



Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Ekuk Fisheries Well D
Public Drinking Water System,
Ekuk, Alaska
PWSID # 261208.002

DRINKING WATER PROTECTION REPORT 1750

Alaska Department of Environmental Conservation

December, 2008

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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 number: 1-866-956-7656.

December, 2008

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Source Water Assessment for Ekuk Fisheries Well D Source of Public Drinking Water, Ekuk, Alaska

Drinking Water Protection Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Ekuk Fisheries is a Class B (transient/non-community) water system consisting of six wells located just over a mile south of Clark's Point, in Ekuk, Alaska. This report applies only to Well D (261208.002). 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 current sources of contaminants for Ekuk Fisheries Well D public drinking water source include: a landfill, an assumed septic system, and assumed heating oil tanks. These identified potential and existing sources of contamination are considered as sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the public water sources for Ekuk Fisheries Well D received a vulnerability rating of **Medium** 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 Ekuk Fisheries to protect public health.

EKUK FISHERIES WELL D PUBLIC DRINKING WATER SYSTEM

Ekuk Fisheries public water system is a Class B (transient/non-community) water system. The system consists of six wells located about 15 miles south of Dillingham, in Ekuk, Alaska. This report applies only to Well D (PWSID 261208.002). Ekuk and Clark's Point lie on the eastern shore of Nushagak Bay on Alaska's west coast. Ekuk officially has a population of zero, but it historically was a large village and is now mostly seasonal, as it is home to a salmon fishery processing plant and its supporting buildings. The village of Clark's Point, about a mile north, has a population of 66. Spring-fed wells supply water to most of the community and some of the homes have piped sewage, while others use honeybuckets. Electricity is provided by the City (ADCCED, 2008).

The soils in the Ekuk area are typical of coastal deltas. Layers of alluvial sediments overlay a deep layer of marine clays, which in turn overlay water-bearing sand and gravel layers. The marine clays act as an aquitard

thus confining the aquifer below them. This well is an artesian well, as the water rises above the top of the casing and flows freely (Ward's Cove Packing, 2000).

According to the sanitary survey (08/05/2005), Well D extends approximately 250 to 300 feet below the ground surface. No well log is available, so it is assumed to be completed in a confined aquifer based on information from similar nearby wells. The sanitary survey also states that the well is capped and grouted according to DEC regulations, but the land is not appropriately sloped away from the well.

This system operates from May to August and serves a total of seventy-five non-residents through sixteen service connections.

EKUK FISHERIES WELL D 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 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 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 Ekuk Fisheries Well D was determined using an analytical calculation and includes Zones A and B (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 Ekuk Fisheries Well D drinking water protection. 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 EKUK FISHERIES WELL D 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.

$$\begin{aligned}
 &\text{Susceptibility of the Wellhead (0-25 Points)} \\
 &\quad + \\
 &\text{Susceptibility of the Aquifer (0-25 Points)} \\
 &\quad = \\
 &\text{Natural Susceptibility of the Well (0-50 Points)}
 \end{aligned}$$

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 Well D at Ekuk Fisheries received a **Low** susceptibility rating. The sanitary survey indicates that the well is capped and properly grouted according

to DEC regulations. However, the land surface is not appropriately sloped away from the well. Sanitary seals prevent potential contaminants from entering the well, while sloping of the land surface away from the wellhead provides adequate surface water drainage, and concrete or grouting around the wellhead helps to prevent potential contaminants from traveling down the outside of the well casing.

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

As no well log is available for Well D at Ekuk Fisheries, it is assumed to draw water from a confined aquifer overlain by a 100-foot thick confining layer of clay. This assumption is based on the well log for the adjacent well (PWSID 261208.001). It received a **Low** susceptibility rating because of the deep nature of the aquifer and the thick confining layer. Deeper aquifers are more protected from surface contaminants while thicker confining layers provide greater protection from any contamination that does manage to penetrate to that depth.

Table 2 summarizes the Susceptibility scores and ratings for the Ekuk Fisheries Well D system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	4	Low
Natural Susceptibility	9	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 Ekuk Fisheries Well D system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	40	Very High
Nitrates and/or Nitrites	50	Very High
Volatile Organic Chemicals	40	Very High

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

$$\begin{aligned}
 &\text{Natural Susceptibility (0-50 Points)} \\
 &+ \\
 &\text{Contaminant Risks (0-50 Points)} \\
 &= \\
 &\text{Vulnerability of the Drinking Water Source to} \\
 &\text{Contamination (0-100 Points)}
 \end{aligned}$$

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 Ekuk Fisheries Well D system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	50	Medium
Nitrates and/or Nitrites	55	Medium
Volatile Organic Chemicals	50	Medium

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High** with a landfill and a septic system contributing to the risk to the drinking water well.

Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are 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. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2008).

Only a small amount of bacteria and viruses are required to endanger public health. Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus contamination. Bacteria and viruses have not been detected during recent water sampling of the system at Ekuk Fisheries Well D (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 is **Very High** with a landfill and a septic system contributing to the risk to the drinking water well.

The sampling history for Ekuk Fisheries Well D indicates that nitrates have not been detected in the water in the past five years (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 **Very High** with the landfill, septic system, and heating oil tanks contributing to the risk to the drinking water well.

The drinking water at Ekuk Fisheries Well D has not been recently 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 **Medium**.

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 Ekuk Fisheries 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 Ekuk Fisheries Well D drinking water source.

REFERENCES

Alaska Department of Commerce, Community and Economic Development (ADCCED), Accessed 2008 [WWW document]. URL: http://www.commerce.state.ak.us/dca/commdb/CF_COMDB.htm

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

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

Ward's Cove Packing, 2000. Ekuk Cannery Class B Public Water System Waiver Request. Prepared by Travis/Peterson Environmental Consulting, Inc.

APPENDIX A

Ekuk Fisheries Well D Drinking Water Protection Area Location Map (Map A)

Public Water Well System for PWS #261208.002 Ekuk Fisheries - Well D



Legend

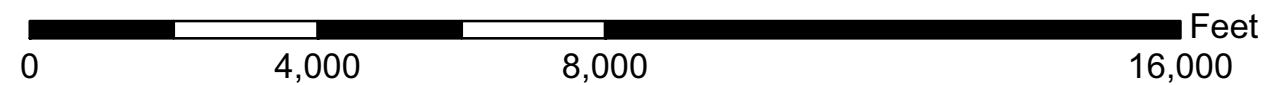
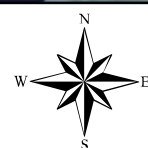
- Class B Public Water Systems
- Groundwater Protection Zones**
- Zone A Protection Area - Several Months Travel Time
 - Zone B Protection Area - 2 Years Travel Time

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.



APPENDIX B

Contaminant Source Inventory and Risk Ranking for Ekuk Fisheries Well D (Tables 1-4)

Table 1

**Contaminant Source Inventory for
Ekuk Fisheries - Well D**

PWSID 261208.002

Contaminant Source Type	Contaminant Source ID	CS ID tag	Zone	Map Number	Comments
Landfills (municipal; Class III)	D51	D51	A	C	
Septic systems (serves one single-family home)	R02	R02	A	C	1 assumed
Tanks, heating oil, residential (above ground)	R08	R08	A	C	16 assumed

Table 2

*Contaminant Source Inventory and Risk Ranking for
Ekuk Fisheries - Well D
Sources of Bacteria and Viruses*

PWSID 261208.002

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Landfills (municipal; Class III)	D51	D51	A	High	C	
Septic systems (serves one single-family home)	R02	R02	A	Low	C	1 assumed

Table 3

*Contaminant Source Inventory and Risk Ranking for
Ekuk Fisheries - Well D
Sources of Nitrates/Nitrites*

PWSID 261208.002

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Landfills (municipal; Class III)	D51	D51	A	Very High	C	
Septic systems (serves one single-family home)	R02	R02	A	Low	C	1 assumed

Table 4

*Contaminant Source Inventory and Risk Ranking for
Ekuk Fisheries - Well D
Sources of Volatile Organic Chemicals*

PWSID 261208.002

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Landfills (municipal; Class III)	D51	D51	A	High	C	
Septic systems (serves one single-family home)	R02	R02	A	Low	C	1 assumed
Tanks, heating oil, residential (above ground)	R08	R08	A	Medium	C	16 assumed

APPENDIX C

Ekuk Fisheries Well D Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map C)

**Public Water Well System for PWS #261208.002 Ekuk Fisheries - Well D
Showing Potential and Existing Sources of Contamination**



Ekuk Fisheries Well D
PWSID:261208.002

Zone A contains 1 assumed septic system, 16 assumed heating oil tanks, and a landfill.

Legend

- Class B Public Water Systems
- Groundwater Protection Zones**
- Zone A Protection Area - Several Months Travel Time
- Zone B Protection Area - 2 Years Travel Time
- Existing or Potential Sources of Contamination**
- D51 - Landfills (municipal; Class III)

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

Apparent misalignment between geographic features and aerial imagery may be present due to differences in source data. URS Corporation does not guarantee the accuracy or validity of the data provided.

