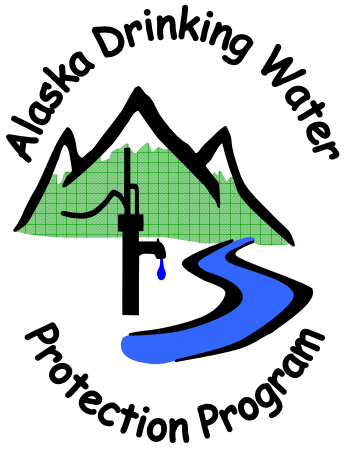

Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Alyeska PS 7 Drinking Water System, Elliot Highway MP 42, Alaska PWSID 300303

July 2006

DRINKING WATER PROTECTION REPORT Report 1580
Alaska Department of Environmental Conservation

Source Water Assessment for Alyeska PS7 Drinking Water System Elliot Highway MP 42, Alaska PWSID 300303

July 2006

DRINKING WATER PROTECTION REPORT Report 1580

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 (ADEC), 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 Program Coordinator of DWP, (907) 269-7521.

CONTENTS

TABLES

APPENDICES

Source Water Assessment for Alyeska PS 7 Source of Public Drinking Water, Elliot Highway MP 42, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

This source water assessment provides an evaluation of the vulnerability of the public water system serving the Alyeska PS 7 to potential contamination. This Class A (community) water system consists of one well off of the Elliot Highway near milepost 42. The well received a natural susceptibility rating of **Low**. This rating is a combination of a susceptibility rating of **Low** for the actual wellhead and a **Low** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the Alyeska PS 7 public water system include: roads, a pipeline, an injection well, a landfill, and an incinerator. These are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals (VOCs), heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals (SOCs), and other organic chemicals (OOCs). Combining the natural susceptibility of the well with the contaminant risk, the public water system for Alyeska PS 7 received an overall vulnerability rating of **High** for nitrates and/or nitrites, heavy metals, cyanide, and other inorganic chemicals, SOCs, OOCs, and bacteria and viruses; and, a **Medium** for VOCs.

ALYESKA PS 7 PUBLIC DRINKING WATER SYSTEM

Alyeska PS 7 public water system is a Class A (community) water system. The system consists of one well off of the Elliot Hwy milepost 42 just outside of the Fairbanks North Star Borough. The Borough's current population is 82,840 making it the second-largest population center in the state (ADCED, 2002). Communities located within the Borough include: College, Eielson Air Force Base, Ester, Fairbanks, Fox, Harding Lake, Moose Creek, North Pole, Pleasant Valley, Salcha, and Two Rivers.

The majority of residents located in the area surrounding the city of Fairbanks use individual water wells or hauled water, and septic systems (ADCED, 2002). Heating oil (typically stored in both above and below ground 275 to 500-gallon tanks) is used for heating homes and buildings. Refuse is transported to the Fairbanks North Star Borough landfill.

The Elliot Highway MP 42 includes two distinct topographic areas: the alluvial plain between the Tanana River and the Chena River, and the uplands north of this alluvial plain. The Alyeska PS 7 water system is located in the alluvial plain at an elevation of approximately 425 feet above sea level.

According to the most recent sanitary survey (8/15/2003) for this water system, the depth of the well is 345 feet below the ground surface. Other wells in this area are screened in a combination of sand and gravel and it is assumed that this one is also. The alluvial plain consists of alternating layers of sand and gravel up to over 500 feet thick, in some locations overlain by 1 to 10 feet of silt or sandy silt or a few feet of peat (Glass and others, 1996). Discontinuous permafrost (perennially frozen areas) is also common in the alluvial plain. The depth to permafrost in these areas ranges between 2 and 45 feet below the ground surface with the thickness of the permafrost ranging between 5 and 265 feet (Pewe, T.L. 1958). Areas with discontinuous permafrost may locally affect the ground water flow directions.

Primarily the Tanana River, but also the Chena River, contributes water to this alluvial aquifer. The Chena River typically only contributes water when its stage is high and the Tanana is low (Nelson, 1978). The Tanana River gets approximately 85% of its water from snowmelt of the Alaska Range and 15% from the Yukon-Tanana uplands (Anderson, 1970).

The Alyeska PS 7 public water system serves approximately 30 non-residents through 4 service connections.

ALYESKA PS 7 DRINKING WATER PROTECTION AREA

The pathways most likely for surface contamination to reach the groundwater are identified as the first step in determining a drinking water system's risk. 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 area that contributes water to the well, the groundwater capture zone. The groundwater capture zone is located in the area circling the well (the area influenced by pumping) and also the area of the water table upgradient of the well, usually forming a parabola shape.

There are many different methods for calculating the size of capture zones. 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 capture zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The capture zone calculated by the DWP is an estimate using the available information and resources, and may differ slightly from the actual capture zone.

The parameters used to calculate the shape of this capture zone are general for the area 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).

Because of uncertainties and changing site conditions, a factor of safety is added to the groundwater capture zone to form the drinking water protection area for the well.

The protection areas established for wells are usually separated into two zones, limited by the watershed. These zones correspond to times-of-travel (TOT) of the water moving through the aquifer to the well (plus the factor of safety).

The following is a summary of the two zones for wells and the calculated time-of-travel for each:

Table 1. Definition of Zones

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

The time of travel for contaminants within the water varies with their unique physical and chemical characteristics.

The drinking water protection area outlined for the Alyeska PS 7 on Map 1 of Appendix A will serve as the focus for voluntary protection efforts.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

Drinking Water Protection (DWP) has completed an inventory of potential and existing sources of contamination within the Alyeska PS 7 protection area. This inventory was completed through a search of agency records and other publicly available information. 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 A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic organic chemicals; and
- Other organic chemicals.

The sources are displayed on Map 2 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 each 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 combination of toxicity and volume associated with that source. Rankings include:

- Low
- Medium
- High
- Very High

Tables 2 through 7 in Appendix B contain the ranking of inventoried potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals and other organic chemical

VULNERABILITY OF ALYESKA PS 7 DRINKING WATER SYSTEM

The vulnerability of public drinking water systems to regulated contaminants is determined by assessing the susceptibility of the wellhead, the susceptibility of the aquifer and the potential contaminant sources identified within the protection area.

The Drinking Water Protection developed a vulnerability assessment tool that assigns a vulnerability risk ranking based upon various factors associated with the well, aquifer and potential and existing contaminants identified within the protection area.

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 Alyeska PS 7 received a **Low** susceptibility rating. The most recent sanitary survey

(8/15/2003) indicates the well is capped with a sanitary seal, the land surface is sloped away from the well, and the well is grouted. A sanitary seal prevents potential contaminant from entering the well while sloping of the land surface and grouting help 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 aquifer the Alyeska PS 7 well is completed in received a **Low** susceptibility rating. The low rating is on account of the depth of the well and confinement of the aquifer which help to keep contaminants from percolating down to the aquifer. Table 2 summarizes the Susceptibility scores and ratings for Alyeska PS 7.

Table 2: Susceptibility

	Rating
Susceptibility of the Wellhead	Low
Susceptibility of the Aquifer	Low
Natural Susceptibility	Low

The Contaminant Risk has been 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.

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 3. Contaminant Risks

Category	Rating
Bacteria and Viruses	Very High
Nitrates and/or Nitrites	Very High
Volatile Organic Chemicals	High
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Very High
Synthetic Organic Chemicals	Very High
Other Organic Chemicals	Very High

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

Natural Susceptibility
+
Contaminant Risks
=
Vulnerability of the
Drinking Water Source to Contamination

Table 4 contains the overall ratings for each of the six categories of drinking water contaminants.

Table 4. Overall Vulnerability

Category	Rating
Bacteria and Viruses	High
Nitrates and Nitrites	High
Volatile Organic Chemicals	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	High
Synthetic Organic Chemicals	High
Other Organic Chemicals	High

Bacteria and Viruses

The roads, landfill, and injection well in the protection area represent the greatest risk for bacteria and viruses to the drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coliforms are found naturally in the environment and although they aren't necessarily a health threat, it is an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms and E. coli which only come from human and animal fecal waste (EPA, 2006). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2006). There have been no detections of coliforms in recent sampling history.

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 roads, landfill, and injection well in the protection area also represent the greatest risk to to nitrates and nitrites for this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have been detected in recent sampling history for the Alyeska PS 7 well, at levels 4% of the Maximum Contaminant Level (MCL=10mg/L). In much higher concentrations nitrates can cause 'blue baby syndrome' in infants, and hemorrhaging of the spleen (EPA 2006).

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 roads, landfill, injection well, and pipelines represent the greatest identified risk for volatile organic chemical contamination to the well.

In recent sampling history Total Trihalomethanes (TTHMs) have been detected at levels of 2.92% of the MCL (MCL = 0.1mg/L). TTHMs are a disinfectant byproduct (EPA 2006).

Volatile Organic Chemicals have not been detected within source waters. 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**.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The roads, landfill, injection well, pipelines and incinerator represent the greatest risk for inorganic chemicals to the well.

Cyanide was detected at the greatest concentration in sampling from 6/28/2001 at 6% of its MCL (MCL=0.2mg/L). In sampling from 6/5/2003 no inorganics were detected. In greater quantities, cyanide is known to cause weight loss, thyroid effects, and nerve damage (EPA, 2006).

After combining the contaminant risk for heavy metals, cyanide and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **high**.

Synthetic Organic Chemicals

The landfill and injection well represent the greatest risk for synthetic organic chemicals to the well.

Synthetic organic chemicals have not been detected in this water system.

After combining the contaminant risk for snythetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **high**.

Other Organic Chemicals

The roads, landfill, injection well, and pipelines represent the greatest risk for other organic chemicals to the well.

Other organic chemicals have not been detected in this water system.

After combining the contaminant risk for snythetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **high**.

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APPENDIX A

Alyeska PS 7
Drinking Water Protection Area Location Map
(Map 1)

Map 1- Alyeska PS7 and Surrounding Water Systems

PWSID: 300303.001

Alaska Department of Environmental Conservation

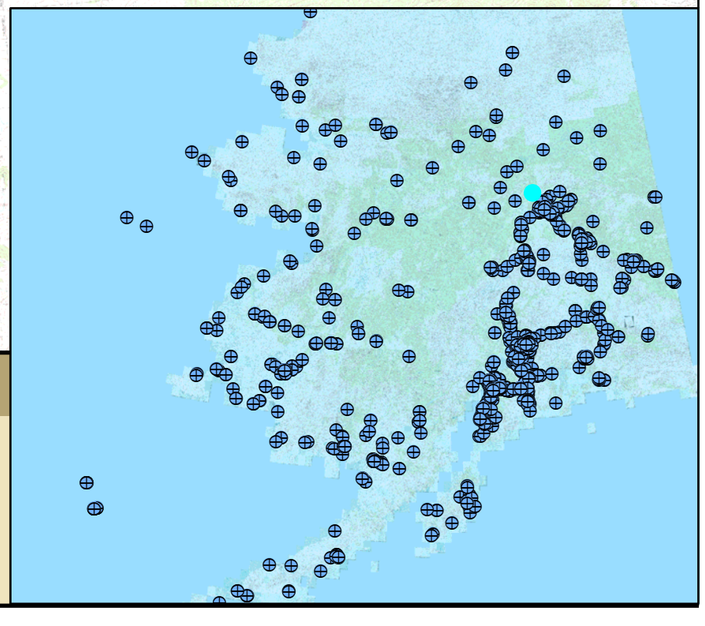
Alaska Drinking Water Protection Program

0 Feet

1:295,012 62,000

Data Sources:
Potential Sources of Contamination: ADEC

- Public Water Sources
- Zone A Protection Area
- Zone B Protection Area



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Alyeska PS 7 (Tables 1-7)

Table 1

Contaminant Source Inventory for ***Alyeska PS 7 Perm***

PWSID 300303.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Landfills (municipal; Class III)	D51	D51-1	A		APSC Comments: This is retired landfill DS 67-5.
Recycling and waste reduction facilities	D57	D57-1	A		APSC Comments: We assume this refers to the incinerator, which is not in service. There are no plans to use the incinerator in the future.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A		APSC Comments: Elliott Highway
Pipelines (oil and gas)	X28	X28-1	A		APSC Comments: TAPS
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B		APSC Comments: Our understanding is that this refers to the "Wilder Construction Camp leachfield" The construction camp was removed long ago, and the leachfield is inactive.
Highways and roads, paved (cement or asphalt)	X20	X20-2	B		APSC Comments: Elliot Highway

Table 2

Contaminant Source Inventory and Risk Ranking for Alyeska PS 7 Perm Sources of Bacteria and Viruses

PWSID 300303.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Landfills (municipal; Class III)	D51	D51-1	A	High		APSC Comments: This is retired landfill DS 67-5.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		APSC Comments: Elliott Highway
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	High		APSC Comments: Our understanding is that this refers to the "Wilder Construction Camp leachfield" The construction camp was removed long ago, and the leachfield is inactive.
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low		APSC Comments: Elliot Highway

Table 3

Contaminant Source Inventory and Risk Ranking for Alyeska PS 7 Perm Sources of Nitrates/Nitrites

PWSID 300303.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Landfills (municipal; Class III)	D51	D51-1	A	Very High		APSC Comments: This is retired landfill DS 67-5.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		APSC Comments: Elliott Highway
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	High		APSC Comments: Our understanding is that this refers to the "Wilder Construction Camp leachfield" The construction camp was removed long ago, and the leachfield is inactive.
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low		APSC Comments: Elliot Highway

Table 4

Contaminant Source Inventory and Risk Ranking for Alyeska PS 7 Perm
Sources of Volatile Organic Chemicals

PWSID 300303.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Landfills (municipal; Class III)	D51	D51-1	A	High		APSC Comments: This is retired landfill DS 67-5.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		APSC Comments: Elliott Highway
Pipelines (oil and gas)	X28	X28-1	A	Medium		APSC Comments: TAPS
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	Low		APSC Comments: Our understanding is that this refers to the "Wilder Construction Camp leachfield" The construction camp was removed long ago, and the leachfield is inactive.
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low		APSC Comments: Elliot Highway

Table 5

Contaminant Source Inventory and Risk Ranking for Alyeska PS 7 Perm

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 300303.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Landfills (municipal; Class III)	D51	D51-1	A	High		APSC Comments: This is retired landfill DS 67-5.
Recycling and waste reduction facilities	D57	D57-1	A	High		APSC Comments: We assume this refers to the incinerator, which is not in service. There are no plans to use the incinerator in the future.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		APSC Comments: Elliott Highway
Pipelines (oil and gas)	X28	X28-1	A	Low		APSC Comments: TAPS
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	Low		APSC Comments: Our understanding is that this refers to the "Wilder Construction Camp leachfield" The construction camp was removed long ago, and the leachfield is inactive.
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low		APSC Comments: Elliot Highway

Table 6

Contaminant Source Inventory and Risk Ranking for Alyeska PS 7 Perm

Sources of Synthetic Organic Chemicals

PWSID 300303.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Landfills (municipal; Class III)	D51	D51-1	A	Very High		APSC Comments: This is retired landfill DS 67-5.
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	Low		APSC Comments: Our understanding is that this refers to the "Wilder Construction Camp leachfield" The construction camp was removed long ago, and the leachfield is inactive.

Table 7

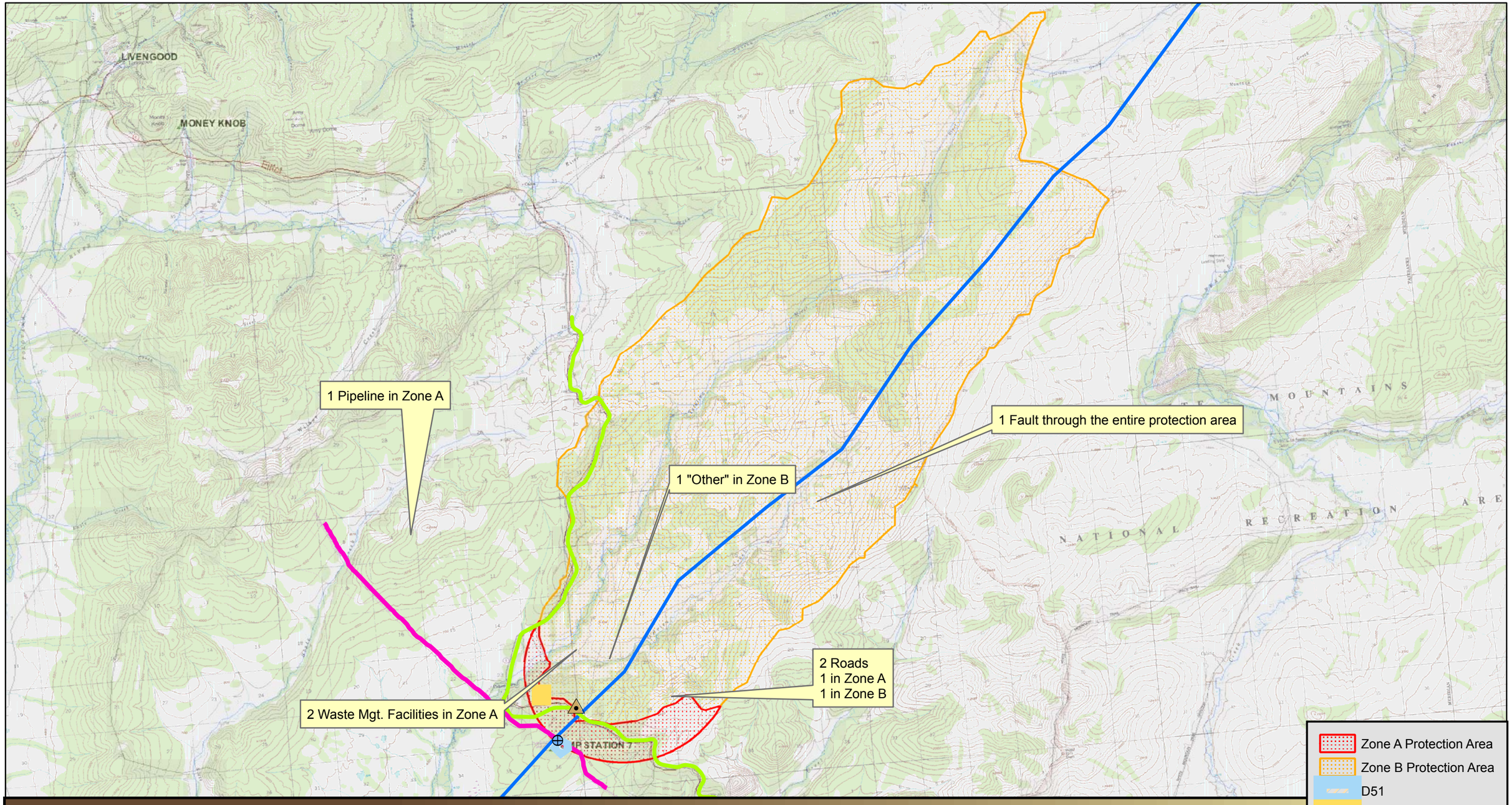
Contaminant Source Inventory and Risk Ranking for Alyeska PS 7 Perm
Sources of Other Organic Chemicals

PWSID 300303.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Landfills (municipal; Class III)	D51	D51-1	A	Very High		APSC Comments: This is retired landfill DS 67-5.
Highways and roads, paved (cement or asphalt)	X20	X20-1	A	Low		APSC Comments: Elliott Highway
Pipelines (oil and gas)	X28	X28-1	A	High		APSC Comments: TAPS
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1	B	Low		APSC Comments: Our understanding is that this refers to the "Wilder Construction Camp leachfield" The construction camp was removed long ago, and the leachfield is inactive.
Highways and roads, paved (cement or asphalt)	X20	X20-2	B	Low		APSC Comments: Elliot Highway

APPENDIX C

Alyeska PS 7
Drinking Water Protection Area
Potential and Existing Contaminant Sources
(Map 2)



Map 2- Alyeska PS7 Potential Contaminants

PWSID: 300303.001

Alaska Department of Environmental Conservation

Alaska Drinking Water Protection Program

0 1:123,292 Feet 28,000

Data Sources:
Kenai Borough: Roads and parcels
Aerial Photo: USGS and Microsoft Terraserver
Potential Sources of Contamination: ADEC