# Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Slate Creek Inn Public Drinking Water System, Coldfoot area, Alaska PWSID # 334035.001

DRINKING WATER PROTECTION REPORT 1802

Alaska Department of Environmental Conservation

February, 2009

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DRINKING WATER PROTECTION REPORT 1802

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 number: 1-866-956-7656.

February, 2009

# CONTENTS



# TABLES



# APPENDICES

# Source Water Assessment for Slate Creek Inn Source of Public Drinking Water, Coldfoot area, Alaska

**Drinking Water Protection**
**Alaska Department of Environmental Conservation**

## EXECUTIVE SUMMARY

The public water system for Slate Creek Inn is a Class B (transient/non-community) water system consisting of one well located on the Dalton Highway, in Coldfoot, Alaska. DEC records indicate this system is classified as groundwater under the direct influence of surface water (GWUDISW). The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **Very High**. An aquifer susceptibility rating of high to very high is typical for all systems that receive a component of surface water, or are classified as GWUDISW. Combining these two ratings produces a **Very High** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Slate Creek Inn public drinking water source include: assumed septic systems and assumed heating oil tanks. 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 Slate Creek Inn received a vulnerability rating of **High** 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 Slate Creek Inn to protect public health.

## SLATE CREEK INN PUBLIC DRINKING WATER SYSTEM

Slate Creek Inn public water system is a Class B (transient/non-community) water system. The system consists of one well located on the Dalton Highway, in Coldfoot, Alaska (see Map A of Appendix A). Coldfoot is located at the confluence of Slate Creek and the Koyukuk River, at Mile 175 of the Dalton Highway. The current population of Coldfoot is 11, and it is classified as an isolated village. Residents use individual wells and septic tanks as there no community-wide water distribution or sewage systems exist. Individual generators provide electricity to residents (ADCCED, 2009).

According to the well log, the well extends approximately 40 feet below the ground surface and is completed in an unconfined aquifer. The well characteristics, in combination with the characteristics of the unconfined aquifer at this location, indicate that this well is GWUDISW.

This system operates continuously and serves 3 residents and up to 120 non-residents through 8 service connections.

## SLATE CREEK INN DRINKING WATER PROTECTION AREA

Determining the risk for groundwater wells that are under the influence of surface water bodies necessitates an evaluation of both groundwater and surface water contamination pathways. The pathways most likely for surface contamination to reach the groundwater are determined by looking at the characteristics of the soil, groundwater, aquifer, and well. The pathways most likely for surface contamination to reach water intake areas are initially determined by looking at the drainage area contributing overland water flow to a surface water source intake.

The most probable area for contamination to reach the drinking water well is the drinking water protection area. For groundwater sources, 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. For surface water sources, the drinking water protection area is the entire drainage area. Because releases of contaminants within these combined protection areas are most likely to impact the well, these areas will serve as the focus for voluntary protection efforts.

There are many different methods for calculating the size of protection areas for groundwater sources. 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 the 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 groundwater wells by the DEC are usually separated into two zones (A and B), 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 protection area established for surface water sources by DEC is usually separated into three zones (E, F, and G), limited by the watershed boundary. These zones correspond to the overland-flow distance that water travels to get to the source. The DEC Drinking Water Protection Technical Advisory Committee developed guidelines for derivation of these zones in 1998.

The following is a summary of the five protection area zones for groundwater wells that are under the influence of surface water bodies and the calculated time-of-travel or distance from the water body for each:

**Table 1. Definition of Zones**

| Zone | Definition |
|---|---|
| A | Several months time-of-travel |
| B | Less than the 2 year time-of-travel |
| E | Areas within 1000 feet of the water body, including areas within 1000 feet of all lakes/ streams up to a stream order of 2 below the stream order at the source |
| F | Areas within 1 mile of water body, including areas within 1 mile of all lakes/ streams up to a stream order of 2 below the stream order at the source |
| G | Entire watershed |

The drinking water protection area for Slate Creek Inn was determined using an analytical calculation and includes Zones A, B, E, F, and G (see Map A of Appendix A).

## INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

DWP has completed an inventory of potential and existing sources of contamination within the Slate Creek Inn 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.

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant. Bacteria and viruses are only inventoried in Zones A and B because of their short life span. 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 SLATE CREEK INN 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 in place, protection from flooding, and if the well casing is properly grouted.

The wellhead for the Slate Creek Inn received a **Very High** susceptibility rating. The most recent sanitary survey (09/27/2003) indicates the well is capped with a sanitary seal, but the seal has an open hole and it should be replaced. It also states that the concrete pad around the well is cracked and needs repair. The land surface is sloped away from the well. 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 Slate Creek Inn system draws water from an unconfined aquifer consisting of sand, silt, and gravel. It received a **Very High** susceptibility rating because of its unconfined status and the presence of other wells within the protection area. Because an unconfined aquifer is recharged by surface water and precipitation that migrates downward from the surface, it is susceptible to contamination from outside sources. Furthermore, the presence of other wells penetrating the vadose zone of the protection area can allow contaminants to travel into the shared aquifer with precipitation and runoff.

Table 2 summarizes the Susceptibility scores and ratings for Slate Creek Inn system.

**Table 2: Susceptibility**

| | Score | Rating |
|---|---|---|
| Susceptibility of the Wellhead | 25 | Very High |
| Susceptibility of the Aquifer | 25 | Very High |
| Natural Susceptibility | 50 | Very High |

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 Slate Creek Inn system.

**Table 3. Contaminant Risks**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 12 | Low |
| Nitrates and/or Nitrites | 12 | Low |
| Volatile Organic Chemicals | 12 | 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 Slate Creek Inn system. Note: scores are rounded off to the nearest five.

**Table 4. Overall Vulnerability**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 60 | High |
| Nitrates and/or Nitrites | 60 | High |
| Volatile Organic Chemicals | 60 | High |

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is **Low** with septic systems 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 in the last 5 years of sampling at Slate Creek Inn (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 **High**.

**Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is **Low** with septic systems contributing to the risk to the drinking water well.

The sampling history for Slate Creek Inn 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 **High**.

**Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is **Low** with septic systems and heating oil tanks contributing to the risk to the drinking water well.

The drinking water at Slate Creek Inn 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 **High**.

**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 Slate Creek Inn 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 Slate Creek Inn 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

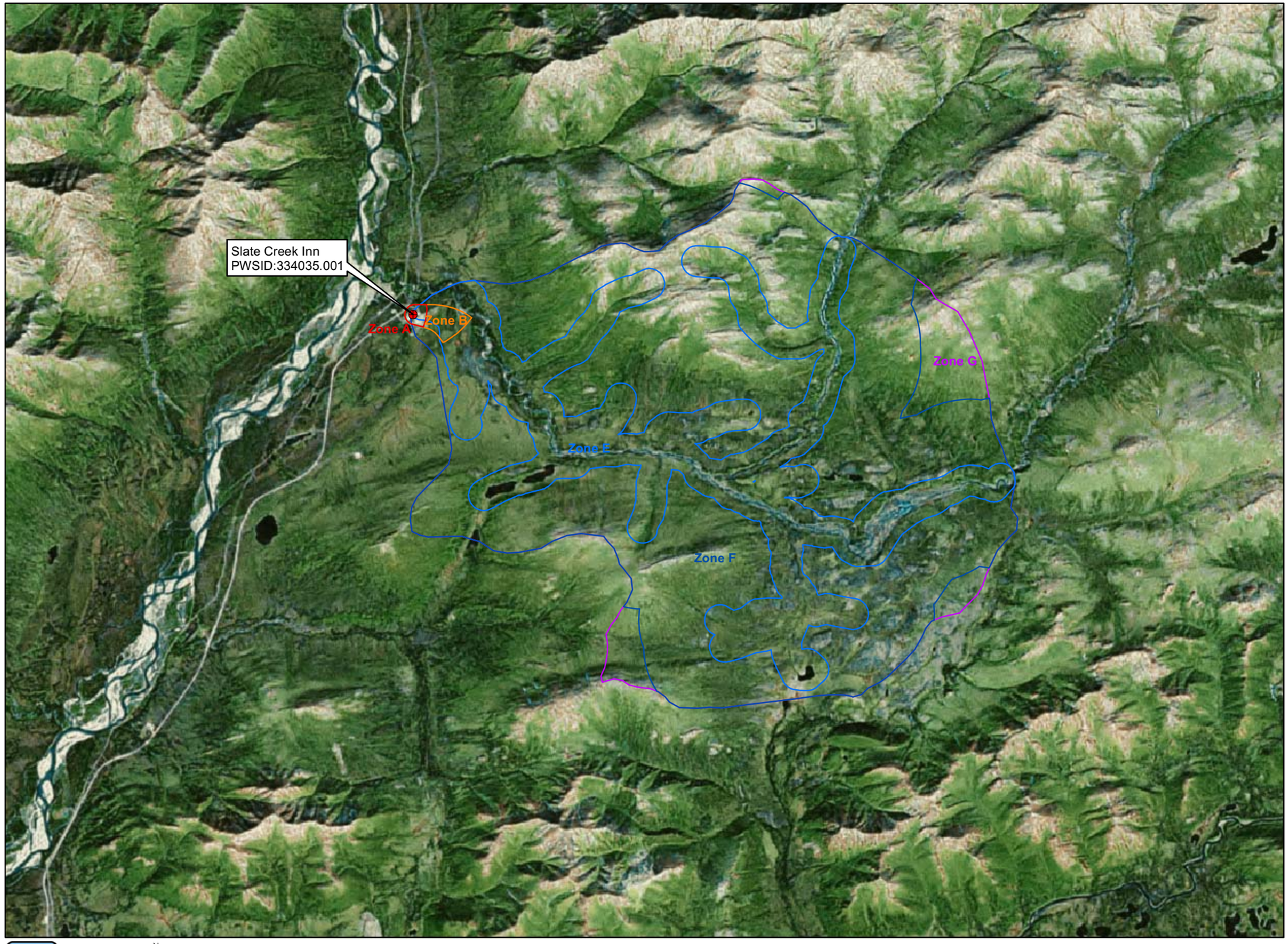
Freeze, R.A. and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.

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

# APPENDIX A

## Slate Creek Inn
## Drinking Water Protection Area Location Map
## (Map A)

# Public Water Well System for PWS #334035.001 Slate Creek Inn




## Legend

Class B Public Water System Well

**Groundwater Protection Zones**

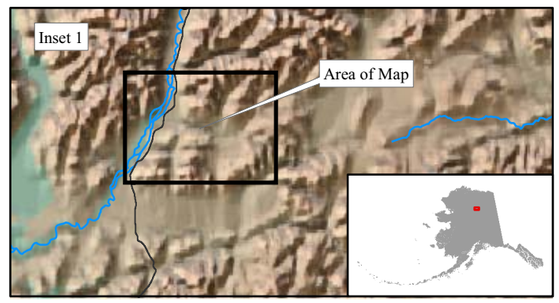
- Zone A Protection Area - Several Months Travel Time
- Zone B Protection Area - 2 Years Travel Time
- Zone E Protection Area - Up to 1,000 Feet from Surface Water Body
- Zone F Protection Area - Up to 1 Mile from Surface Water Body
- Zone G Protection Area - Remainder of Watershed (Up to 10 Miles Upstream of Intake)

**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.**




N
W E
S

0 1 2 4 Miles

Slate Creek Inn
PWS 334035.001

**Appendix A Map A**

# APPENDIX B

## Contaminant Source Inventory and Risk Ranking for Slate Creek Inn (Tables 1-4)

***Table 1***

*Contaminant Source Inventory for*

***SLATE CREEK INN***

***PWSID 334035.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Map Number* | *Comments* |
|---|---|---|---|---|---|
| Septic systems (serves one single-family home) | R02 | R02 | A | C | 2 assumed septic systems |
| Tanks, heating oil, residential (above ground) | R08 | R08 | A | C | 2 assumed heating oil tanks |

***Table 2***

# *Contaminant Source Inventory and Risk Ranking for SLATE CREEK INN Sources of Bacteria and Viruses*

***PWSID 334035.001***

| *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 | 2 assumed septic systems |

***Table 3***

# *Contaminant Source Inventory and Risk Ranking for SLATE CREEK INN*

## *Sources of Nitrates/Nitrites*

***PWSID 334035.001***

| *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 | 2 assumed septic systems |

**Table 4**

# *Contaminant Source Inventory and Risk Ranking for SLATE CREEK INN*

## *Sources of Volatile Organic Chemicals*

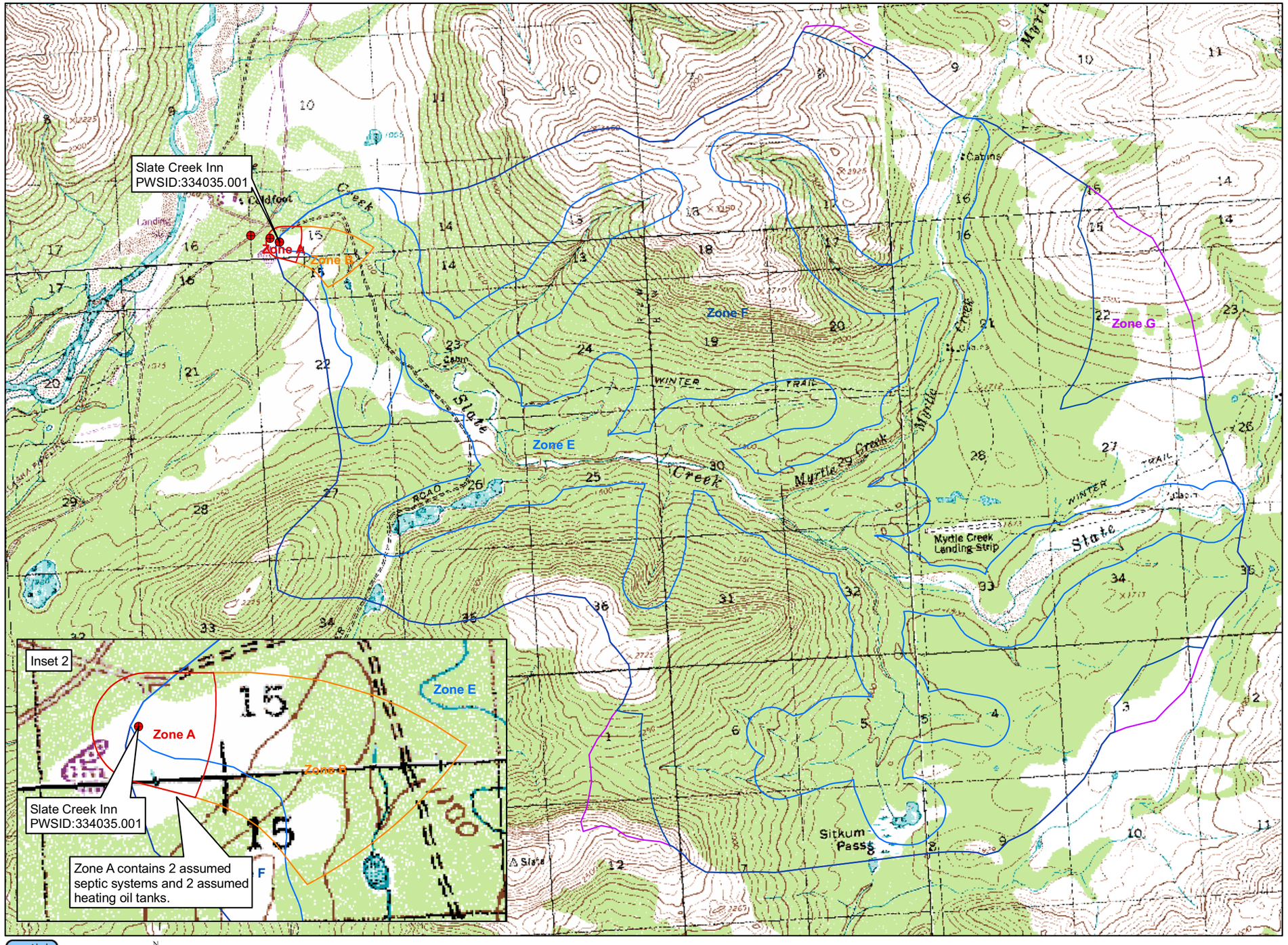
**PWSID 334035.001**

| *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 | 2 assumed septic systems |
| Tanks, heating oil, residential (above ground) | R08 | R08 | A | Low | C | 2 assumed heating oil tanks |

# APPENDIX C

## Slate Creek Inn
## Drinking Water Protection Area
## and Potential and Existing Contaminant Sources
## (Map C)

# Public Water Well System for PWS # 334035.001 Slate Creek Inn
# Showing Potential and Existing Sources of Contamination




## 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
- Zone E Protection Area - Up to 1,000 Feet from Surface Water Body
- Zone F Protection Area - Up to 1 Mile from Surface Water Body
- Zone G Protection Area - Remainder of Watershed (Up to 10 Miles Upstream of Intake)

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

**All other data:**
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**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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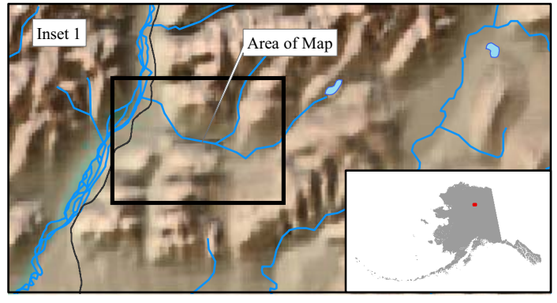


0 0.5 1 2 Miles

Slate Creek Inn
PWS 334035.001

**Appendix C Map C**