Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Miller's Landing Public Drinking Water System, Lowell Point, Alaska PWSID # 249079.001

DRINKING WATER PROTECTION REPORT 1721

Alaska Department of Environmental Conservation

January, 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.

January, 2009

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EXECUTIVE SUMMARY

The public water system for Miller's Landing is a Class B (transient/non-community) water system consisting of one well located at Lowell Point, near Seward, Alaska. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **Very High** rating for the natural susceptibility of the well. Identified potential and existing sources of contaminants for Miller's Landing public drinking water source include: assumed septic systems, assumed residential heating oil tanks, and a road. 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 Miller's Landing received a vulnerability rating of **Medium** for bacteria and viruses, **Medium** for nitrates and nitrites, and **High** for volatile organic chemicals. 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 Miller's Landing to protect public health.

MILLER'S LANDING PUBLIC DRINKING WATER SYSTEM

Miller's Landing public water system is a Class B (transient/non-community) water system. The system consists of one well and is located on Lowell Point Road, in Lowell Point, Alaska (see Map A in Appendix A). Lowell Point (population 85) sits at the base of Bear Mountain, approximately 3 miles south of Seward near the head of Resurrection Bay, at the southern end of the Kenai Peninsula. It is approximately 125 miles south of Anchorage, and lies within the Kenai Peninsula Borough, which has a population of approximately 50,000 and encompasses an area of more than 25,600 square miles (KPB, 2008).

The area receives 66 inches of rainfall annually in addition to 80 inches of snowfall, and average temperatures range from 17 to 38 degrees Fahrenheit in the winter and from 49 to 63 degrees Fahrenheit in the summer (ADCCED, 2009).

Nearly half the homes in Lowell Point are occupied only seasonally, and all residents must rely on individual water wells and septic systems. Electricity is provided by Seward Electric System, who purchases power from Chugach Electric Association (ADCCED, 2009).

The Kenai Peninsula is divided into two distinct geographic areas: the Kenai Mountains to the east and the Kenai Lowlands to the west. The Kenai Lowlands are a glaciated coastal shelf approximately 100 miles long, bordered on the west and north by Cook Inlet and on the east by the northeast-trending Kenai Mountains. The Lowlands are predominately drained by the Kenai River and contain the communities of Sterling, Soldotna, Kenai, Nikiski, Clam Gulch, and Homer. The Kenai Mountains extend from the southern tip of the Peninsula north to Turnagain Arm, and include the communities of Hope, Moose Pass, Cooper Landing, and Seward (Karlstrom, 1964). The Seward area is characterized by steep topography highly influenced by glaciation.

According to the well log (09/21/2006), the Miller's Landing well extends approximately 60 feet below the ground surface and is completed in an unconfined aquifer of sand and gravel.

This system seasonally from May to September and serves approximately twenty-five non-residents through twenty-five service connections.

MILLER'S LANDING 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 Miller's Landing 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 Miller's Landing 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 MILLER'S LANDING 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 Miller's Landing received a **Very High** susceptibility rating. Because no sanitary survey is available, it is assumed that there is no sanitary seal installed on the well, the land surface is not sloped away from the wellhead, 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 confining layer.

The Miller's Landing system draws water from an unconfined aquifer consisting of sand and gravel. It received a **Very High** susceptibility rating because of its unconfined status and the permeable nature of the aquifer substrate, in addition to 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. The Seward area receives abundant rainfall and is surrounded by steep topography, resulting in high levels of surface water and therefore a greater risk. Other wells penetrating the vadose zone can also allow contaminants to travel down to the shared aquifer with precipitation and runoff.

Table 2 summarizes the Susceptibility scores and ratings for Miller's Landing system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	20	Very High
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	45	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 Miller's Landing system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	13	Low
Volatile Organic Chemicals	25	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 Miller's Landing system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	55	Medium
Nitrates and/or Nitrites	55	Medium
Volatile Organic Chemicals	70	High

Bacteria and Viruses

The contaminant risk to the drinking water well for bacteria and viruses is determined to be **Low** with septic systems and a road 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. Bacteria and viruses have not been detected during the last 5 years of sampling at Miller's Landing (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 for Miller's Landing is determined to be **Low** with septic systems and a road contributing to the risk to the drinking water well.

The sampling history for Miller's Landing indicates that nitrates and nitrites have been identified within the past 5 years. A nitrate concentration of 0.21 mg/L was detected on 7/25/2005 (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 determined to be **Medium** with heating oil tanks, septic systems and a road contributing to the risk to the drinking water well.

The drinking water at Miller's Landing 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 Miller's Landing 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 Miller's Landing drinking water source.

REFERENCES

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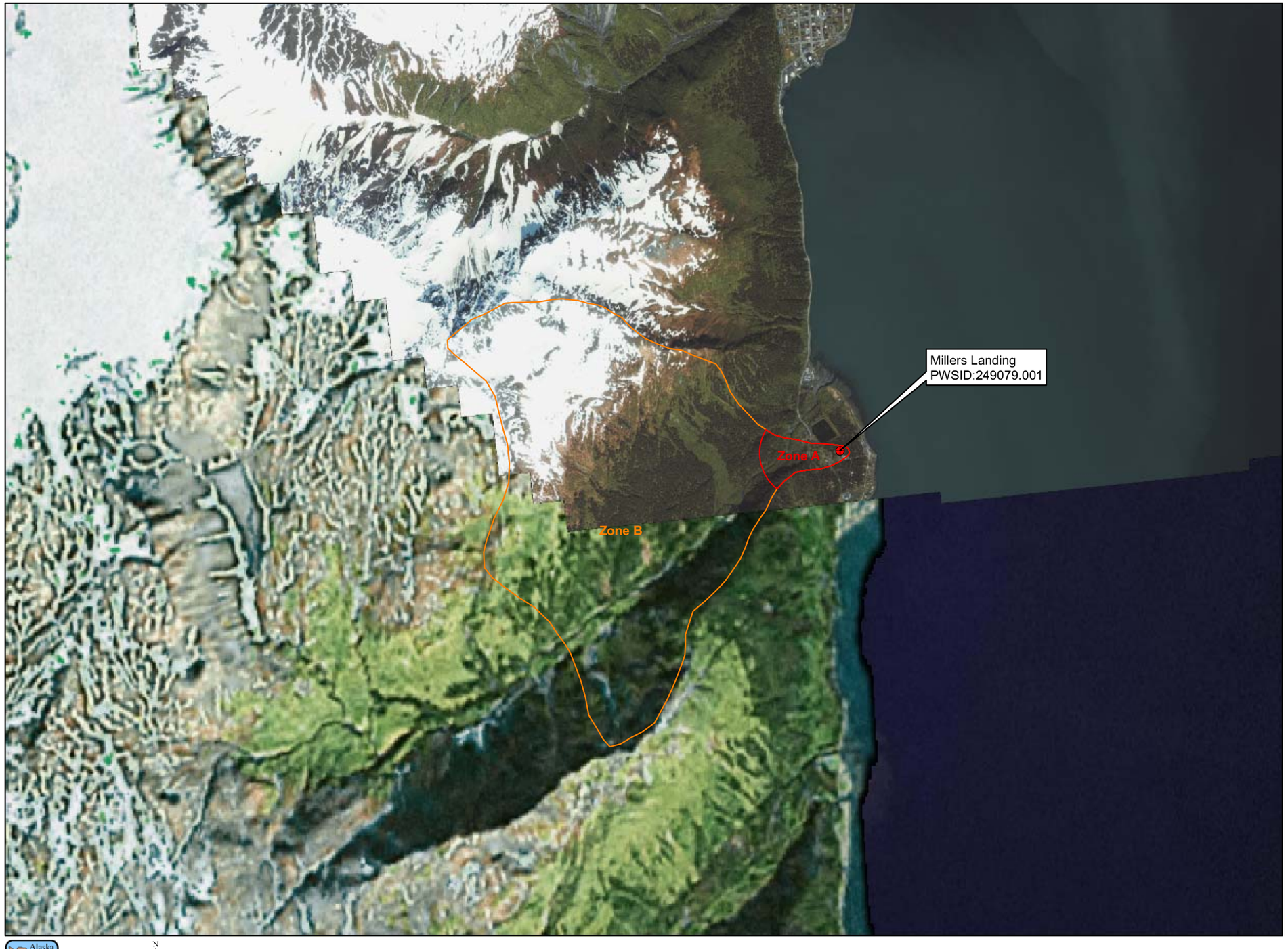
APPENDIX A

Miller's Landing
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #249079.001 Millers Landing



Legend

Class B Public Water System Well

Groundwater Protection Zones

Zone A Protection Area - Several Months Travel Time

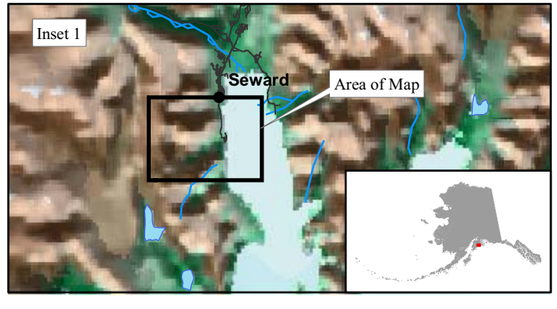
Zone B Protection Area - 2 Years Travel Time

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.



N
W E
S

0 0.5 1 2 Miles

Millers Landing
PWS 249079.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Miller's Landing (Tables 1-4)

Table 1

Contaminant Source Inventory for

Millers Landing

PWSID 249079.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02	A	C	3 assumed septic systems
Tanks, heating oil, residential (above ground)	R08	R08	A	C	3 assumed heating oil tanks
Highways and roads, paved (cement or asphalt)	X20	X20	A	C	1 road

Table 2

Contaminant Source Inventory and Risk Ranking for Millers Landing
Sources of Bacteria and Viruses

PWSID 249079.001

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	3 assumed septic systems
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road

Table 3

Contaminant Source Inventory and Risk Ranking for Millers Landing
Sources of Nitrates/Nitrites

PWSID 249079.001

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	3 assumed septic systems
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road

Table 4

Contaminant Source Inventory and Risk Ranking for Millers Landing

Sources of Volatile Organic Chemicals

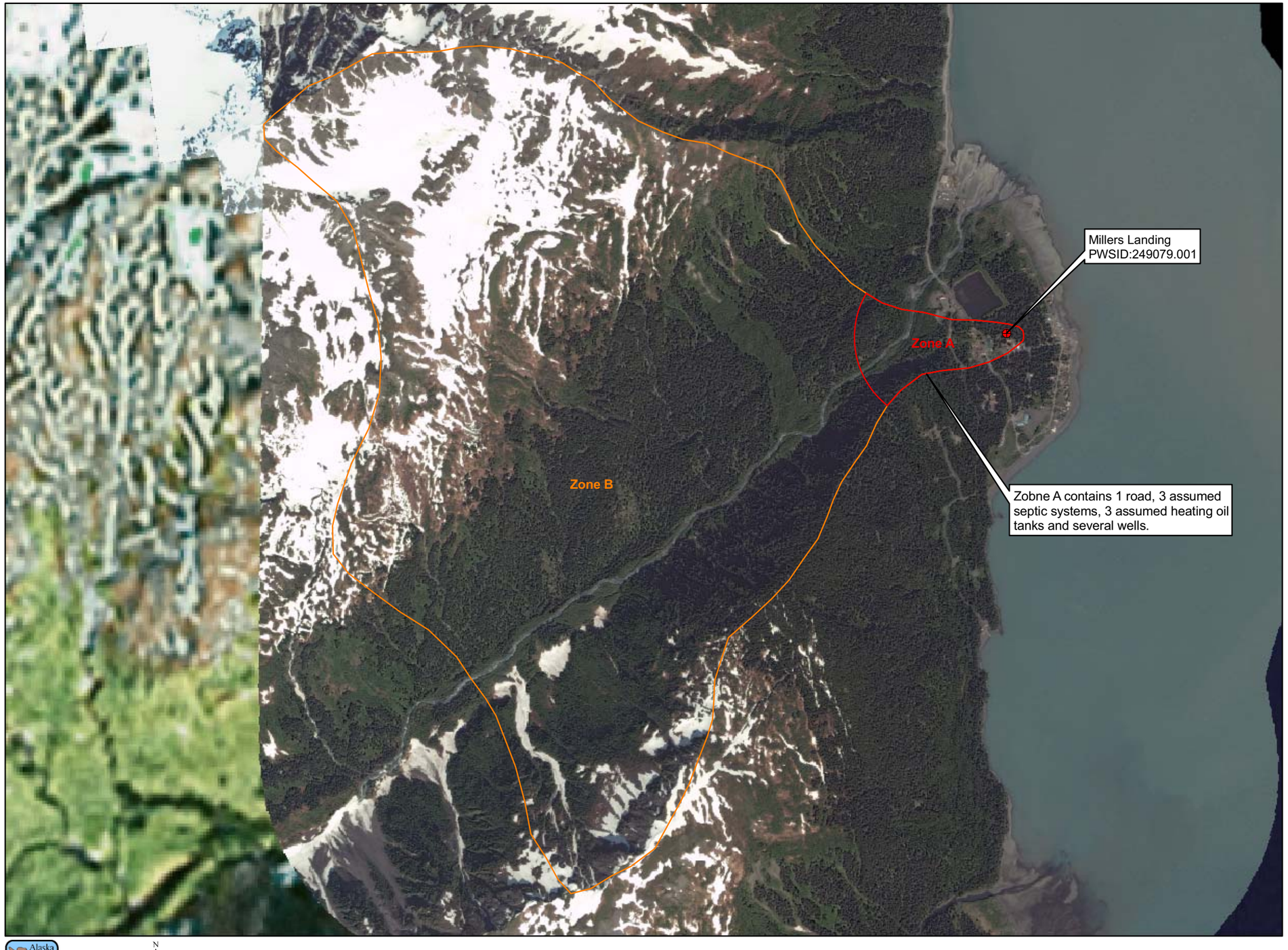
PWSID 249079.001

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	3 assumed septic systems
Tanks, heating oil, residential (above ground)	R08	R08	A	Medium	C	3 assumed heating oil tanks
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road

APPENDIX C

Miller's Landing
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS # 249079.001 Millers Landing
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

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

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

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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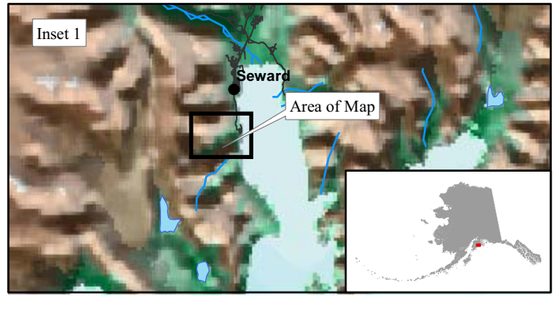

N
W E
S

0 0.25 0.5 1 Miles

Millers Landing
PWS 249079.001

Appendix C Map C