Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Copper Center Lodge - Old Well Public Drinking Water System, Copper Center, Alaska PWSID # 292801.002

DRINKING WATER PROTECTION REPORT 1770

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

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Source Water Assessment for Copper Center Lodge - Old Well Source of Public Drinking Water, Copper Center, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Copper Center Lodge is a Class B (transient/non-community) water system consisting of two wells located on Mile 101 of the Old Richardson Highway, on Loop Road in Copper Center, Alaska. This Source Water Assessment applies only to PWSID 292801.001, also known as the Old Well. 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 Copper Center Lodge - Old Well public drinking water source include: assumed septic systems, assumed heating oil tanks, roads, an oil pipeline, and an airport. 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 Copper Center Lodge - Old Well 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 Copper Center Lodge to protect public health.

COPPER CENTER LODGE - OLD WELL PUBLIC DRINKING WATER SYSTEM

Copper Center Lodge public water system is a Class B (transient/non-community) water system. The system consists of two wells located at Mile 101 of the Old Richardson Highway, on Loop Road in Copper Center, Alaska (see Map A in Appendix A). This Source Water Assessment applies only to PWSID 292801.001, also known as the Old Well. The community of Copper Center (population 337) lies on the west bank of the Copper River, at its confluence with the Klutina River. It is located between Mile 101 and Mile 105 of the Richardson Highway, approximately 200 road miles east of Anchorage, and incorporates the Native Village of Kluti-Kaah. The area receives 9 inches of precipitation annually, and average temperatures reach -10 degrees Fahrenheit in January and 56 degrees Fahrenheit in July (ADCCED, 2009).

Most homes in the area have private wells, although water quality can be very poor in the area, so many residents choose to have treated water hauled in from a well operated by Copper Center Safe Water. Copper Valley Electric provides electricity (ADCCED, 2009).

Copper Center lies in the southern portion of the Copper River basin, in southeastern Interior Alaska. The basin, ranging from nearly 500 feet to more than 4,000 feet above sea level, is an intermontane basin rimmed by peaks of the Chugach, Alaska, Talkeetna, and Wrangell mountain ranges. The terrain of the basin can be divided into two physiographic sub-units: the Copper River basin piedmont surface, and the Copper River basin trough. The Copper River basin trough is generally flat, while the Copper River basin piedmont surface has a rolling, hummocky character (Nichols, 1956).

The terrain and geology of the basin have been formed from events from the Pleistocene era through to recent times. Glaciers from the Chugach, Wrangell, Talkeetna, and Alaska Ranges have repeatedly invaded the basin, perhaps at times filling it and flowing across the divides to the north, west, east, and south. Such extensive glaciation has resulted in the deposition of thick layers of coarse glacial boulder clays (till) and coarse outwash gravel and sand on the piedmont surface, with finer till and outwash mixed with lake deposits in the basin trough. As a result, soils in the area generally consist of silt, clay and till, layered with sand and gravel (Nichols, 1956).

According to DEC correspondence, the Old Well at the Copper Center Lodge extends approximately 16 feet below the ground surface and is completed in an unconfined aquifer. This system operates year-round and serves twenty residents and seventy-eight non-residents through two service connections.

The well characteristics, in combination with the characteristics of the unconfined aquifer at this location, indicate that this well is GWUDISW.

COPPER CENTER LODGE - OLD WELL 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 are 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 the Old Well at the Copper Center Lodge 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 Copper Center Lodge - Old Well 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 COPPER CENTER LODGE - OLD WELL 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 Old Well at the Copper Center Lodge received a **Very High** susceptibility rating. No sanitary survey is available for this system, so it is assumed that no sanitary seal is installed on the well, the land surface is not sloped away from the well, and the well is not 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 depth and thickness of the confining layer.

The Copper Center Lodge - Old Well system draws water from an unconfined aquifer consisting of cobbles and gravel. It received a **Very High** susceptibility rating because of its shallow, unconfined status, and the presence of other wells that penetrate the vadose zone 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. For this reason, deeper aquifers provide more protection than shallow ones. Furthermore, the presence of other wells penetrating the vadose zone can allow contaminants to travel down to the shared aquifer with precipitation and runoff, thus increasing the risk of contamination.

Table 2 summarizes the Susceptibility scores and ratings for Copper Center Lodge - Old Well 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 Copper Center Lodge - Old Well system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	22	Medium
Nitrates and/or Nitrites	15	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 Copper Center Lodge - Old Well system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	70	High
Nitrates and/or Nitrites	65	High
Volatile Organic Chemicals	60	High

Bacteria and Viruses

The contaminant risk to the drinking water well for bacteria and viruses is determined to be **Medium**, with risk resulting primarily from positive coliform sampling results. Assumed septic systems and roads further contribute to the risk.

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 been detected several times during the last five years of sampling at Copper Center Lodge. Positive results have been detected on 08/29/2007, 09/10/2007, and 09/25/2007 (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 for the Old Well at Copper Center Lodge is determined to be **Low**, with minimal risk resulting from assumed septic systems, an airport, and roads.

The sampling history for Copper Center Lodge indicates that nitrates and nitrites have been detected within the last five years. A concentration of 0.681 mg/L was detected on 09/10/2007 (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 determined to be **Low**. Assumed heating oil tanks, a pipeline, and an airport are the main contributors to this ranking, while assumed septic systems and roads increase the risk.

The drinking water at Copper Center Lodge - Old Well 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 Copper Center 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 Copper Center Lodge - Old Well drinking water source.

REFERENCES

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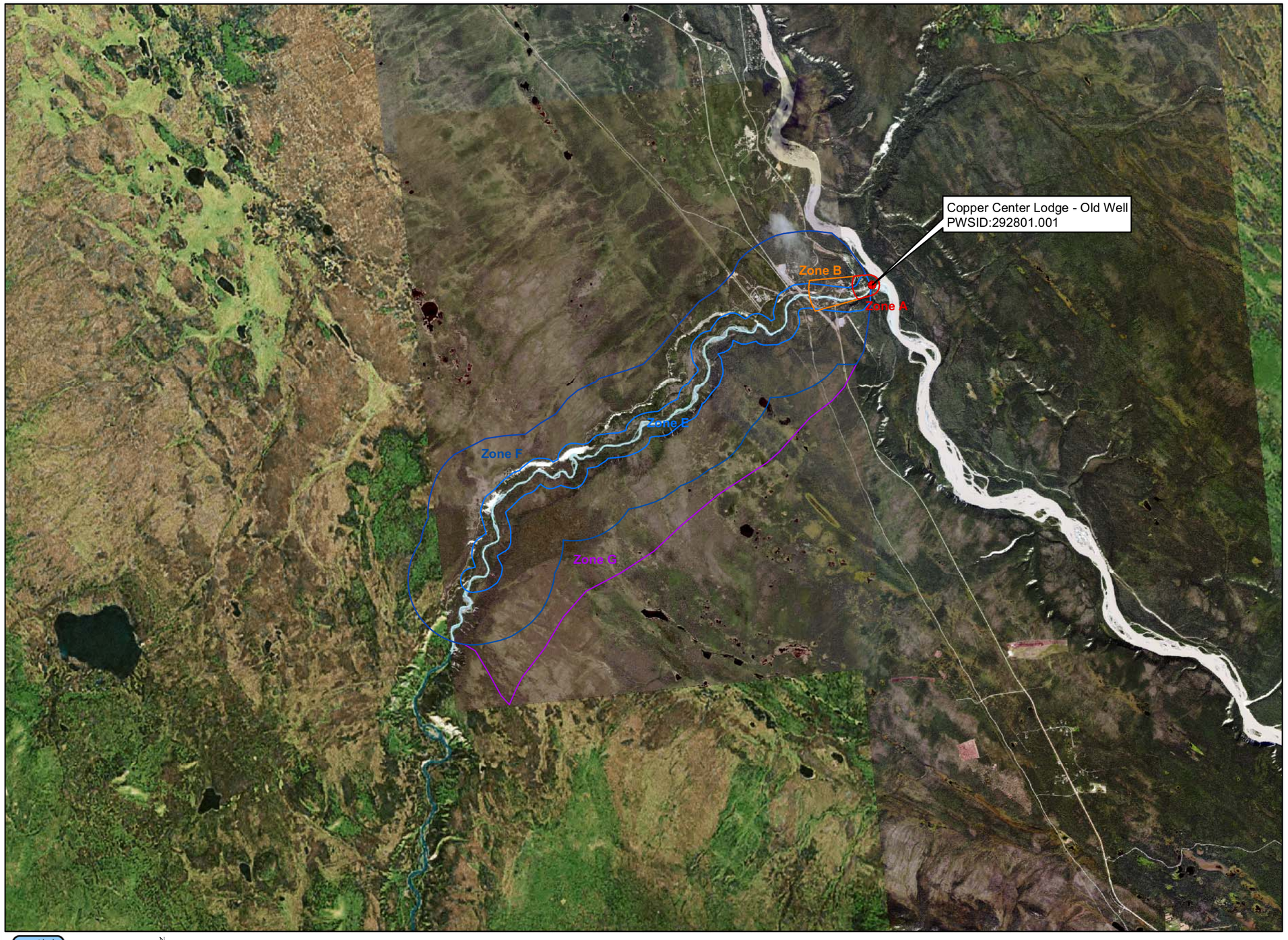
APPENDIX A

Copper Center Lodge - Old Well
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #292801.002 Copper Center Lodge - Old Well



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

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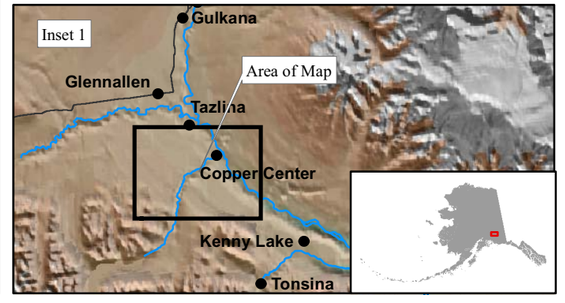

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Copper Center Lodge - Old Well
PWS 292801.002

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Copper Center Lodge - Old Well (Tables 1-4)

Table 1

Contaminant Source Inventory for ***Copper Center Lodge - Old Well***

PWSID 292801.002

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02	A	C	5 assumed septic systems
Tanks, heating oil, residential (above ground)	R08	R08	A	C	5 assumed heating oil tanks
Highways and roads, paved (cement or asphalt)	X20	X20	A	C	2 roads
Septic systems (serves one single-family home)	R02	R02	B	C	15 assumed septic systems
Tanks, heating oil, residential (above ground)	R08	R08	B	C	15 assumed heating oil tanks
Highways and roads, paved (cement or asphalt)	X20	X20	B	C	3 roads
Septic systems (serves one single-family home)	R02	R02	E	C	30 assumed septic systems
Tanks, heating oil, residential (above ground)	R08	R08	E	C	30 assumed heating oil tanks
Highways and roads, paved (cement or asphalt)	X20	X20	E	C	4 roads
Pipelines (oil and gas)	X28	X28	E	C	1 oil pipeline
Septic systems (serves one single-family home)	R02	R02	F	C	30 assumed septic systems
Tanks, heating oil, residential (above ground)	R08	R08	F	C	30 assumed heating oil tanks
Airports	X14	X14	F	C	
Highways and roads, paved (cement or asphalt)	X20	X20	F	C	4 roads
Pipelines (oil and gas)	X28	X28	F	C	1 oil pipeline
Highways and roads, paved (cement or asphalt)	X20	X20	G	C	2 roads
Pipelines (oil and gas)	X28	X28	G	C	1 oil pipeline

Table 2

Contaminant Source Inventory and Risk Ranking for Copper Center Lodge - Old Well Sources of Bacteria and Viruses

PWSID 292801.002

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	5 assumed septic systems
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 roads
Septic systems (serves one single-family home)	R02	R02	B	Low	C	15 assumed septic systems
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	3 roads
Septic systems (serves one single-family home)	R02	R02	E	Low	C	30 assumed septic systems
Highways and roads, paved (cement or asphalt)	X20	X20	E	Low	C	4 roads
Septic systems (serves one single-family home)	R02	R02	F	Low	C	30 assumed septic systems
Highways and roads, paved (cement or asphalt)	X20	X20	F	Low	C	4 roads
Highways and roads, paved (cement or asphalt)	X20	X20	G	Low	C	2 roads

Table 3

Contaminant Source Inventory and Risk Ranking for Copper Center Lodge - Old Well Sources of Nitrates/Nitrites

PWSID 292801.002

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	5 assumed septic systems
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 roads
Septic systems (serves one single-family home)	R02	R02	B	Low	C	15 assumed septic systems
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	3 roads
Septic systems (serves one single-family home)	R02	R02	E	Low	C	30 assumed septic systems
Highways and roads, paved (cement or asphalt)	X20	X20	E	Low	C	4 roads
Septic systems (serves one single-family home)	R02	R02	F	Low	C	30 assumed septic systems
Airports	X14	X14	F	Low	C	
Highways and roads, paved (cement or asphalt)	X20	X20	F	Low	C	4 roads
Highways and roads, paved (cement or asphalt)	X20	X20	G	Low	C	2 roads

Table 4

Contaminant Source Inventory and Risk Ranking for Copper Center Lodge - Old Well Sources of Volatile Organic Chemicals

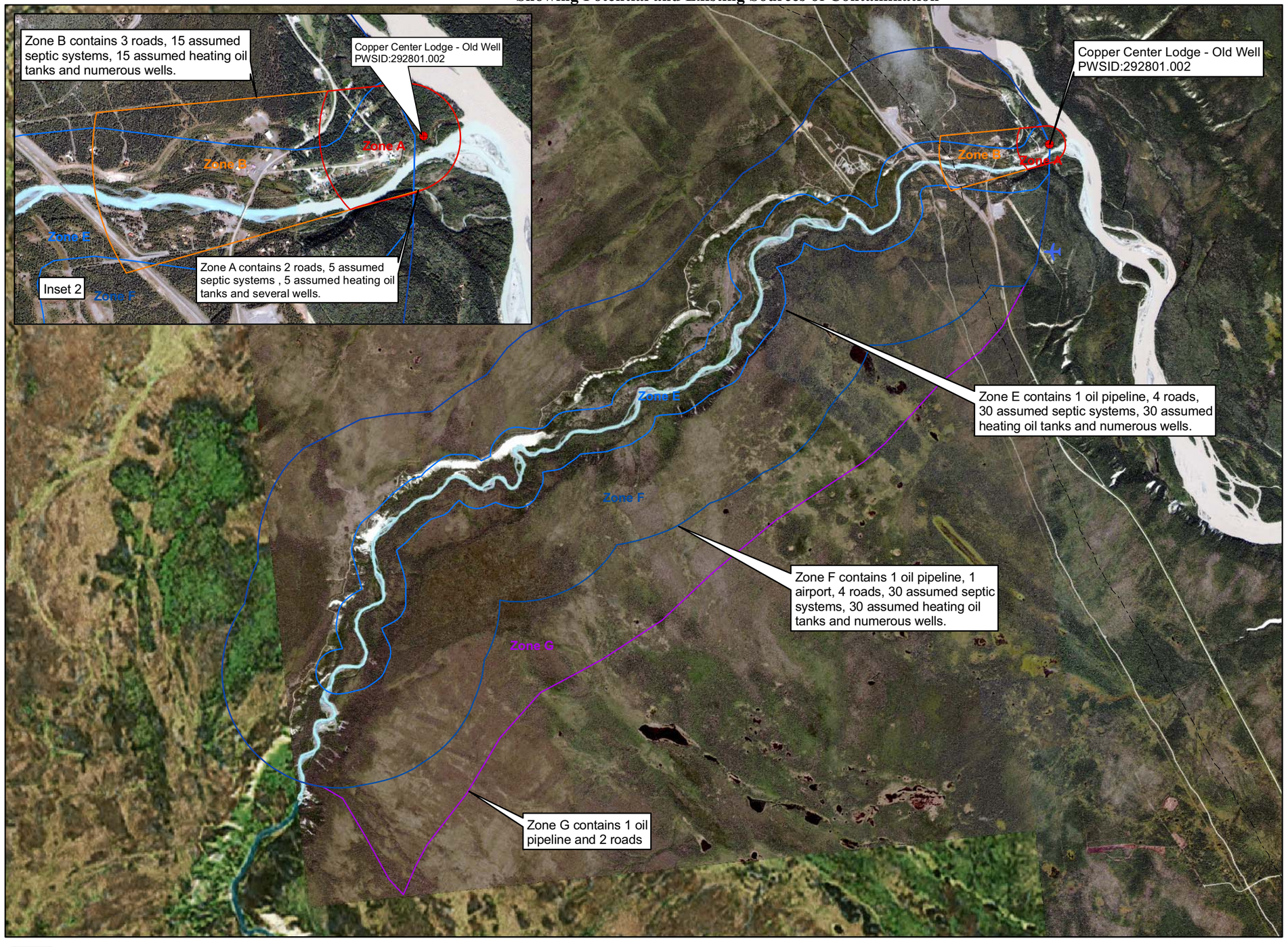
PWSID 292801.002

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	5 assumed septic systems
Tanks, heating oil, residential (above ground)	R08	R08	A	Low	C	5 assumed heating oil tanks
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 roads
Septic systems (serves one single-family home)	R02	R02	B	Low	C	15 assumed septic systems
Tanks, heating oil, residential (above ground)	R08	R08	B	Low	C	15 assumed heating oil tanks
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	3 roads
Septic systems (serves one single-family home)	R02	R02	E	Low	C	30 assumed septic systems
Tanks, heating oil, residential (above ground)	R08	R08	E	Low	C	30 assumed heating oil tanks
Highways and roads, paved (cement or asphalt)	X20	X20	E	Low	C	4 roads
Pipelines (oil and gas)	X28	X28	E	Medium	C	1 oil pipeline
Septic systems (serves one single-family home)	R02	R02	F	Low	C	30 assumed septic systems
Tanks, heating oil, residential (above ground)	R08	R08	F	Low	C	30 assumed heating oil tanks
Airports	X14	X14	F	Medium	C	
Highways and roads, paved (cement or asphalt)	X20	X20	F	Low	C	4 roads
Pipelines (oil and gas)	X28	X28	F	Medium	C	1 oil pipeline
Highways and roads, paved (cement or asphalt)	X20	X20	G	Low	C	2 roads
Pipelines (oil and gas)	X28	X28	G	Medium	C	1 oil pipeline

APPENDIX C

Copper Center Lodge - Old Well
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS # 292801.002 Copper Center Lodge - Old Well
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
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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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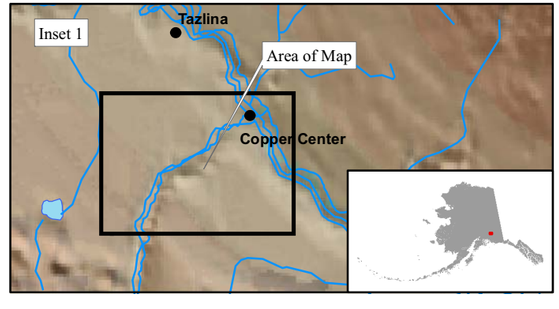

Alaska DEC

N W E S

0 1 2 4 Miles

Copper Center Lodge - Old Well
PWS 292801.002

Appendix C Map C