sources were identified in the inventory region. Land use in the inventory region is limited to grazing.

Contaminant sources are not inventoried within the recharge region. Land use is identified and evaluated. The recharge region is controlled by the colony, and is grazing land.

Despite the aquifer's high sensitivity, Cascade Colony is fortunate in that its source water is reasonably well defined, and within the colony's control. However, the small size of the aquifer is something of a mixed blessing. While the colony can control the management areas, the small size of the aquifer means that any future contamination is not likely to be diluted or naturally attenuated before reaching the infiltration system.

The costs associated with contaminated drinking water are high, and prevention is vastly preferable to treatment. Public awareness is a powerful tool for protecting drinking water. The information in this report is intended to help increase public awareness about the relationship between land use activities and drinking water quality.

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## 1.0 INTRODUCTION

The primary purpose of this source water delineation and assessment report (SWDAR) is to provide information that helps the Cascade Colony public water supply (PWS) protect its drinking water sources. The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies. The Cascade Colony PWS is classified as a community PWS, as it serves more than 25 year-round residents.

This Source Water Delineation and Assessment Report is intended to meet the technical requirements for delineation and assessment of the Cascade Colony Public Water System as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 [U.S. Code Title 42, Chapter 6A, Subchapter XII, Part E, § 300j-13-(a) Source Water Assessment].

Eric Siverson, a hydrogeologist with the Montana Department of Environmental Quality (DEQ) Source Water Protection Section, completed the Cascade Colony (PWS ID No. MT0001738) Source Water Delineation and Assessment Report. Further information on the PWS was obtained from a hydrogeologic assessment performed by the Montana Bureau of Mines & Geology (MBMG) and the most recent sanitary survey (June 2004). Additional references are detailed at the end of this report.

## 2.0 BACKGROUND

The Cascade Colony PWS is located in Cascade County in north-central Montana, approximately 25 miles west of Great Falls ([Figure 1](#)). According to the Census Bureau, the population of Cascade County in 2000 was 80,357, with 56,690 persons residing in Great Falls. Approximately 125 persons reside at the Cascade Colony.

### 2.1 PHYSICAL SETTING

#### 2.1.1 Geography and Geology

The PWS lies on the Sun River bench, approximately 25 miles west of Great Falls. The bench is a topographic high bounded by the Sun River valley to the north, and the Missouri River valley to the south. The colony's elevation is approximately 3,700 feet above mean sea level. The colony is located at the southeastern foot of Shaw Butte, which rises approximately 1,000 feet above the surrounding plains. The springs that provide the colony's water are situated in a coulee above the colony, at approximately 3,900 feet above sea level.

Shaw Butte is capped by intrusive igneous rock that intruded the surrounding sediments approximately 50 million years ago (Alt and Hyndman, 1986). Geologists call this type of formation a laccolith, which refers to an igneous intrusion that is slightly mushroom-shaped (*i.e.* flat on the bottom and slightly convex on top). The igneous rock is of a type called shonkinite, which is generally rare, but common in the Adel Mountains south of the colony. The topographic expression of the butte is due to the fact that the shonkinite is resistant to erosion, and has protected the softer Cretaceous sediments beneath it. The units beneath the laccolith are sediments of Cretaceous age: the Virgelle Formation, the Telegraph Creek Formation, and the Marias River Shale (Kevin Member). The Virgelle and Telegraph Creek Formations are predominantly sandstone, and the Marias River Shale is shale and siltstone (Vuke, 2000).

More detailed information on the hydrogeology of the study area is provided in Section 2.1.3.

### 2.1.2 Climate

Based upon data from the Sun River climate station (**Table 1**), climate in the area is typical of west-central Montana. Annual total precipitation is 12.5 inches, and is most abundant in April through September. Bill O'Connell of Montana Rural Water Systems, Inc. noted that there is some anecdotal evidence that the local microclimate is milder than the surrounding area, possibly due to the year-round spring. Climate data is provided by the Western Regional Climate Center, operated by the Desert Research Institute of Reno, Nevada.

**Table 1. Monthly Climate Summary: Sun River Climate Station (243749)**

Period of Record: 07/02/1948 to 12/31/2004

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Ave. Max. Temp (F)	34.6	40.3	46.3	56.7	66.2	74.0	82.6	81.3	71.3	60.8	45.3	37.6	58.1
Ave. Min. Temp. (F)	11.6	16.3	20.4	29.6	38.2	45.9	50.1	48.3	40.7	33.4	23.0	15.8	31.1
Ave Tot. Precip. (in.)	0.46	0.37	0.65	1.17	2.20	2.43	1.42	1.30	1.00	0.68	0.46	0.39	12.54
Ave. Tot. Snowfall (in.)	7.7	5.5	7.5	6.1	1.3	0.2	0.0	0.1	0.8	2.4	5.4	6.6	43.4
Ave Snow Depth (in.)	2	1	1	0	0	0	0	0	0	0	1	1	1

### 2.1.3 Source Water

Much of the information regarding the colony's source water is derived from a hydrogeologic assessment (Martin and Vuke, 2000) completed by the MBMG. This study was completed under contract with DEQ, as part of the Ground Water Under the Direct Influence of Surface Water (GWUDISW) program. [This program was established under 1986 the Surface Water Treatment Rule provisions of the Safe Drinking Water Act, and required states to assess all systems using groundwater to determine whether the groundwater source is influenced by surface water.] The hydrogeologic assessment is attached as Appendix A. Discussion of the PWS source water is also based upon available geologic maps and reports.

The springs that provide water to the colony are located in minor quaternary alluvial fan/colluvial deposits in a coulee on the southeastern edge of Shaw Butte. The source of the water appears to be sandstone of the Cretaceous Telegraph Creek Formation. Several springs are present around the margins of Shaw Butte, and in all locations the springs are located at the contact between the Telegraph Creek Formation and less permeable siltstone and shale of the Cretaceous Marias River Shale (Kevin Member). Martin and Vuke (2000) concluded that the Telegraph Creek aquifer is probably recharged by infiltration of precipitation falling on Shaw Butte. They hypothesized that local groundwater flow in this aquifer is oriented radially out from the center of the butte. The idea of local recharge is supported by a helium-tritium analysis of groundwater from the colony spring that yielded an age of approximately four years.

The source aquifer is shallow and unconfined sandstone. According to the DEQ Source Water Protection Program (DEQ, 1999), the groundwater source is considered to be highly sensitive to potential contaminant sources. Given that the colony's water supply originates from a relatively small area, this is doubly appropriate.

## 2.2 THE PUBLIC WATER SUPPLY

### 2.2.1 Water Supply System

Two springs provide groundwater to the system. The springs are tapped by one infiltration assembly, and are considered to be a single source. A deep (2,301 feet) well is located on the colony facility, but according to the most recent sanitary survey (June 2004) it was inactive. The spring is indicated on [Figure 1](#) and [Figure 2](#). The PWS distributes water through 20 service connections, serving an estimated population of 125. The collection lines run both to a 20,000-gallon concrete cistern and a 100,000-gallon concrete cistern. Either cistern can provide water to the distribution system, depending on demand. The Cascade Colony PWS is classified as a community public water system since it serves more than 25 year-round residents. The sanitary survey is attached as Appendix B.

### 2.2.2 Spring Information

The only available construction details are anecdotal, as provided in the hydrogeologic assessment. No as-built plans are available. The collection system is comprised of multiple screened 1¼-inch galvanized steel pipes, which were driven into alluvial fan/colluvial deposits in the coulee above the colony. The available logs are attached as Appendix B.

## 2.3 WATER QUALITY

Each PWS performs regular sampling of its water supply to detect contamination. The analytical parameters for a community PWS include: coliform bacteria, nitrates, metals, petroleum hydrocarbons, synthetic organic chemicals, and radionuclides. The monitoring schedule depends on factors such as the type of PWS, type of source water (surface water or groundwater), the number of supplies (e.g. wells, springs or intakes), and the population served. Monitoring programs are tailored to each system, following the general protocols defined by DEQ and the US EPA. Monitoring schedules are available online at: <http://nris.state.mt.us/wis/swap/swapquery.asp>. The Cascade Colony PWS monitoring data from DEQ's database for the past five years was reviewed and is summarized in this section. Analytical results are reported in units of milligrams per liter (mg/L, equivalent to one part per million) or micrograms per liter (µg/L, equivalent to one part per billion). The results are compared to quality standards established by the US EPA. Maximum Contaminant Levels (MCLs) are enforceable standards limiting the amount of a contaminant in drinking water. National Secondary Drinking Water Standards (known as SMCLs) are non-enforceable guidelines regarding contaminants that may cause aesthetic (color, odor, taste) or cosmetic (staining, skin/tooth discoloration) issues.

### 2.3.1 Public Water Supply Monitoring Results

Coliform bacteria have not been detected in the Cascade Colony PWS water within the past five years. Nitrate levels have been moderately low, below 3 mg/L. By comparison, the EPA maximum contaminant level (MCL) is 10 mg/L. While reported dissolved solids are low (low levels of fluoride: 0.48 mg/L and barium: 0.009 mg/L). In general, the water quality appears high.

The water quality analysis summary report is attached as Appendix B.

### 2.3.2 Background Water Quality Monitoring Results

MBMG analyzed background water quality for the subject PWS. Background water quality typically includes general water quality parameters: major dissolved ions (calcium,

magnesium, sodium, potassium, iron, manganese, silica, bicarbonate, carbonate, chloride, sulfate, nitrate, fluoride and orthophosphate), trace elements, and metals. The water is characterized by moderate levels of calcium (Ca), sodium (Na) and sulfate (SO<sub>4</sub>). The water is hard, with bicarbonate (HCO<sub>3</sub>) around 180 mg/L.

### 3.0 MANAGEMENT AREA DELINEATION

This report delineates three source water management areas. The goal of source water management is protection of the source water by 1) controlling activities in the control zone(s), 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. Methods and criteria for delineating source water protection areas for public water supplies are specified in the Montana Source Water Protection Program (DEQ, 1999).

#### 3.1 DELINEATION

*Control Zone* – A 100-foot radius control zone is delineated around the infiltration gallery.

*Inventory Region* – The inventory region is generally the area that is expected to contribute to the water supply over three years; this is sometimes referred to as a three-year capture zone. As the helium-tritium dating of the water supply yielded an age of approximately 4 years, the inventory region is extended to coincide with the recharge region. The inventory region is illustrated on [Figure 2](#), and is essentially half of Shaw Butte upgradient of the infiltration points.

*Recharge Region* – The recharge area is delineated as the upgradient extent of Shaw Butte, which comprises approximately half of the butte ([Figure 3](#)). As stated above, this is coincident with the inventory region.

### 4.0 INVENTORY

Prior to assessing PWS susceptibility to contamination, an inventory of potential contaminant sources must be created. To this end, potential contaminant sources in the control zone and inventory region were inventoried. The inventory focuses on facilities or features that generate, use, store, or transport potential contaminants, as well as certain land uses. The methods and data sources used in the inventory process are explained below. It is important to remember that the sources identified in this section are only potential sources of contamination to the drinking water. Contamination of drinking water sources is less likely when potential contaminants are properly managed.

#### 4.1 INVENTORY METHOD

Information on facilities and land uses that are potential sources of regulated contaminants was obtained from a number of databases. The process for completing the inventory includes the following:

- Step 1: The Montana State Library Natural Resources Information System (NRIS) GIS database was queried to identify septic land application sites, wastewater treatment plants, animal feeding operations, septic system density, sewer systems, and agricultural land uses.
- Step 2: The DEQ PWS files were reviewed to identify agricultural activities or wastewater treatment in the vicinity of the PWS.
- Step 3: The US Environmental Protection Agency's (EPA) Envirofacts System <<http://www.epa.gov/enviro/>> was queried to identify EPA-regulated facilities located in the management areas. This system accesses facilities listed in the following databases: Resource

Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory System (TRIS), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) and the Permit Compliance System (PCS - for Concentrated Animal Feeding Operations with MPDES permits). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility should be classified as a significant potential contaminant source.

- Step 4: Montana DEQ databases were queried to identify any of the following in the management areas:

Underground storage tanks (USTs) and leaking underground storage tanks (LUSTs) <<http://www.deq.state.mt.us/UST/USTDownloads.asp>>

Hazardous waste contaminated sites, above ground storage tanks (ASTs), landfills, and abandoned and active mines, including gravel pits <<http://nris.state.mt.us/gis/bundler/>>

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

Potential contaminant sources are considered significant if they fall into one or more of the following categories:

- |   |   |
|---|---|
| 1. Large quantity hazardous waste generators.   | 7. Cultivated cropland exceeding 20% of the inventory region.                         |
| 2. Landfills.   | 8. Animal feeding operations.   |
| 3. Underground storage tanks.   | 9. Wastewater treatment facilities, sludge handling sites, or land application areas. |
| 4. Known groundwater contamination (including open or closed hazardous waste sites, state or federal Superfund sites, and leaking UST sites). | 10. Septic systems.   |
| 5. Underground injection well.  | 11. Sewer mains.  |
| 6. Major roads or rail transportation routes.   | 12. Storm sewer outflows.   |
|   | 13. Abandoned or active mines   |

## 4.2 INVENTORY RESULTS

No point sources were identified in the databases. The inventory was completed using the MRWS report, the most recent sanitary survey, and available aerial photographs.

### 4.2.1 Control Zone Inventory Results

No potential sources of contamination were identified within the control zone. The hydrogeologic assessment and sanitary survey noted that the area was fenced to exclude livestock.

### 4.2.2 Inventory Region Results

No conventional sources of contamination (as described in Section 4.1) were identified.

*Nonpoint Sources:* The grazing land on Shaw Butte is not generally considered to pose a risk to the water supply. The moderately low nitrate levels in the water may be due to grazing.

### 4.2.3 Recharge Region Results

Contaminant sources are not inventoried within the recharge region. However, land use patterns are identified and evaluated. Land use within the recharge region is dominated by grazing.

## 5.0 SUSCEPTIBILITY ASSESSMENT

*Susceptibility* is the degree of likelihood for a public water supply to be impacted by inventoried contaminant sources. Susceptibility is determined in accordance with the DEQ Source Water Protection Program (DEQ, 1999). This guidance document is available on the DEQ Source Water Protection website (see the Reference section), or by request.

Susceptibility is determined by considering the *hazard* that a significant potential contaminant source presents to the PWS source water, relative to any *barriers* to the contaminant. Hazard is determined by the proximity or density of significant potential contaminant sources, according to a formula laid out in the Source Water Protection Program (DEQ, 1999). Barriers to contamination are anything that decreases the likelihood of contaminants reaching a water source. No barriers are identified for the PWS.

As Cascade Colony facility land comprises much of the entire inventory region, the colony is in the fortunate position of being able to manage its source water.

As no potential contaminant sources were identified, a susceptibility assessment could not be performed.

## 6.0 LIMITATIONS

This Source Water Delineation and Assessment Report is intended to meet the technical requirements for delineation and assessment of the Cascade Colony Public Water System (PWS) as required by the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 [U.S. Code Title 42, Chapter 6A, Subchapter XII, Part E, § 300j-13-(a) Source Water Assessment]. The following limitations should be noted:

- Potential sources of contamination were identified using previous reports and overhead and map imagery. The author did not conduct field surveys and inspections of the inventory region. It is highly recommended that the operator or other persons knowledgeable about the colony review the inventory, and revise it as necessary.
- Unregulated activities or unreported contaminant releases may have been overlooked. Multiple data sources are used to increase the likelihood that major threats to the source water are identified. The inventory is not exhaustive. Absence of potential contaminants in the inventory or susceptibility assessment of this report does not mean that the potential for contamination does not exist, or that there is no threat.
- This report is not, and should not be construed as, a guarantee, warranty or certification that the PWS will not be impacted by any potential contaminant sources.

## 7.0 CONCLUSIONS

Cascade Colony's drinking water is supplied by one infiltration system. An inactive well is present on the property, but is not connected to the system. The water source is groundwater. According to the Source Water Protection Program (DEQ, 1999) the source aquifer is considered to have **high sensitivity** to potential contamination, since the aquifer is unconfined shallow sandstone.

Three source water protection management areas were mapped for the Cascade Colony public water system. They are: the control zone, the inventory region, and the recharge region. The control zone (sometimes called the exclusion zone) is a 100-foot radius circle around the infiltration gallery. The goal of management in the control zone is to avoid introducing contaminants directly into the water supply. The inventory region is generally the region expected to contribute groundwater to the spring over the next three years. The recharge region represents the area that will contribute water to the spring over long periods of time. Helium-tritium age dating of water from the spring yielded an age of approximately 4 years. For this reason, the inventory region and the recharge region are coincident, and extend over approximately half of Shaw Butte. An inventory of potential contaminant sources was completed for the control zone and inventory region, and the results are as follows:

- No potential contaminant sources were identified within the control zone.
- No conventional contaminant sources were identified in the inventory region. Land use in the inventory region is limited to grazing.

Contaminant sources are not inventoried within the recharge region. Land use is identified and evaluated. The recharge region is controlled by the colony, and is grazing land.

Despite the aquifer's high sensitivity, Cascade Colony is fortunate in that its source water is reasonably well defined, and within the colony's control. However, the small size of the aquifer is something of a mixed blessing. While the colony can control the management areas, the small size of the aquifer means that any future contamination is not likely to be diluted or naturally attenuated before reaching the infiltration system.

The costs associated with contaminated drinking water are high, and prevention is vastly preferable to treatment. Public awareness is a powerful tool for protecting drinking water. The information in this report is intended to help increase public awareness about the relationship between land use activities and drinking water quality.

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## 8.0 REFERENCES

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## 9.0 GLOSSARY

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.

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.

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

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

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

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

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.

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

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

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

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

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

Nonpoint Source Pollution. Pollution sources that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. Examples of nonpoint- source pollution include agriculture, forestry, and run-off from city streets. Nonpoint sources of pollution, such as the use of herbicides, can

concentrate low levels of these chemicals into surface and/or groundwaters at increased levels that may exceed MCLs.

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

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).

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

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

Sensitivity. The relative ease with which contaminants can migrate to source water through the natural materials

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

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

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

Static Water Level (SWL). Water level 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.

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.

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



## **FIGURES**



**APPENDIX A**

**HYDROGEOLOGIC ASSESSMENT**



**APPENDIX B**

**LOGS & PWS SANITARY SURVEY**



**APPENDIX C**

**WATER QUALITY ANALYTICAL REPORTS**



**APPENDIX D**

**CONCURRENCE LETTER**