A Source Water Assessment (SWA) for

PWSID #240472 – Tyonek Water System – WL001 (Well 1)

What is an SWA?

The Drinking Water Protection group of the Drinking Water Program is producing Source Water Assessments (SWAs) in compliance with the Safe Drinking Water Act (SDWA) Amendments of 1996. Each SWA includes:

- A delineation of the drinking water source area;
- Inventory of potential and existing sources of contamination;
- Risk ranking for the identified contaminants;
- Evaluation of the overall vulnerability to the PWS source.

What is a Protection Area?

The most probable area for contamination to reach the drinking water well is within the drinking water protection area (DWPA). The DWPA for a groundwater source is the area around 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 DWPA are most likely to impact the well, this area will serve as the focus for voluntary protection efforts.

The DWPAs established for wells by DEC are separated into 2 zones, limited by the watershed. The following is a summary of the two zones for wells and the estimated time-of-travel for each:

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

Natural Susceptibility

Susceptibility of a groundwater source is a measure of a water supply's potential to become contaminated based on information gathered on the wellhead and the aquifer.

Table 1: Public Water System Source Information

PWS Name	Tyonek Water System
PWSID Number	240472
Federal Designation	Community water system (CWS)
State Assigned ID	WL001
Facility Name	Well 1 (TW 1-05) Secondary
Source Type	Groundwater
Total Depth of Well (ft bls*)	150
Static Water Level (ft bls*)	80
Aquifer Type	Confined
Aquifer Formation	Gravel and Sand
Description and Cumulative Thickness of Barrier (ft)	Clay (61-69') Silty clay (69-85') Gravelly Clay (115-126')
Date Well Completed	11/18/2005

*"*ft bls*" = feet below land surface

Executive Summary

The public water system (PWS) for Tyonek Water System is a Community water system (CWS) consisting of two (2) active wells at the time of this report, and is located in Tyonek, Alaska. This report is an assessment of well WL001 (WELL 1 – TW 1-05 – Secondary). An assessment of the susceptibility of the wellhead and aquifer to contamination, and the vulnerability of the well to potential and existing contamination were evaluated as of May 2014. The wellhead for WL001 received a susceptibility rating of ***Low*** and the aquifer received a susceptibility rating of ***Medium***. Combining these two ratings produces a ***Low*** rating for the natural susceptibility of the well and aquifer. Identified potential and existing sources of contamination for Tyonek Water System WL001 include: areas of coal mining, highways and roads (dirt/gravel), a domestic wastewater treatment plant disposal pond/lagoon, and a class III municipal landfill. These are considered sources of one or more of the following six (6) contaminant risk categories: 1) bacteria and viruses; 2) nitrates and/or nitrites; 3) volatile organic chemicals (VOCs); 4) heavy metals, cyanide, and other inorganic chemicals (inorganic chemicals); 5) synthetic organic chemicals (SOCs); and 6) other organic chemicals (OOCs).

Combining the natural susceptibility of the well and aquifer with the six (6) contaminant risk categories, Tyonek Water System WL001 received an overall vulnerability rating of ***Medium*** for bacteria and viruses; ***Medium*** for nitrates and/or nitrites; ***High*** for VOCs; ***High*** for inorganic chemicals; and a ***Medium*** for SOCs and ***High*** for OOCs.

Introduction

Source Water Assessments (SWAs) are intended to provide PWS operators, owners, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The SWA for the Tyonek Water System WL001 is a tool to be used as the foundation or "stepping stone" to comprehensive management and protection of its groundwater resource. Protecting the quality of your drinking water is a sensible investment.

Drinking Water Protection Area

For groundwater sources, a combination of a numerical flow model and natural factors such as drainage divides, subsurface barriers, and manmade structures are used to determine the size and shape of the Drinking Water Protection Area (DWPA). The orientation of the DWPA is typically drawn using a groundwater surface, or a land surface, elevation map. Because of uncertainties and changing site conditions, a factor of safety is added in calculating the size of the DWPA. (See Map 1 of the Appendices)

Natural Susceptibility (Wellhead and Aquifer)

The susceptibility of a wellhead to the introduction of contaminants to the drinking water is determined by, but not limited to, the following risk factors: presence of a sanitary seal, protection from flooding, drainage, and presence of adequate grouting.

The wellhead for the Tyonek Water System WL001 received a ***Low*** susceptibility rating. The most recent sanitary survey (completed July 2011) indicates that the well is capped with a sanitary seal, is not in a floodplain, the land surface is sloped to drain away from the wellhead, and that a subsurface grout seal was installed to the required depth. A sanitary seal prevents potential contaminants 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, or through casing seams/cracks to the inside of the well casing, and into the well and/or aquifer.

The susceptibility of an aquifer to the introduction of contaminants is determined by, but not limited to, the following risk factors: whether the aquifer is confined or unconfined, whether the well is completed in unconsolidated or fractured bedrock, whether other nearby wells and bore holes are penetrating the aquifer and if applicable the characteristics of the confining layer(s).

The Tyonek Water System WL001 draws water from a confined aquifer completed in gravel and sand. It received a ***Medium*** susceptibility rating primarily due to the topography of the surrounding area and the degree of confinement of the source aquifer. A confined aquifer is generally more protected than an unconfined aquifer from the infiltration of surface water potentially carrying contaminants by migrating downward from the surface to the aquifer.

The Natural Susceptibility of the well and aquifer to contamination is ***Low***. Table 2 summarizes the susceptibility ratings for the Tyonek Water System WL001.

Table 2: Susceptibility Ratings

Susceptibility of the wellhead	***Low***
+	
Susceptibility of the aquifer	***Medium***
=	
Natural susceptibility	***Low***

Inventory of Potential and Existing Sources Contamination

The Drinking Water Protection (DWP) group has completed an inventory of potential and existing sources of contamination within the DWPA for the Tyonek Water System WL001. This inventory was completed through a search of agency records and other publicly available information. Potential sources of contamination 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. The identified potential sources of contamination are summarized in Table 3 and are portrayed in Map 2 of the Appendices.

Table 3: Contaminant Source Inventory

Contaminant Source Type	Contaminant Source ID	Zone	Comments
Coal mining	E01-01	A	(active or inactive?)
Highways and roads, dirt/gravel	X24-01-20	A	Assumed less than 20
Domestic wastewater treatment plant disposal ponds/lagoons	D02-01	B	Wastewater Lagoon
Domestic wastewater treatment plants	D05-01	B	Wastewater treatment plant (domestic)
Landfills (municipal; Class III)	D51-01	B	Landfill
Coal mining	E01-02	B	(active or inactive?)
Highways and roads, dirt/gravel	X24-21-70	B	Assumed less than 50

Contaminant Risks

Inventoried contaminant sources are sorted by the Drinking Water Protection (DWP) group according to the six (6) major categories of contaminants regulated for drinking water: 1) bacteria and viruses; 2) nitrates and/or nitrites; 3) volatile organic chemicals (VOCs); 4) heavy metals, cyanide, and other inorganic chemicals (inorganic chemicals); 5) synthetic organic chemicals (SOCs); and 6) other organic chemicals (OOCs). The contaminant sources are then given a ranking (within each category) according to the density of sources within the DWPA, the PWS sampling history, as well as the degree of risk posed to human health based on the volume, toxicity, persistence, and the mobility of the contaminants involved. The contaminant risk rankings are summarized in Table 4.

Table 4: Contaminant Risk Rankings

Contaminant Source Type	Contaminant	Zone	Bacteria	Nitrates	VOC	Metals	SOC	OOC
Coal mining	E01-01	A	N/A	N/A	High	Very High	Medium	High
Highways and roads, dirt/gravel	X24-01-20	A	Low	Low	Low	Low	N/A	Low
Domestic wastewater treatment plant disposal ponds/lagoons	D02-01	B	High	High	Low	Low	Low	Low
Domestic wastewater treatment plants	D05-01	B	Medium	Medium	Low	Low	Low	Low
Landfills (municipal; Class III)	D51-01	B	High	Very High	High	High	Very High	Very High
Coal mining	E01-02	B	N/A	N/A	High	Very High	Medium	High
Highways and roads, dirt/gravel	X24-21-70	B	Low	Low	Low	Low	N/A	Low
*Contaminant Category Risk Ranking***			*Very High*	*Very High*	*Very High*	*Very High*	*Very High*	*Very High*

** Includes heavy metals, cyanide, and other inorganic chemicals.*
*** Scores based on additional factors, such as sampling history, and number/density of sources.*

The contaminant category risk ranking for Bacteria & Viruses is ***Very High***. This ranking is driven primarily by a municipal class III landfill, and the density of roads located within the DWPA. A positive Total Coliform (which may include fecal coliform and *E. Coli*, but not a confirmation of the presence of either) has not been detected in recent years. Coliforms are naturally present in the environment, as well as feces; fecal coliforms and *E. Coli* only come from human and animal fecal waste. Total Coliforms is not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present.

The contaminant category risk ranking for Nitrates and/or Nitrites is ***Very High***. This ranking is driven primarily by a municipal class III landfill, and the density of roads located within the DWPA. Nitrates and/or nitrites have not been detected in samples collected in recent years. Sources of nitrate and/or nitrite may include runoff from fertilizer use, leaking from septic tanks, sewage, and/or erosion from natural deposits. Potential health effects include serious illness and, if untreated, death for infants below the age of six months; symptoms include a shortness of breath and blue-baby syndrome.

The contaminant category risk ranking for VOCs is ***Very High***. This ranking is driven primarily by a municipal class III landfill, coal mining areas, and the density of roads located within the DWPA. VOCs have been detected in samples collected in recent years. On 3/13/2012 and 1/25/2011 Xylenes were detected at 0.0007 and 0.0015 mg/L, respectively. The Maximum Contaminant Level (MCL) for xylenes, as determined by the EPA, is 10 mg/L. Sources of VOCs may be either natural or anthropogenic. Potential health effects are typically compounding long-term, and not acute.

The contaminant category risk ranking for Inorganic Chemicals is ***Very High***. This ranking is driven primarily by a municipal class III landfill, coal mining areas, and the density of roads located within the DWPA. Barium was detected at a concentration of 0.0144 milligrams per liter (mg/L) (.72% of the MCL of 2 mg/L) March 2012. Chromium was detected at a concentration of 0.000614 milligrams per liter (mg/L) (.61% of the MCL of .1 mg/L) March 2012. Fluoride was

detected at a concentration of 0.18 milligrams per liter (mg/L) (4.50% of the MCL of 4 mg/L) March 2012. Sources of Barium may include discharge of drilling wastes, discharge from metal refineries, and erosion of natural deposits. A potential health effect from long-term exposure above the MCL may include an increase in blood pressure. Sources of Chromium may include industrial processes and discharge, or natural erosion. . A potential health effect from long-term exposure above the MCL may include experiencing allergic dermatitis. Sources of fluoride may include discharge from fertilizer or aluminum factories. Fluoride is a naturally occurring compound that is found in most water supplies, and is also added to the water in many communities to promote dental health.

The contaminant category risk ranking for SOCs is ***Very High***. This ranking is driven primarily by a municipal class III landfill and coal mining areas located within the DWPA. This PWS has received an SOC Monitoring Waiver for compliance periods 2011-2013, 2008-2010, and 2005-2007.

The contaminant category risk ranking for OOCs is ***Very High***. This ranking is driven primarily by a municipal class III landfill, coal mining areas, and the density of roads located within the DWPA. This PWS has received an SOC Monitoring Waiver for compliance periods 2011-2013, 2008-2010, and 2005-2007.

Overall Vulnerability of the Drinking Water Source to Contamination

An overall vulnerability is determined by combining each of the contaminant category risk rankings with the natural susceptibility score:

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

Table 5 summarizes the overall vulnerability ratings for each of the six (6) contaminant categories.

Table 5: Overall Vulnerability

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

Using the Source Water Assessment

This assessment of contaminant risks and source vulnerability can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the Tyonek Water System PWS to protect public health. Communities can use the Source Water Assessment (SWA) to create a drinking water protection plan to manage the identified potential and existing sources of regulated drinking water contaminants and to prevent or minimize new contaminant threats in the drinking water protection area.

The Tyonek Water System PWS can use a number of different drinking water protection methods to limit or prevent contamination of its drinking water source.

- *Non-Regulatory Options include:*
    - Public education about where drinking water comes from and the effects of contaminants is probably the most effective and least costly method of protection;

- Household hazardous waste collection - household hazardous wastes are usually generated in small amounts but can have a big impact on the environment;
- The source water assessment report is a tool that can be used to prioritize protection strategies identified in a drinking water protection plan;
- Taking proactive measures towards proper waste storage and disposal can help eliminate the need to find an alternative drinking water source by preventing source water contamination;
- Conservation easements - easements can assist in protecting the area by limiting development;
- Make a written plan on what you will do if an accidental spill happens that could contaminate your source of drinking water; and
- Local drinking water protection plan (an example or template is available from DEC).

- *Regulatory Options include:*
  - Source protection regulations prohibiting the presence or use of all or specific chemicals within the drinking water protection area;
  - Zoning ordinances to control development within the different protection areas around the source;
  - Subdivision ordinance; and
  - Operating standards for industrial and other activities within the different protection areas around the source.

Source Water Assessments can be updated to reflect any changes in the vulnerability and/or susceptibility of the TYONEK WATER SYSTEM WL004 and WL005. The data that is used to generate the SWA is updated on an on-going basis as identified in the field or if changes are identified and brought to the attention of the Drinking Water Program.

Where to go from here?

The SWA is a comprehensive evaluation of the potential risk of contamination to the PWS and the source(s) of drinking water used by the system. Identifying potential sources of contamination and the vulnerability of the PWS is an important first step in protecting the drinking water source from contamination. However, in order to prevent contamination from occurring, action must be taken by the PWS owner and/or operator. The SWA can be used by the PWS to educate the local community and to prioritize community-driven protection strategies. Inviting community members, council members, and local government officials to help develop a drinking water protection plan is one essential component towards successful drinking water protection efforts. For questions regarding, or assistance to begin, the process of developing a drinking water protection plan, please contact the Drinking Water Protection group toll-free at #1-866-956-7656 (within Alaska only), or direct at #907-269-7656.

Other Resources

The Drinking Water Protection group, the Environmental Protection Agency (EPA), and local organizations are available to help you build on this SWA report as you continue to improve drinking water protection in your community.

- DEC, Drinking Water Protection - http://dec.alaska.gov/eh/dw/DWP/DWP_main.html
- EPA, Drinking Water Protection - http://cfpub.epa.gov/safewater/sourcewater/index.cfm
- Groundwater Foundation - http://www.groundwater.org
- Groundwater Protection Council- http://www.gwpc.org
- National Ground Water Association: http://www.ngwa.org/Pages/default.aspx

Appendices

- TYONEK WATER SYSTEM WL001 Drinking Water Protection Area Location Map (Map 1);
- TYONEK WATER SYSTEM WL001 Drinking Water Protection Area with Potential and Existing Contaminant Sources (Map 2);
- Example Best Management Strategies for Potential Contaminants Identified within a Drinking Water Protection Area.

Source Water Assessment Report

Map 1 - Contaminant Source Inventory

PWSID 240472: Tyonek Water System

WL001: Tyonek Secondary Well

Legend

DWP-Regulated Water System Sources

- Community Water System (Formerly Class A)
- NonTransient/NonCommunity (Formerly Class A)
- NonCommunity (Formerly Class B)
- NonPublic (Class C-State Regulated)

Identified Drinking Water Protection Areas (DWPAs)

- Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer
- Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)

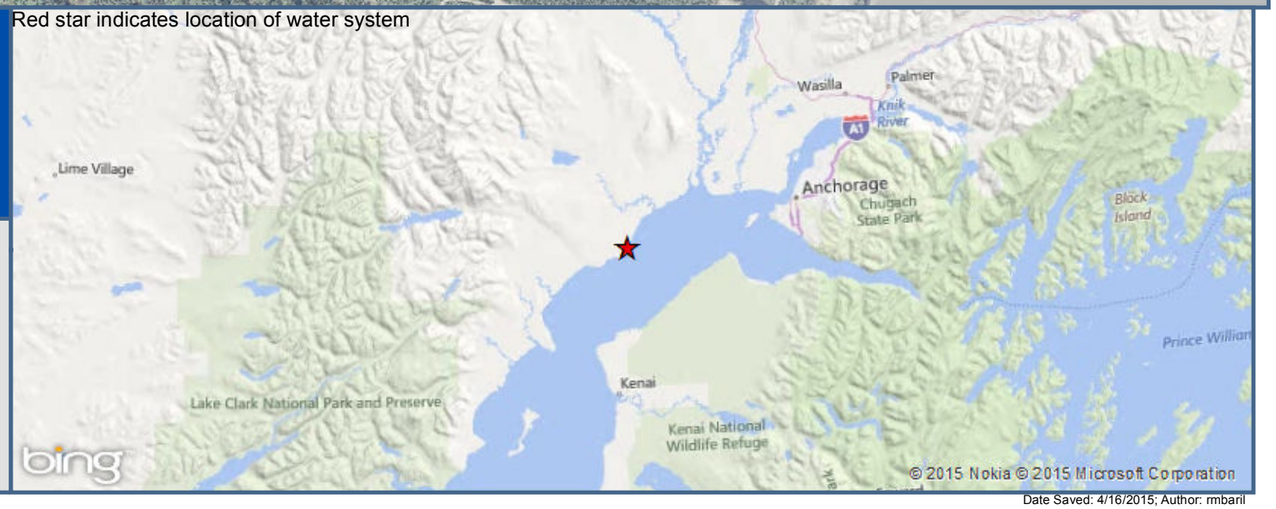
Other Identified Drinking Water Protection Areas (DWPAs)

- Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer
- Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)

0 1,000 2,000 4,000 Feet

1 inch = 2,500 feet

Red star indicates location of water system



Data sources: Alaska DEC: Public Water System sources and Drinking Water Protection Areas; Alaska Mapped Best Data Layer Web Map Service: Aerial imagery.

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Inset Map

Additional Potential Sources of Contamination (Zone A)
X24: Highways and Roads - dirt/gravel (assumed less than 20)

WL002 Tyonek Primary Well

WL001 Tyonek Secondary Well

0 500 1,000 2,000 Feet
1 inch = 1,000 feet

Additional Potential Sources of Contamination (Zone B)
X24: Highways and Roads - dirt/gravel (assumed less than 50)

N W E S

See Inset

0 0.5 1 2 Miles
1 in = 1 miles

Identified Existing and Potential Sources of Contamination

- Pipelines
- D02 - Domestic wastewater treatment plant (lagoon)
- D05 - Domestic wastewater treatment plant
- D51 - Landfill (Municipal Class III)
- D51--Landfills (municipal; Class III)
- E01--Coal mining (active or inactive)

SolidWasteSites

- Active

Source Water Assessment Report

Map 2 - Contaminant Source Inventory

PWSID 240472: Tyonek Water System

WL001: Tyonek Secondary Well

Legend

DWP-Regulated Water System Sources

- Community Water System (Formerly Class A)
- NonTransient/NonCommunity (Formerly Class A)
- NonCommunity (Formerly Class B)
- NonPublic (Class C-State Regulated)

Identified Drinking Water Protection Areas (DWPAs)

- Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer
- Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)

Other Identified Drinking Water Protection Areas (DWPAs)

- Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer
- Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)

Data sources: Alaska DEC: Public Water System sources and Drinking Water Protection Areas; Alaska Mapped Best Data Layer Web Map Service: Aerial imagery.

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