Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Wildrose Circle Drinking Water System, Palmer, Alaska PWSID 227149

March 2006

DRINKING WATER PROTECTION REPORT Report 1575
Alaska Department of Environmental Conservation

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The Drinking Water Protection (DWP) section of the Drinking Water Program is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation (ADEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. It is anticipated this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWP, (907) 269-7521.

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Source Water Assessment for Wildrose Circle Source of Public Drinking Water, Palmer, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

This source water assessment provides an evaluation of the vulnerability of the public water system serving the Wildrose Circle to potential contamination. This Class A (community) water system consists of one well in the middle of Wildrose Circle off of the Glenn Highway in Palmer, Alaska. The well received a natural susceptibility rating of **Low**. This rating is a combination of a susceptibility rating of **Low** for the actual wellhead and a **Medium** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the Wildrose Circle public water system include: residential septic systems, roads, and residential areas. These are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals (VOCs), heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals (SOCs), and other organic chemicals (OOCs). Combining the natural susceptibility of the well with the contaminant risk, the public water system for Wildrose Circle received an overall vulnerability rating of **Low** for VOCs, OOCs**,** nitrates and/or nitrites, heavy metals, cyanide, and other inorganic chemicals, bacteria and viruses, and SOCs.

WILDROSE CIRCLE PUBLIC DRINKING WATER SYSTEM

Wildrose Circle public water system is a Class A (community) water system. The system consists of one well in the middle of Wildrose Circle in Palmer, Alaska (Sec. 04, T017N, R002E, Seward Meridian). Palmer is located in the center of the lush farmlands of the Matanuska Valley, 42 miles northeast of Anchorage on the Glenn Highway. (ADCED, 2006).

Water is provided by three deep wells, is treated and stored in a million-gallon reservoir. Sewage is collected by pipe and treated in an aerated lagoon facility. The schools and Palmer Correctional Center operate individual well systems. All homes are completely plumbed. Matanuska Electric Assoc. is part owner of the Alaska Electric Generation & Transmission Cooperative, Inc., which operates a gas turbine plant in Soldotna and also purchases electricity from Chugach Electric and the Bradley Lake Hydroelectric Project. Piped natural gas, provided by Enstar, is used to heat homes. The Mat-Su Borough operates the landfill in Palmer. A sludge disposal site is also available. Electricity is provided by Matanuska Electric Association. There are 7 schools located in the community, attended by 2,983 students (ADCED, 2006).

According to the most recent sanitary survey (9/21/05) for this water system, the depth of the well is 121 feet below the ground surface. The well is screened in a combination of sand and gravel. The chief aquifers are composed of outwash sand and gravel laid down by melt-water streams or in lakes. The outwash deposits are of two chief forms. The first consists of sheet-like deposits that lie just beneath the ground surface. These deposits range in thickness from a few feet to more than 100 feet. They typically rest on till or bedrock. The water in these deposits is unconfined. The other outwash deposits are buried beneath till. They are known to be as much as 50 to 60 feet thick, and probably are considerably thicker in some places. They commonly contain confined, or artesian, groundwater. Well logs and data from pumping tests suggest that outwash sand and gravel form a continuous or nearly continuous sheet in an area of more than 10 square miles north and west of Palmer (Jakola et al, 1991).

The glacial till and bedrock form aquifers of minor importance. The chief hydrologic significance of the till is in confining the artesian aquifer. Generally, the till is poorly permeable, although locally thin layers of sand may yield small quantities of water. Till that is present at or near the land surface in much of the area makes the acquisition of shallow groundwater difficult. The bedrock is poorly permeable. It yields water only from fractures, whose location and frequency cannot be easily predicted.

The Wildrose Circle public water system serves 25 residents through 8 service connections.

WILDROSE CIRCLE DRINKING WATER PROTECTION AREA

The pathways most likely for surface contamination to reach the groundwater are identified as the first step in determining a drinking water system's risk. These areas are determined by looking at the characteristics of the soil, groundwater, aquifer, and well.

The most probable area for contamination to reach the drinking water well is the area that contributes water to the well, the groundwater capture zone. The groundwater capture zone is located in the area circling the well (the area influenced by pumping) and also the area of the water table upgradient of the well, usually forming a parabola shape.

There are many different methods for calculating the size of capture zones. Drinking Water Protection (DWP) uses a combination of two simple groundwater flow equations, the Thiem and uniform flow equations for all groundwater wells screened in unconsolidated material. The orientation of the capture zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The capture zone calculated by the DWP is an estimate using the available information and resources, and may differ slightly from the actual capture zone.

The parameters used to calculate the shape of this capture zone are general for the whole alluvial plain and were obtained from various United States Geological Survey (USGS) reports, area well logs, and the Groundwater textbook by Freeze and Cherry (Freeze and Cherry, 1979).

In the Mat-Su Valley, groundwater is primarily recharged by snowmelt and precipitation infiltrating both directly and also from the infiltration into the foothill slopes of the Talkeetna and Chugach Mountains. In addition,, aquifers may be recharged by streams where surface water percolates into surrounding permeable sediments (losing reaches of streams). This is the case for the water-table aquifers in the terrace south of Palmer and in the Bodenburg Butte area, which receive underground flow from the Matanuska River. Groundwater flow in the confined aquifers is generally from the north and north-northwest. The direction of groundwater flow in the upper unconfined aquifer is more variable due to the influence from surficial topography as well as its close connection with surface water bodies (Trainer,1960).

Because of uncertainties and changing site conditions, a factor of safety is added to the groundwater capture zone to form the drinking water protection area for the well.

The protection areas established for wells are usually separated into two zones, limited by the watershed. These zones correspond to times-of-travel (TOT) of the water moving through the aquifer to the well (plus the factor of safety).

The following is a summary of the two zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

Zone	Definition
A	Several months travel time
B	Less than 2 years time-of-travel

The time of travel for contaminants within the water varies with their unique physical and chemical characteristics.

The drinking water protection area outlined for the Wildrose Circle on Map 1 of Appendix A will serve as the focus for voluntary protection efforts.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

Drinking Water Protection (DWP) has completed an inventory of potential and existing sources of contamination within the Wildrose Circle protection area. This inventory was completed through a search of agency records and other publicly available information. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of all Class A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic organic chemicals; and
- Other organic chemicals.

The sources are displayed on Map 2 of Appendix C and summarized in Table 1 of Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination have been identified, they are each assigned a ranking according to what type and level of risk they represent. Ranking of contaminant risks for a "potential" or "existing" source of contamination is a combination of toxicity and volume associated with that source. Rankings include:

- Low
- Medium
- High
- Very High

Tables 2 through 7 in Appendix B contain the ranking of inventoried potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals and other organic chemical

VULNERABILITY OF WILDROSE CIRCLE DRINKING WATER SYSTEM

The vulnerability of public drinking water systems to regulated contaminants is determined by assessing the susceptibility of the wellhead, the susceptibility of the aquifer and the potential contaminant sources identified within the protection area.

The Drinking Water Protection developed a vulnerability assessment tool that assigns a vulnerability risk ranking based upon various factors associated with the well, aquifer and potential and existing contaminants identified within the protection area.

Factors contributing to the susceptibility of the wellhead are: whether the sanitary seal in place, protection from flooding, and if the well casing is properly grouted.

The wellhead for the Wildrose Circle received a **Low** susceptibility rating. The most recent sanitary survey (9/28/00) indicates the well is capped with a sanitary seal, the land surface is sloped away from the well, and the well is grouted. A sanitary seal prevents potential contaminant from entering the well while sloping of the land surface and grouting help to prevent potential contaminants from traveling down the outside of the well casing.

Factors contributing to the susceptibility of the aquifer are: whether the aquifer is confined or unconfined, whether the well is completed in unconsolidated or fractured bedrock, whether wells and bore holes are penetrating the aquifer and, if applicable, the confining layer.

The aquifer the Wildrose Circle well is completed in received a **Medium** susceptibility rating. The transmissive aquifer material in the area allows contaminants to travel downward from the surface with the precipitation and surface water runoff. Table 2 summarizes the Susceptibility scores and ratings for Wildrose Circle.

Table 2: Susceptibility

	Rating
Susceptibility of the Wellhead	Low
Susceptibility of the Aquifer	Medium
Natural Susceptibility	Low

The Contaminant Risk has been derived from an evaluation of the routine sampling results of the water system and the presence of potential sources of contamination. Contaminant risks to a drinking water source depend on the type and distribution of contaminant sources.

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	Rating
Bacteria and Viruses	Low
Nitrates and/or Nitrites	Low
Volatile Organic Chemicals	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Low
Synthetic Organic Chemicals	Low
Other Organic Chemicals	Low

Finally, an overall vulnerability is determined for each water system by combining each of the contaminant risk scores with the natural susceptibility score:

Natural Susceptibility
+
Contaminant Risks
=
Vulnerability of the
Drinking Water Source to Contamination

Table 4 contains the overall ratings for each of the six categories of drinking water contaminants.

Table 4. Overall Vulnerability

Category	Rating
Bacteria and Viruses	Low
Nitrates and Nitrites	Low
Volatile Organic Chemicals	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Low
Synthetic Organic Chemicals	Low
Other Organic Chemicals	Low

Bacteria and Viruses

The residential areas, roads, and residential septic systems in the protection area represent the greatest risk for bacteria and viruses to the drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coliforms are found naturally in the environment and although they aren't necessarily a health threat, it is an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms and E. coli which only come from human and animal fecal waste (EPA, 2006). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2006). Coliforms have not been detected in sampled water.

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

Nitrates and Nitrites

The roads, residential areas, and residential septic systems in the protection area also represent the greatest risk to to nitrates and nitrites for this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have not been detected in recent sampling history for the Wildrose Circle well.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

Volatile Organic Chemicals

The roads, residential areas, and residential septic systems represent the greatest identified risk for volatile organic chemical contamination to the well.

Volatile Organic Chemicals have not been detected within source waters. After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The residential septic systems, roads, and residential areas represent the greatest risk for inorganic chemicals to the well.

Inorganic chemicals were sampled on 8/31/05. Chromium was detected well below its maximum contaminant levels (MCL = 0.1mg/L). In greater quantities, and long periods of time, chromium has been known to cause damage to liver, kidney, circulatory, and nerve tissues (EPA, 2006).

After combining the contaminant risk for heavy metals, cyanide and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

Synthetic Organic Chemicals

The residential septic systems and residential areas represent the greatest risk for synthetic organic chemicals to the well.

Synthetic organic chemicals have not been sampled for in this water system.

After combining the contaminant risk for snythetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

Other Organic Chemicals

The roads, residential septic systems, and residential areas represent the greatest risk for other organic chemicals to the well.

Other organic chemicals have not been sampled for in this water system.

After combining the contaminant risk for snythetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

REFERENCES

Alaska Department of Community and Economic Development (ADCED), 2002 [WWW document]. URL http://www.dced.state.ak.us/mra/CF_BLOCK.cfm.

Freeze, R.A. and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.

United States Environmental Protection Agency (EPA), 2002 [WWW document]. URL http://www.epa.gov/safewater/mcl.html.

APPENDIX A

Wildrose Circle
Drinking Water Protection Area Location Map
(Map 1)

Map 1- Wildrose Circle and Surrounding Water Systems

PWSID: 227149.001

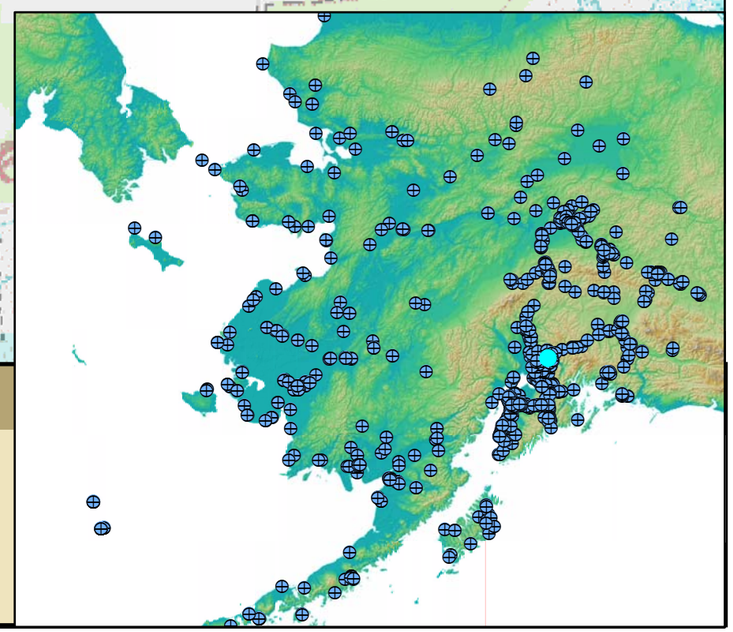
Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1:17,352 3,600 Feet

Data Sources:
Mat-Su: Borough: Roads and parcels
Potential Sources of Contamination: ADEC

- Public Water Sources
- Zone A Protection Area
- Zone B Protection Area



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Wildrose Circle (Tables 1-7)

Table 1

Contaminant Source Inventory for
Wildrose Circle Water Corporation

PWSID 227149.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A		almost 1 acre in Zone A.
Septic systems (serves one single-family home)	R02	R02-1	A		
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A		
Residential Areas	R01	R01-2-19	B		18 acres in Zone B.
Septic systems (serves one single-family home)	R02	R02-2-3	B		

Table 2

Contaminant Source Inventory and Risk Ranking for Wildrose Circle Water Corporation Sources of Bacteria and Viruses

PWSID 227149.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low		almost 1 acre in Zone A.
Septic systems (serves one single-family home)	R02	R02-1	A	Low		
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low		
Residential Areas	R01	R01-2-19	B	Low		18 acres in Zone B.
Septic systems (serves one single-family home)	R02	R02-2-3	B	Low		

Table 3

Contaminant Source Inventory and Risk Ranking for Wildrose Circle Water Corporation Sources of Nitrates/Nitrites

PWSID 227149.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low		almost 1 acre in Zone A.
Septic systems (serves one single-family home)	R02	R02-1	A	Low		
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low		
Residential Areas	R01	R01-2-19	B	Low		18 acres in Zone B.
Septic systems (serves one single-family home)	R02	R02-2-3	B	Low		

Table 4

Contaminant Source Inventory and Risk Ranking for Wildrose Circle Water Corporation Sources of Volatile Organic Chemicals

PWSID 227149.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low		almost 1 acre in Zone A.
Septic systems (serves one single-family home)	R02	R02-1	A	Low		
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low		
Residential Areas	R01	R01-2-19	B	Low		18 acres in Zone B.
Septic systems (serves one single-family home)	R02	R02-2-3	B	Low		

Table 5

Contaminant Source Inventory and Risk Ranking for Wildrose Circle Water Corporation Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 227149.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low		almost 1 acre in Zone A.
Septic systems (serves one single-family home)	R02	R02-1	A	Low		
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low		
Residential Areas	R01	R01-2-19	B	Low		18 acres in Zone B.
Septic systems (serves one single-family home)	R02	R02-2-3	B	Low		

Table 6

Contaminant Source Inventory and Risk Ranking for Wildrose Circle Water Corporation Sources of Synthetic Organic Chemicals

PWSID 227149.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low		almost 1 acre in Zone A.
Septic systems (serves one single-family home)	R02	R02-1	A	Low		
Residential Areas	R01	R01-2-19	B	Low		18 acres in Zone B.
Septic systems (serves one single-family home)	R02	R02-2-3	B	Low		

Table 7

Contaminant Source Inventory and Risk Ranking for Wildrose Circle Water Corporation Sources of Other Organic Chemicals

PWSID 227149.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Residential Areas	R01	R01-1	A	Low		almost 1 acre in Zone A.
Septic systems (serves one single-family home)	R02	R02-1	A	Low		
Highways and roads, paved (cement or asphalt)	X20	X20-1-3	A	Low		
Residential Areas	R01	R01-2-19	B	Low		18 acres in Zone B.
Septic systems (serves one single-family home)	R02	R02-2-3	B	Low		

APPENDIX C

Wildrose Circle
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

19 acres of Residential land use

7 Roads
3 in Zone A
4 in Zone B

3 Septics
1 in Zone A
2 in Zone B

VALLEY CREST
TAYLOR
Hilsher
STONINGTON
SHOOTING STAR
STAPLETON
ROSE
Palmer

Map 2- Wildrose Circle Potential Contaminants

PWSID: 227149.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1:4,332 Feet 1,080

Data Sources:
Mat-Su Borough: Roads and parcels
Potential Sources of Contamination: ADEC

- Zone A
- Zone B
- Residential
- Roads
- Public Water Sources
- D10
- R2