Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Ft. Wainwright Golf Maintenance Public Drinking Water System, Ft. Wainwright, Alaska PWSID # 314750.001

DRINKING WATER PROTECTION REPORT 1793

Alaska Department of Environmental Conservation

February, 2009

Source Water Assessment for Ft. Wainwright Golf Maintenance Public Drinking Water System, Ft. Wainwright, Alaska PWSID# 314750.001

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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 (DEC), 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 DWP staff at the following toll-free number 1-866-956-7656.

February, 2009

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Source Water Assessment for Ft. Wainwright Golf Maintenance Source of Public Drinking Water, Ft. Wainwright, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Ft. Wainwright Golf Maintenance is a Class B (transient/non-community) water system consisting of one well located on Kinney Road in Ft. Wainwright, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Ft. Wainwright Golf Maintenance public drinking water source include: assumed septic systems, assumed heating oil tanks, a golf course, a large-capacity septic system, and roads. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for Ft. Wainwright Golf Maintenance received a vulnerability rating of **Medium** for all three contaminant categories. This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of Ft. Wainwright Golf Maintenance to protect public health.

FT. WAINWRIGHT GOLF MAINTENANCE PUBLIC DRINKING WATER SYSTEM

Ft. Wainwright Golf Maintenance public water system is a Class B (transient/non-community) water system. The system consists of one well located on Kinney Road within the Ft. Wainwright Golf Course at Ft. Wainwright, Alaska (see Map A in Appendix A). Ft. Wainwright is located between Fairbanks and North Pole. The Fairbanks area, including Ft. Wainwright, is located between the Chena and Tanana Rivers. Temperatures in the area range from -19 to -2 degrees Fahrenheit in January, and from 53 to 72 degrees in July. Annual precipitation in the Fairbanks area is 11.5 inches, including 67.8 inches of snowfall (ADCCED, 2009).

Treated water is pumped throughout the Fairbanks area by 15 circulating pump stations. Water, sewer, and electric utilities are provided by a private company. Ft. Wainwright operates its own landfill (ADCCED, 2008).

According to the well log, the depth of the well is approximately 52 feet below the ground surface in an unconfined aquifer. The sanitary survey for this system (1/26/2007) states that a sanitary seal is installed, the land surface is appropriately sloped away from the well, and the well is grouted according to DEC regulations.

This system serves 20 residents continuously, and 175 non-residents seasonally (from May through September) through one service connection.

FT. WAINWRIGHT GOLF MAINTENANCE DRINKING WATER PROTECTION AREA

In order to evaluate whether a drinking water source is at risk, we must first evaluate what are the most likely pathways for surface contamination to reach the groundwater. 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 Drinking Water Protection Area. The Drinking Water Protection Area is the area circling the well (the area influenced by pumping) and also the area upgradient of the well, usually forming a parabola shape. Because releases of contaminants within the protection area are most likely to impact the well, this area will serve as the focus for voluntary protection efforts.

There are many different methods for calculating the size of protection areas. 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 protection zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The protection zone calculated by DWP is an estimate using the available information and resources, and may differ slightly from the actual capture zone. Because of uncertainties and changing site conditions, a factor of safety is added to the protection zone to form the drinking water protection area for the well.

The parameters used to calculate the shape of this protection 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).

The protection areas established for wells by the DEC are usually separated into two zones, limited by the

watershed. These zones correspond to differences in the time-of-travel (TOT) of the water moving through the aquifer to the well. An analytical calculation was used to determine the size and shape of the protection area.

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. The following is a summary of the two protection area zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

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

The Drinking Water Protection Area for Ft. Wainwright Golf Maintenance was determined using an analytical calculation and includes Zones A and B (see Map A in Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

DWP has completed an inventory of potential and existing sources of contamination within the Ft. Wainwright Golf Maintenance drinking water protection area. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination to the drinking water aquifer include a wide range of categories and types. 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 B public water system assessments, the following three categories of drinking water contaminants were inventoried:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals

The sources are displayed on Map C 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 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 function of toxicity and volumes of specific contaminants associated with that source. Rankings include:

- Low;
- Medium;
- High; and
- Very High.

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

VULNERABILITY OF FT. WAINWRIGHT GOLF MAINTENANCE DRINKING WATER SYSTEM

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural Susceptibility; and
- Contaminant Risks.

A score for the Natural Susceptibility of the well is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0-25 Points)
+
Susceptibility of the Aquifer (0-25 Points)
=
Natural Susceptibility of the Well (0-50 Points)

A ranking is assigned for the Natural Susceptibility according to the point score:

Natural Susceptibility Ratings	
40-50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

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

The wellhead for the Ft. Wainwright Golf Maintenance received a **Low** susceptibility rating. The most recent sanitary survey (1/26/2007) indicates that a sanitary seal is installed on the well, the land surface is sloped away from the well, and the well is grouted according to DEC regulations. Sanitary seals prevent potential contaminants from entering the well, while sloping of the land surface away from the wellhead provides adequate surface water drainage, and concrete or grouting around the wellhead helps 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 Ft. Wainwright Golf Maintenance system draws water from an unconfined aquifer consisting of sand and gravel. It received a **High** susceptibility rating because of its unconfined status and the presence of other wells within the protection area. Unconfined aquifers are susceptible to contamination from outside sources, while other wells can penetrate the vadose zone and allow contaminants to travel down to the aquifer with precipitation and runoff.

Table 2 summarizes the Susceptibility scores and ratings for the Ft. Wainwright Golf Maintenance system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	18	High
Natural Susceptibility	18	Low

Contaminant risks are 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. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

Contaminant Risk Ratings	
40-50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants for the Ft. Wainwright Golf Maintenance system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	32	High
Nitrates and/or Nitrites	35	High
Volatile Organic Chemicals	28	Medium

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

Natural Susceptibility (0-50 Points)
+
Contaminant Risks (0-50 Points)
=
Vulnerability of the Drinking Water Source to Contamination (0-100 Points)

Again, rankings are assigned according to a point score:

Overall Vulnerability Ratings	
80-100 pts	Very High
60 to < 80 pts	High
40 to < 60 pts	Medium
< 40 pts	Low

Table 4 contains the overall vulnerability scores (0-100) and ratings for each of the three categories of drinking water contaminants for the Ft. Wainwright Golf Maintenance system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	50	Medium
Nitrates and/or Nitrites	55	Medium
Volatile Organic Chemicals	45	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **High** with the septic systems, large-capacity septic system, and roads contributing to the risk to the drinking water well.

Coliforms (a bacteria) are found naturally in the environment and while not necessarily a direct health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically fecal coliforms

and E. coli. These bacteria only come from human and animal fecal waste and can cause diarrhea, cramps, nausea, headaches, and other symptoms (EPA, 2008).

Samples testing positive for bacteria and viruses increase the overall vulnerability of the drinking water source by indicating that the source is susceptible to bacteria and virus contamination. Only a small number of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected during recent water sampling of the system at Ft. Wainwright Golf Maintenance (data reviewed in April, 2008).

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 **Medium**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **High** with the septic systems, golf course, large-capacity septic system, and roads contributing to the risk to the drinking water well.

Sampling history for Ft. Wainwright Golf Maintenance well indicates that nitrates have not been detected in the water within the last 5 years of sampling (data reviewed in April, 2008).

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 **Medium**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Medium** with the septic systems, heating oil tanks, large-capacity septic system, and roads contributing to the risk of volatile organic chemicals.

Sampling history for Ft. Wainwright Golf Maintenance well indicates that volatile organic chemicals have been detected in the water within the last 5 years of sampling. The system received a positive result of 0.0052 mg/l for total trihalomethanes on 11/1/2004 (data reviewed in April, 2008).

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 **Medium**.

Using the Source Water Assessment

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of Ft. Wainwright Golf Maintenance to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of Ft. Wainwright Golf Maintenance drinking water source.

REFERENCES

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

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APPENDIX A

Ft. Wainwright Golf Maintenance
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #314750.001 Ft. Wainwright Golf Maintenance

Legend

Class B Public Water System

Groundwater Protection Zones

Zone A Protection Area - Several Months Travel Time

Zone B Protection Area - 2 Years Travel Time

Data Sources:
Contaminant Sources, Public Water System Wells, Alaska Department of Environmental Conservation (ADEC)

All other data:
Alaska Statewide Digital Mapping Initiative (SDMI)

Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class B Public Water Systems" published by ADEC

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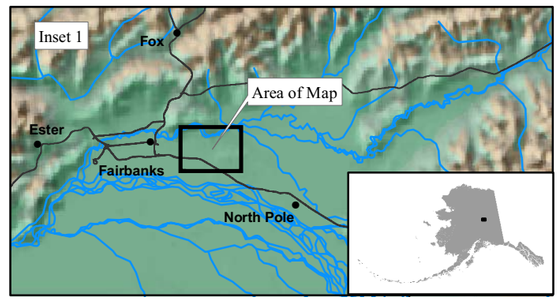

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Ft. Wainwright Golf Maintenance
PWS 314750.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Ft. Wainwright Golf Maintenance (Tables 1-4)

Table 1

Contaminant Source Inventory for

Ft. Wainwright Golf Maintenance

PWSID 314750.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02	A	C	1 assumed
Tanks, heating oil, residential (above ground)	R08	R08	A	C	1 assumed
Golf courses	X02	X02	A	C	
Highways and roads, paved (cement or asphalt)	X20	X20	A	C	1 road
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	B	C	
Septic systems (serves one single-family home)	R02	R02	B	C	7 assumed
Tanks, heating oil, residential (above ground)	R08	R08	B	C	7 inferred
Highways and roads, paved (cement or asphalt)	X20	X20	B	C	2 road

Table 2

Contaminant Source Inventory and Risk Ranking for Ft. Wainwright Golf Maintenance Sources of Bacteria and Viruses

PWSID 314750.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Septic systems (serves one single-family home)	R02	R02	A	Low	C	1 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	B	High	C	
Septic systems (serves one single-family home)	R02	R02	B	Low	C	7 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	2 road

Table 3

Contaminant Source Inventory and Risk Ranking for Ft. Wainwright Golf Maintenance Sources of Nitrates/Nitrites

PWSID 314750.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Septic systems (serves one single-family home)	R02	R02	A	Low	C	1 assumed
Golf courses	X02	X02	A	Medium	C	
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	B	High	C	
Septic systems (serves one single-family home)	R02	R02	B	Low	C	7 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	2 road

Table 4

Contaminant Source Inventory and Risk Ranking for Ft. Wainwright Golf Maintenance Sources of Volatile Organic Chemicals

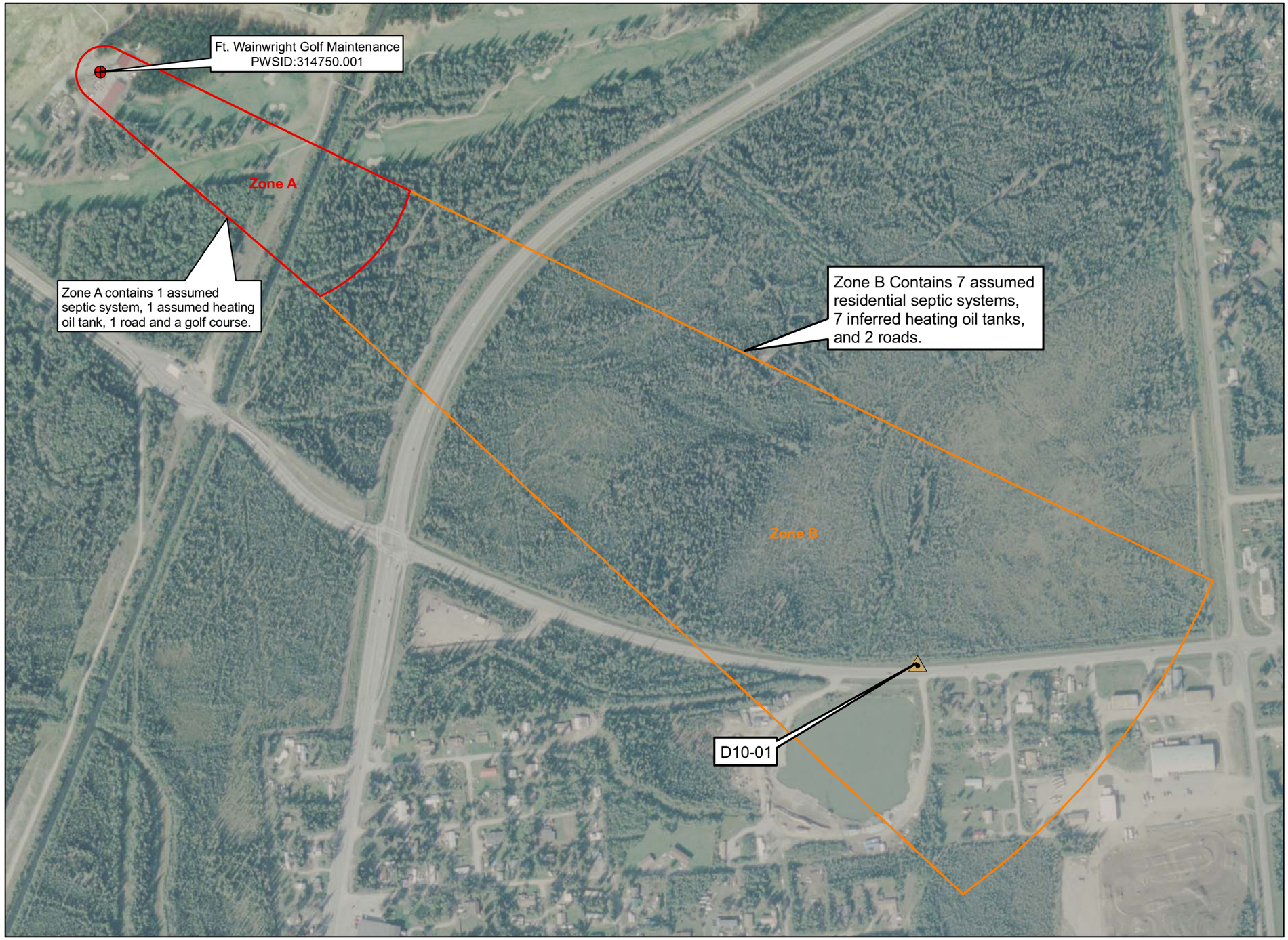
PWSID 314750.001

Contaminant Source Type	***Contaminant Source ID***	***CS ID tag***	***Zone***	***Risk Ranking for Analysis***	***Map Number***	***Comments***
Septic systems (serves one single-family home)	R02	R02	A	Low	C	1 assumed
Tanks, heating oil, residential (above ground)	R08	R08	A	Medium	C	1 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	B	Low	C	
Septic systems (serves one single-family home)	R02	R02	B	Low	C	7 assumed
Tanks, heating oil, residential (above ground)	R08	R08	B	Medium	C	7 inferred
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	2 road

APPENDIX C

Ft. Wainwright Golf Maintenance
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS #314750.001 Ft. Wainwright Golf Maintenance
Showing Potential and Existing Sources of Contamination



Legend

Groundwater Protection Zones

- Zone A Protection Area - Several Months Travel Time
- Zone B Protection Area - 2 Years Travel Time

Existing or Potential Contaminant Sources

- Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) (D10)

Data Sources:
Contaminant Sources, Public Water System Wells, Alaska Department of Environmental Conservation (ADEC)

All other data:
Alaska Statewide Digital Mapping Initiative (SDMI)

Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class B Public Water Systems" published by ADEC

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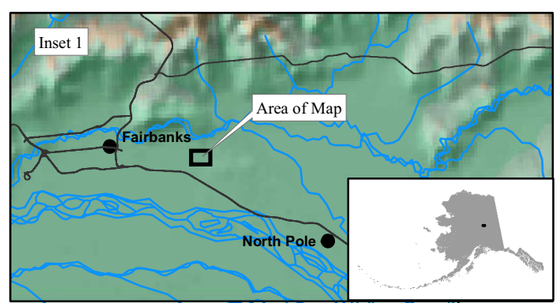

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Ft. Wainwright Golf Maintenance
PWS 314750.001

Appendix C Map C