Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Knik River Lodge Public Drinking Water System, Knik River, Alaska PWSID # 220405.001

DRINKING WATER PROTECTION REPORT 1653

Alaska Department of Environmental Conservation

February, 2009

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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

CONTENTS

TABLES

APPENDICES

Source Water Assessment for
Knik River Lodge Source of Public Drinking Water, Knik River, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Knik River Lodge is a Class B (transient/non-community) water system consisting of one well located on Knik River Road in Knik River, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Low**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. There are no identified potential and current sources of contaminants for Knik River Lodge public drinking water source. Overall, the public water sources for Knik River Lodge received a vulnerability rating of **Low** 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 Knik River Lodge to protect public health.

KNIK RIVER LODGE
PUBLIC DRINKING WATER SYSTEM

The Knik River Lodge public water system is a Class B (transient/non-community) water system. The system consists of one well located on Knik River Road, about 16.5 miles southeast of Palmer, in Knik River, Alaska (see Map A in Appendix A). The community of Knik River lies on the south shore of the Knik River, along the Old Glenn Highway and Knik River Road. Temperatures in January range from -35 to 33 degrees Fahrenheit, and from 42 to 85 degrees in July. The community receives 16.5 inches of precipitation annually, including 43 inches of snowfall (ADCCED, 2009).

Most homes in Knik River use individual water wells and septic systems, while others haul water and use outhouses. Electricity is provided by Matanuska Electric Association and refuse is taken to a Borough-operated transfer site in Butte (ADCCED, 2009).

According to the well log (01/04/2006), the well extends approximately 325 feet below the ground surface and is completed in a confined aquifer.

This system operates from May through September and serves 31 non-residents through one service connection.

KNIK RIVER LODGE
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 Knik River Lodge 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 Knik River Lodge 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 are inventoried:

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

There were no known sources of contaminants within the protection area for this system. This is reflected in Map B in Appendix B.

RANKING OF CONTAMINANT RISKS

Once the potential and existing sources of contamination are 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.

There were no known contaminant sources within the protection area for this system. No rankings were assigned.

VULNERABILITY OF KNIK RIVER LODGE 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 Knik River Lodge received a **Low** susceptibility rating. The most recent sanitary survey (02/01/2007) 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 Knik River Lodge system draws water from a confined aquifer overlain by 37 feet of silt and clay. It received a **Low** susceptibility rating because of the deep nature of the aquifer and the thick confining layer. Deeper aquifers are more protected from surface contaminants while thicker confining layers provide greater protection from any contamination that does manage to penetrate to that depth.

Table 2 summarizes the Susceptibility scores and ratings for the Knik River Lodge system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	9	Low
Natural Susceptibility	9	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 Knik River Lodge system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	0	Low
Nitrates and/or Nitrites	0	Low
Volatile Organic Chemicals	0	Low

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 Knik River Lodge system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	10	Low
Nitrates and/or Nitrites	10	Low
Volatile Organic Chemicals	10	Low

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Low** with no known contaminant sources 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).

Only a small number of bacteria and viruses are required to endanger public health. 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. Bacteria and viruses have not recently been detected during water sampling of the system at Knik River Lodge (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 **Low**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Low** with no known contaminant sources contributing to the risk to the drinking water well.

Nitrates and nitrites have not recently been detected during water sampling of the system at Knik River Lodge (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 **Low**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Low** with no known contaminant sources contributing to the risk to the drinking water well.

The drinking water at Knik River Lodge has not recently been sampled for volatile organic chemicals (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 **Low**.

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 Knik River Lodge 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 Knik River Lodge drinking water source.

REFERENCES

Alaska Department of Commerce, Community and Economic Development (ADCCED), Accessed 2009 [WWW document]. URL: http://www.commerce.state.ak.us/dca/commdb/CF_COMDB.htm

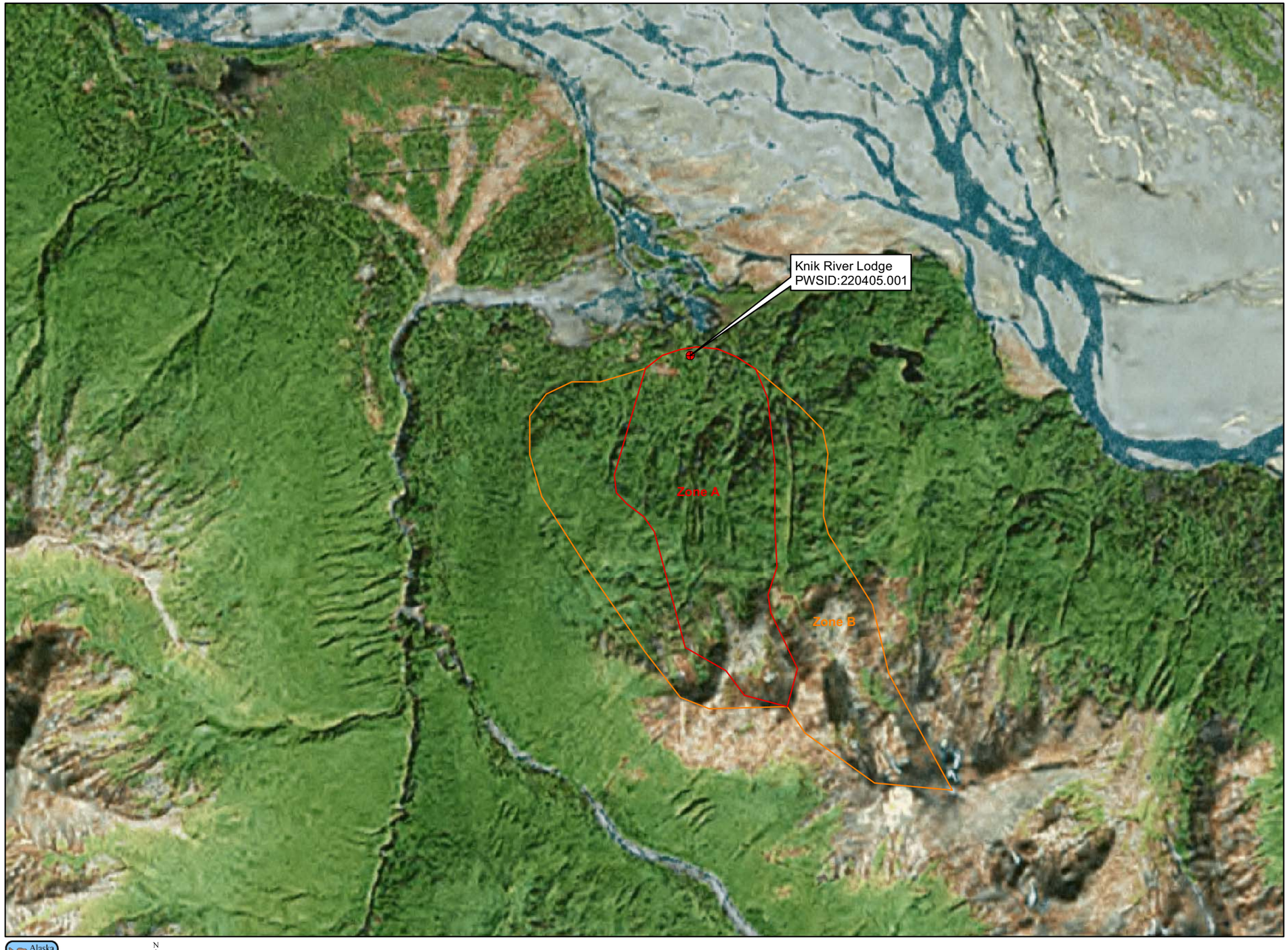
Freeze, R.A. and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.

United States Environmental Protection Agency (EPA), Accessed 2008 [WWW document]. URL: http://www.epa.gov/safewater/contaminants/index.html.

APPENDIX A

Knik River Lodge
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #220405.001 Knik River Lodge



Legend

Class B Public Water System Well

Groundwater Protection Zones

Zone A Protection Area - Several Months Travel Time

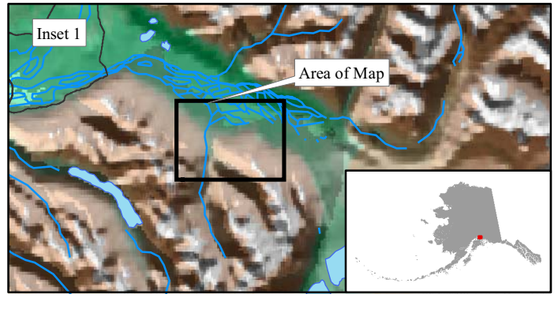
Zone B Protection Area - 2 Years Travel Time

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

URS Corporation does not guarantee the accuracy or validity of the data provided.



Alaska DEC

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Knik River Lodge
PWS 220405.001

Appendix A Map A