Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Port MacKenzie Ferry Terminal Public Drinking Water System, Knik-Fairview, Alaska PWSID # 220167.001

DRINKING WATER PROTECTION REPORT 1649

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
Port MacKenzie Ferry Terminal Source of Public Drinking Water, Knik-Fairview, Alaska

Drinking Water Protection
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Port MacKenzie Ferry Terminal is a Class B (transient/non-community) water system consisting of one well located on the north shore of Cook Inlet, at the end of Port MacKenzie Road, in Knik-Fairview, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Low**. Combining these two ratings produces a **Low** rating for the natural susceptibility of the well. Identified potential and existing sources of contaminants for Port MacKenzie Ferry Terminal public drinking water source include: roads. Overall, the public water sources for Port MacKenzie Ferry Terminal received a vulnerability rating of **Low** for bacteria and viruses, **Low** for nitrates and nitrites, and **Low** 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 Port MacKenzie Ferry Terminal to protect public health.

PORT MACKENZIE FERRY TERMINAL PUBLIC DRINKING WATER SYSTEM

The Port MacKenzie Ferry Terminal public water system is a Class B (transient/non-community) water system. The system consists of one well located on the north shore of Cook Inlet, at the end of Port MacKenzie Road, in Knik-Fairview, Alaska (see Map A in Appendix A). Knik –Fairview (population 12,283) covers an area extending from the shores of Cook Inlet north to Big Lake and Wasilla. It lies within the Mat-Su Valley, and is part of the Matanuska-Susitna Borough (ADCED 2009).

The area receives 16.5 inches of precipitation annually, and average January temperatures range from -28 to 39 degrees Fahrenheit, while average July temperatures range from 44 to 83 degrees Fahrenheit (ADCCED, 2009).

Most homes in the region use individual water wells and septic systems and are fully plumbed. Many homes have access to piped natural gas supplied by Enstar, and electricity is provided by Matanuska Electric Association (ADCCED, 2009).

The regional geology and ground water conditions of the Mat-Su Valley vary greatly depending on location. The terrain is dominated by distinctive landforms created by repeated glacial advances and retreats during the Pleistocene epoch (2 million to 10,000 years before present). The unconsolidated layers (layers of sediment that are not cemented together) are comprised of various mixtures of fine- to coarse-grained particles (clay to boulders). The majority of wells in the Mat-Su Valley are located in unconsolidated layers consisting of relatively well sorted sands and gravels. These unconsolidated layers vary substantially in size and distribution throughout the Valley. In general, the unconsolidated layers increase in thickness towards Cook Inlet, and are interspersed with confining layers ranging in thickness from 1 to 60 feet (Jokela *et. al.*, 1991).

According to the well log, the Port MacKenzie Ferry Terminal well extends approximately 241 feet below the ground surface and is completed in a confined aquifer. This system operates year-round and serves twenty-six non-residents through one service connection.

PORT MACKENZIE FERRY TERMINAL 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 Port MacKenzie Ferry Terminal was determined using an analytical calculation and includes Zones A and B (see Map A in Appendix A).

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

DWP has completed an inventory of potential and existing sources of contamination within the Port MacKenzie Ferry Terminal 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 PORT MACKENZIE FERRY TERMINAL DRINKING WATER SYSTEM

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural Susceptibility; and
- Contaminant Risks.

A score for the Natural Susceptibility of the well is reached by considering the properties of the well and the aquifer.

Susceptibility of the Wellhead (0-25 Points)
+
Susceptibility of the Aquifer (0-25 Points)
=
Natural Susceptibility of the Well (0-50 Points)

A ranking is assigned for the Natural Susceptibility according to the point score:

Natural Susceptibility Ratings	
40-50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

Factors contributing to the susceptibility of the wellhead are: whether the sanitary seal is in place, protection from flooding, and if the well casing is properly grouted.

The wellhead for the Port MacKenzie Ferry Terminal received a **Low** susceptibility rating. No sanitary survey is available for this system, however the well log and site photos indicate that a sanitary seal is installed on the well, the land surface is sloped away from the well, and the well is grouted according to DEC regulations. Sanitary seals prevent potential contaminants from entering the well, while sloping of the land surface away from the wellhead provides adequate surface water drainage, and concrete or grouting around the wellhead helps to prevent potential contaminants from traveling down the outside of the well casing.

Factors contributing to the susceptibility of the aquifer are: whether the aquifer is confined or unconfined, whether the well is completed in unconsolidated or fractured bedrock, whether wells and bore holes are penetrating the aquifer and, if applicable, the depth and thickness of the confining layer.

The Port MacKenzie Ferry Terminal system draws water from a confined aquifer that is overlain by a 78-foot thick confining layer of silty clay. It received a **Low** susceptibility rating because of the relatively thick confining layer and the absence of other wells penetrating the shared aquifer. Deeper, thicker confining layers provide greater protection by making it more difficult for contaminants to reach the aquifer, while the absence of other wells penetrating the confining layer within the protection area means it is unlikely contaminants will travel into the shared water source with precipitation and runoff.

Table 2 summarizes the Susceptibility scores and ratings for the Port MacKenzie Ferry Terminal system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	0	Low
Susceptibility of the Aquifer	6	Low
Natural Susceptibility	6	Low

Contaminant risks are derived from an evaluation of the routine sampling results of the water system and the presence of potential sources of contamination. Contaminant risks to a drinking water source depend on the type and distribution of contaminant sources. Flow charts are used to assign a point score, and ratings are assigned in the same way as for the natural susceptibility:

Contaminant Risk Ratings	
40-50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants for the Port MacKenzie Ferry Terminal 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 Port MacKenzie Ferry Terminal system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	20	Low
Nitrates and/or Nitrites	20	Low
Volatile Organic Chemicals	20	Low

Bacteria and Viruses

The contaminant risk to the drinking water well for bacteria and viruses is determined to be **Low** with roads 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 five years of sampling at Port MacKenzie Ferry Terminal (data reviewed in April, 2008).

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Low**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites for Port MacKenzie Ferry Terminal is determined to be **Low** with roads contributing to the risk to the drinking water well.

The sampling history for Port MacKenzie Ferry Terminal indicates that nitrates and nitrites have been detected once within the last five years, with a concentration of 0.642 mg/L detected on 11/06/2007 (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 **Low**.

Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is determined to be **Low** with roads contributing to the risk to the drinking water well.

The drinking water at Port MacKenzie Ferry Terminal has not recently been sampled for volatile organic chemicals (data reviewed in April, 2008).

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

Using the Source Water Assessment

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of Port MacKenzie Ferry Terminal 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 the Port MacKenzie Ferry Terminal 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.

Jokela, J.B., Munter, J.A., and Evans, J.G., 1991. Ground-water resources of the Palmer-Big Lake area, Alaska: a conceptual model. Division of Geological &Geophysical Surveys Reports of Investigations 90-4, State of Alaska Department of Natural Resources, Fairbanks, AK.

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

APPENDIX A

Port MacKenzie Ferry Terminal
Drinking Water Protection Area Location Map
(Map A)

Public Water Well System for PWS #220167.001 Port MacKenzie Ferry Terminal

Legend

Class B Public Water System Well

Groundwater Protection Zones

Zone A Protection Area - Several Months Travel Time

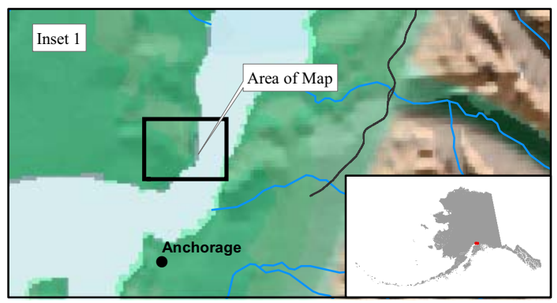
Zone B Protection Area - 2 Years Travel Time

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.



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Port MacKenzie Ferry Terminal
PWS 220167.001

Appendix A Map A

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Port MacKenzie Ferry Terminal (Tables 1-4)

Table 1

Contaminant Source Inventory for

PORT MACKENZIE FERRY TERMINAL

PWSID 220167.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20	A	C	2 roads
Highways and roads, paved (cement or asphalt)	X20	X20	B	C	1 road

Table 2

Contaminant Source Inventory and Risk Ranking for PORT MACKENZIE FERRY TERMINAL Sources of Bacteria and Viruses

PWSID 220167.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 roads
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 road

Table 3

Contaminant Source Inventory and Risk Ranking for PORT MACKENZIE FERRY TERMINAL Sources of Nitrates/Nitrites

PWSID 220167.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 roads
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 road

Table 4

Contaminant Source Inventory and Risk Ranking for PORT MACKENZIE FERRY TERMINAL Sources of Volatile Organic Chemicals

PWSID 220167.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	2 roads
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 road

APPENDIX C

Port MacKenzie Ferry Terminal
Drinking Water Protection Area and
Potential and Existing Contaminant Sources
(Map C)

Public Water Well System for PWS #220167.001 Port MacKenzie Ferry Terminal
Showing Potential and Existing Sources of Contamination

Legend

- Class B Public Water System

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

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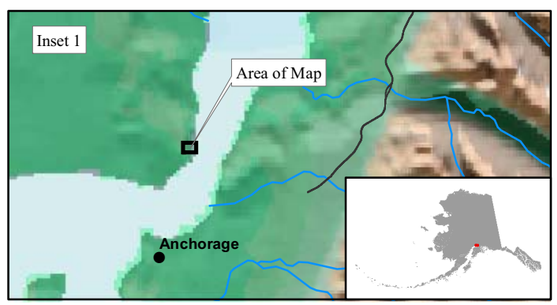

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Port MacKenzie Ferry Terminal
PWS 220167.001

Appendix C Map C