



A Source Water Assessment (SWA) for

PWSID #271999 – Bethel City S/D – 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	Bethel City S/D
PWSID Number	271999
Federal Designation	Community water system (CWS)
State Assigned ID	WL001
Facility Name	Well 1
Source Type	Groundwater
Total Depth of Well (ft bls*)	498
Static Water Level (ft bls*)	25.4
Aquifer Type	Confined
Aquifer Formation	Sand (subpermafrost)
Description and Cumulative Thickness of Barrier (ft)	Permafrost (145')
Date Well Completed	8/18/1999

*"ft bls" = feet below land surface

Executive Summary

The public water system (PWS) for Bethel City S/D is a Community water system (CWS) consisting of one (1) active well at the time of this report, and is located in Bethel, Alaska. This report is an assessment of well WL001 (WELL 1). 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 October 2014. The wellhead for WL001 received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **High**. 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 Bethel City S/D WL001 include: automotive body shops, construction trade areas and materials, motor vehicle dealerships, domestic wastewater collection systems, Class V motor vehicle disposal injection wells, residential areas, residential septic systems, non-residential above ground heating oil tanks, above and below ground gasoline and diesel tanks, wastewater holding tanks, open dumps, abandoned wells, monitoring wells, water supply wells, cemeteries, glycol disposal and/or storage, paved highways and roads, electric power generation (fossil fuels), dog walking areas/foot trails, gasoline stations, motor vehicle supplies stores/repair shops, a Class II municipal landfill, and industrial landfill, accidental spill sites, contaminated sites, transformers containing PCBs, airports, government vehicle maintenance facilities, firehouses, medical/veterinary facilities, and kennels. 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, Bethel City S/D WL001 received an overall vulnerability rating of **High** for bacteria and viruses; **High** for nitrates and/or nitrites; **High** for VOCs; **High** for inorganic chemicals; and a **High** 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 Bethel City S/D 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 Bethel City S/D WL001 received a **Low** susceptibility rating. The most recent sanitary survey (completed December 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 Bethel City S/D draws water from a confined aquifer completed in subpermafrost sand. It received a **High** susceptibility rating primarily because of the many water wells located within the DWPA. 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. However, other wells that penetrate the confining layers create a potential pathway for surface water and contaminants to the aquifer.

The Natural Susceptibility of the well and aquifer to contamination is **Low**. Table 2 summarizes the susceptibility ratings for the Bethel City S/D WL001.

Table 2: Susceptibility Ratings

Susceptibility of the wellhead	Low
+	
Susceptibility of the aquifer	High
=	
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 Bethel City S/D 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
Body shops (automotive)	C05-01	A	Automotive body shop on Ridgecrest Dr, Bethel, AK
Construction trade areas and materials	C09-01	A	Drums (paint and other unidentified chemicals) on the NE corner of Ridgecrest Dr and 6th Ave
Motor vehicle dealerships - cars, trucks, motor cycles, ATV's, snow machines, boats (without service department)	C26-01	A	Dealership on Willow St, south of 5th Ave, Bethel, AK
Domestic wastewater collection systems (sewer lines or lift stations)	D01-01	A	
Domestic wastewater collection systems (sewer lines or lift stations)	D01-02	A	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-01	A	Nicholson's Auto Inc on 630 3rd Ave, Bethel, AK
Residential Areas	R01-01-20	A	Identified approximately 20 acres of residential areas within Zone A
Septic systems (serves one single-family home)	R02-01	A	
Tanks, heating oil, nonresidential (aboveground)	T14-01	A	Heating oil tank for United Pentecostal Church
Tanks, heating oil, nonresidential (aboveground)	T14-02	A	Heating oil tank on ~251 6th Ave, Bethel, AK
Tanks, heating oil, nonresidential (aboveground)	T14-03	A	Heating oil tank on ~251 6th Ave, Bethel, AK

Contaminant Source Type	Contaminant Source ID	Zone	Comments
Tanks, heating oil, nonresidential (aboveground)	T14-04	A	Heating oil tank for United Pentecostal Church
Tanks, heating oil, nonresidential (aboveground)	T14-05	A	Heating oil tank for United Pentecostal Church
Tanks, heating oil, nonresidential (aboveground)	T14-06	A	Heating oil tank for United Pentecostal Church
Tanks, heating oil, nonresidential (aboveground)	T14-07	A	Heating oil tank on ~500-598 Ridgecrest Dr (behind Bethel Native Corp Offices building)
Tanks, heating oil, nonresidential (aboveground)	T14-08	A	Heating oil tank on ~500-598 Ridgecrest Dr (north of Alaska Commercial Store building)
Tanks, heating oil, nonresidential (aboveground)	T14-09	A	Heating oil tank on ~500-598 Ridgecrest Dr (behind Alaska Commerical Store building)
Tanks, heating oil, nonresidential (aboveground)	T14-10	A	Heating oil tank on ~500-598 Ridgecrest Dr (behind Alaska Commerical Store building)
Tanks, heating oil, nonresidential (aboveground)	T14-11	A	Heating oil tank for United Pentecostal Church
Tanks, heating oil, nonresidential (aboveground)	T14-12	A	Heating oil tank on ~ 45-353 7th Ave (north of Tundra Center building)
Wastewater Holding Tank	T22-01	A	Holding tank on ~45-353 7th Ave (east of Tundra Center building)
Wastewater Holding Tank	T22-02	A	Holding tank behind Tundra Center building. Tank is inactive per staff but unsure if tank is empty or not.
Wastewater Holding Tank	T22-03	A	Holding tank for United Pentecostal Church
Wastewater Holding Tank	T22-04	A	Holding tank for United Pentecostal Church
Wastewater Holding Tank	T22-05	A	Holding tank for United Pentecostal Church
Wastewater Holding Tank	T22-06	A	Holding tank behind Bethel Native Corp building
Wastewater Holding Tank	T22-07	A	Holding tank behind Bethel Native Corp building
Wastewater Holding Tank	T22-08	A	Holding tank for United Pentecostal Church
Wastewater Holding Tank	T22-09	A	Holding tank - Bethel Native Corp building
Open dumps	U09-01	A	Auto parts junk storage on ~ 120-225 Ridgecrest Dr, Bethel, AK
Open dumps	U09-02	A	Beauty salon on ~ 456-498 Ridgecrest Dr., Bethel, AK
Open dumps	U09-03	A	Commerical satellite dishes. Delta Dish System on 630 3rd Ave, Bethel, AK
Abandoned wells	W01-01	A	Abandoned well on 251 6th Ave
Abandoned wells	W01-02	A	Abandoned well on 251 6th Ave
Monitoring wells	W06-01	A	Monitoring well behind the Bethel Native Corp building
Monitoring wells	W06-02	A	Monitoring well behind the Bethel Native Corp building
Water supply wells	W09-01	A	Delta Dish System on 630 3rd Avenue, Bethel, AK
Water supply wells	W09-01	A	400' Public Water System (NTNC) well on Ridgecrest Drive

Contaminant Source Type	Contaminant Source ID	Zone	Comments
Water supply wells	W09-02	A	421' Public Water System (NTNC) well on Ridgecrest Drive
Water supply wells	W09-03	A	419' Public Water System (TNC) well on 6th Avenue
Water supply wells	W09-04	A	408' Public Water System (CWS) well on Mission Drive
Water supply wells	W09-05	A	400' Public Water System (TNC) well on Ridgecrest Drive
Water supply wells	W09-06	A	429' Public Water System (TNC) well on Ridgecrest Drive
Cemeteries	X01-01	A	United Pentecostal Church
Glycol (disposal or storage)	X07-01	A	South end of the Alaska Commercial Store - 135 Ridgecrest Dr, Bethel, AK
Glycol (disposal or storage)	X07-02	A	South end of the Alaska Commercial Store - 135 Ridgecrest Dr, Bethel, AK
Highways and roads, paved (cement or asphalt)	X20-01-12	A	Identified 12 roads within Zone A
Electric power generation (fossil fuels)	X36-01	A	Alaska Commercial Store - 135 Ridgecrest Dr., Bethel, AK
Electric power generation (fossil fuels)	X36-02	A	Alaska Commercial Store - 135 Ridgecrest Dr., Bethel, AK
Dog walking areas/foot trails	X46-01	A	Raised boardwalk over wetland area with flowing surface water (All season)
Construction trade areas and materials	C09-02	B	~ on 900-964 3rd Ave, Bethel, AK
Construction trade areas and materials	C09-03	B	Ron Edwards Memorial Dr
Gasoline stations (without repair shop)	C15-01	B	Osier Ave, Bethel, AK (south of Bridge Ave)
Gasoline stations (without repair shop)	C15-02	B	Northstar Gas on 1170 Bridge Ave, Bethel, AK (north of Bridge Ave)
Gasoline stations (with repair shop)	C16-01	B	Nicholson's Auto Inc on 630 3rd Ave, Bethel, AK
Motor/motor vehicle supplies stores	C28-01	B	~ on 201-499 3rd Ave, Bethel, AK
Motor/motor vehicle supplies stores	C28-02	B	Napa Auto parts on 830 3rd Ave, Bethel, AK
Motor/motor vehicle supplies stores	C28-03	B	Nicholson's Auto Inc on 630 3rd Ave, Bethel, AK
Motor /motor vehicle repair shops	C31-01	B	Nicholson's Auto Inc on 630 3rd Ave, Bethel, AK
Domestic wastewater collection systems (sewer lines or lift stations)	D01-03	B	
Domestic wastewater collection systems (sewer lines or lift stations)	D01-04	B	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-02	B	The Shop (Bethel) on 151 D 6th Ave, Bethel, AK
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-03	B	Nicholson's Auto Inc on 630 3rd Ave, Bethel, AK
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-04	B	Nicholson's Auto Inc on 630 3rd Ave, Bethel, AK

Contaminant Source Type	Contaminant Source ID	Zone	Comments
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-05	B	Nicholson's Auto Inc on 630 3rd Ave, Bethel, AK
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-06	B	Nicholson's Auto Inc on 630 3rd Ave, Bethel, AK
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-07	B	Nicholson's Auto Inc on 630 3rd Ave, Bethel, AK
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-08	B	Nicholson's Auto Inc on 630 3rd Ave, Bethel, AK
Landfills (municipal; Class II)	D50-01	B	Bethel Landfill
Landfills	D52-01	B	(industrial; type of industrial waste?); Bethel Asbestos Landfill - RACM and Non-RACM
Residential Areas	R01-21-65	B	Identified approximately 45 acres of residential areas within Zone B
Septic systems (serves one single-family home)	R02-02	B	
Tanks, heating oil, residential (above ground)	R08-01	B	Ron Edwards Memorial Dr, Bethel, AK
Tanks, heating oil, residential (above ground)	R08-02	B	Ron Edwards Memorial Dr, Bethel, AK
Tanks, heating oil, residential (above ground)	R08-03	B	Ron Edwards Memorial Dr, Bethel, AK
Tanks, heating oil, residential (above ground)	R08-04	B	Ron Edwards Memorial Dr, Bethel, AK
Tanks, heating oil, residential (above ground)	R08-05	B	Ron Edwards Memorial Dr, Bethel, AK
Tanks, heating oil, residential (above ground)	R08-06	B	Ron Edwards Memorial Dr, Bethel, AK
Tanks, heating oil, residential (above ground)	R08-07	B	Ron Edwards Memorial Dr, Bethel, AK
Tanks, heating oil, residential (above ground)	R08-08	B	Ron Edwards Memorial Dr, Bethel, AK
Tanks, heating oil, residential (above ground)	R08-09	B	Ron Edwards Memorial Dr, Bethel, AK
Tanks, diesel (above ground)	T06-01	B	South of 4th Ave
Tanks, diesel (above ground)	T06-02	B	South of 4th Ave
Tanks, diesel (underground)	T08-01	B	Diesel UST on Main St
Tanks, gasoline (underground)	T12-01	B	Unleaded UST on Main St
Tanks, heating oil, nonresidential (aboveground)	T14-13	B	South of 4th Ave
Tanks, heating oil, nonresidential (aboveground)	T14-14	B	South of 4th Ave
Tanks, heating oil, nonresidential (aboveground)	T14-15	B	South of 4th Ave

Contaminant Source Type	Contaminant Source ID	Zone	Comments
Tanks, heating oil, nonresidential (aboveground)	T14-16	B	South of 4th Ave
Wastewater Holding Tank	T22-10	B	Northwest corner of 4th Ave and Main St
Wastewater Holding Tank	T22-11	B	Northwest corner of 4th Ave and Main St
Wastewater Holding Tank	T22-12	B	Northwest corner of 4th Ave and Main St
Wastewater Holding Tank	T22-13	B	Northwest corner of 4th Ave and Main St
Wastewater Holding Tank	T22-14	B	Northwest corner of 4th Ave and Main St intersection
Accidental spill sites (not designated a Superfund or 'contaminated site')	U02-01	B	Site Name: Bethel Dump; Problem: Old leaking oil drums; Hazard ID: 1033; Contaminant of Concern: TPH; Status: Cleanup Complete.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04-01	B	Site Name: AKARNG Bethel OMS, near Kilbuck School; Problem: Petroleum contamination in soil; Hazard ID: 3049; Contaminant of Concern: DRO; Status: Active; ETM Groundwater Ingestion: High Potential Exposure as of 03/14/2008.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04-02	B	Site Name: Kuskokwim Inn/Long House Bethel Inn; Problem: Diesel Contaminated soils; Hazard ID: 3206; Contaminants of Concern: Benzene, DRO, RRO; Status: Active; ETM Groundwater Ingestion: De Minimis Exposure as of 01/25/2011.
Water supply wells	W09-07	B	400' Public Water System (TNC) well on 3rd Avenue
Water supply wells	W09-08	B	400' Public Water System (TNC) well on 4th Avenue
Water supply wells	W09-09	B	405' Public Water Sytem (NTNC) well on 4th Avenue
Water supply wells	W09-10	B	350' Public Water System (NP) well on 3rd Avenue
Water supply wells	W09-11	B	368.3' Public Water Sytem (CWS) well on 3rd Avenue
Asbestos, disposed or stockpiled	X05-01	B	North of Ron Edwards Memorial Dr
Glycol (disposal or storage)	X07-03	B	North of Ridgecrest Dr and Willow St intersection
Glycol (disposal or storage)	X07-04	B	Northeast of Main St and 3rd Ave intersection
Glycol (disposal or storage)	X07-05	B	Northeast of Main St and 3rd Ave intersection
Glycol (disposal or storage)	X07-06	B	Northeast of Main St and 3rd Ave intersection
Glycol (disposal or storage)	X07-07	B	Northeast of Main St and 3rd Ave intersection
Glycol (disposal or storage)	X07-08	B	Ron Edwards Memorial Dr
PCB's (transformers)	X10-01	B	Ron Edwards Memorial Dr
Airports	X14-01	B	Seaplane Base on Hangar Lake
Government vehicle maintenance facilities	X19-01	B	Northeast of Willow St and 4th Ave intersection
Highways and roads, paved (cement or asphalt)	X20-13-34	B	Identified 22 roads within Zone B
Firehouses	X38-01	B	Ron Edwards Memorial Dr

Contaminant Source Type	Contaminant Source ID	Zone	Comments
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40-01	B	6th Ave
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40-02	B	4th Ave
Kennels	X49-01	B	7th Ave

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
Body shops (automotive)	C05-01	A	N/A	N/A	Medium	Medium	N/A	Medium
Construction trade areas and materials	C09-01	A	N/A	N/A	Low	Low	N/A	Low
Motor vehicle dealerships - cars, trucks, motor cycles, ATV's, snow machines, boats (without service department)	C26-01	A	N/A	N/A	Low	N/A	N/A	Low
Domestic wastewater collection systems (sewer lines or lift stations)	D01-01	A	Medium	Medium	Low	Low	Low	Low
Domestic wastewater collection systems (sewer lines or lift stations)	D01-02	A	Medium	Medium	Low	Low	Low	Low
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-01	A	Low	N/A	High	High	Low	Medium
Residential Areas	R01-01-20	A	Low	Low	Low	Low	Low	Low
Septic systems (serves one single-family home)	R02-01	A	Low	Low	Low	Low	Low	Low
Tanks, heating oil, nonresidential (aboveground)	T14-01	A	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-02	A	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-03	A	N/A	N/A	Low	Low	N/A	N/A

Contaminant Source Type	Contaminant	Zone	Bacteria	Nitrates	VOC	Metals	SOC	OOC
Tanks, heating oil, nonresidential (aboveground)	T14-04	A	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-05	A	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-06	A	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-07	A	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-08	A	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-09	A	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-10	A	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-11	A	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-12	A	N/A	N/A	Low	Low	N/A	N/A
Wastewater Holding Tank	T22-01	A	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-02	A	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-03	A	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-04	A	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-05	A	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-06	A	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-07	A	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-08	A	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-09	A	Low	Low	Medium	Medium	N/A	Medium
Open dumps	U09-01	A	N/A	N/A	High	High	Medium	Medium
Open dumps	U09-02	A	N/A	N/A	High	High	Medium	Medium
Open dumps	U09-03	A	N/A	N/A	High	High	Medium	Medium
Abandoned wells	W01-01	A	Medium	High	High	Very High	High	High
Abandoned wells	W01-02	A	Medium	High	High	Very High	High	High
Cemeteries	X01-01	A	N/A	Medium	N/A	Low	Medium	N/A
Glycol (disposal or storage)	X07-01	A	N/A	N/A	N/A	Low	N/A	N/A
Glycol (disposal or storage)	X07-02	A	N/A	N/A	N/A	Low	N/A	N/A
Highways and roads, paved (cement or asphalt)	X20-01-12	A	Low	Low	Low	Low	N/A	Low
Electric power generation (fossil fuels)	X36-01	A	N/A	N/A	Medium	Medium	N/A	High

Contaminant Source Type	Contaminant	Zone	Bacteria	Nitrates	VOC	Metals	SOC	OOB
Electric power generation (fossil fuels)	X36-02	A	N/A	N/A	Medium	Medium	N/A	High
Dog walking areas/foot trails	X46-01	A	Low	Low	N/A	N/A	N/A	N/A
Construction trade areas and materials	C09-02	B	N/A	N/A	Low	Low	N/A	Low
Construction trade areas and materials	C09-03	B	N/A	N/A	Low	Low	N/A	Low
Gasoline stations (without repair shop)	C15-01	B	N/A	N/A	High	Low	N/A	Low
Gasoline stations (without repair shop)	C15-02	B	N/A	N/A	High	Low	N/A	Low
Gasoline stations (with repair shop)	C16-01	B	N/A	N/A	High	Low	N/A	Medium
Motor/motor vehicle supplies stores	C28-01	B	N/A	N/A	Low	Low	N/A	N/A
Motor/motor vehicle supplies stores	C28-02	B	N/A	N/A	Low	Low	N/A	N/A
Motor/motor vehicle supplies stores	C28-03	B	N/A	N/A	Low	Low	N/A	N/A
Motor /motor vehicle repair shops	C31-01	B	N/A	N/A	Medium	Medium	N/A	Medium
Domestic wastewater collection systems (sewer lines or lift stations)	D01-03	B	Medium	Medium	Low	Low	Low	Low
Domestic wastewater collection systems (sewer lines or lift stations)	D01-04	B	Medium	Medium	Low	Low	Low	Low
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-02	B	Low	N/A	High	High	Low	Medium
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-03	B	Low	N/A	High	High	Low	Medium
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-04	B	Low	N/A	High	High	Low	Medium
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-05	B	Low	N/A	High	High	Low	Medium
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-06	B	Low	N/A	High	High	Low	Medium
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-07	B	Low	N/A	High	High	Low	Medium
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42-08	B	Low	N/A	High	High	Low	Medium
Landfills (municipal; Class II)	D50-01	B	High	Very High	High	High	Very High	Very High
Landfills	D52-01	B	N/A	N/A	N/A	N/A	N/A	Very High
Residential Areas	R01-21-65	B	Low	Low	Low	Low	Low	Low

Contaminant Source Type	Contaminant	Zone	Bacteria	Nitrates	VOC	Metals	SOC	OOB
Septic systems (serves one single-family home)	R02-02	B	Low	Low	Low	Low	Low	Low
Tanks, heating oil, residential (above ground)	R08-01	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, heating oil, residential (above ground)	R08-02	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, heating oil, residential (above ground)	R08-03	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, heating oil, residential (above ground)	R08-04	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, heating oil, residential (above ground)	R08-05	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, heating oil, residential (above ground)	R08-06	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, heating oil, residential (above ground)	R08-07	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, heating oil, residential (above ground)	R08-08	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, heating oil, residential (above ground)	R08-09	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, diesel (above ground)	T06-01	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, diesel (above ground)	T06-02	B	N/A	N/A	Medium	N/A	N/A	N/A
Tanks, diesel (underground)	T08-01	B	N/A	N/A	High	N/A	N/A	N/A
Tanks, gasoline (underground)	T12-01	B	N/A	N/A	High	Medium	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-13	B	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-14	B	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-15	B	N/A	N/A	Low	Low	N/A	N/A
Tanks, heating oil, nonresidential (aboveground)	T14-16	B	N/A	N/A	Low	Low	N/A	N/A
Wastewater Holding Tank	T22-10	B	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-11	B	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-12	B	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-13	B	Low	Low	Medium	Medium	N/A	Medium
Wastewater Holding Tank	T22-14	B	Low	Low	Medium	Medium	N/A	Medium
Accidental spill sites (not designated a Superfund or 'contaminated site')	U02-01	B	N/A	N/A	Low	N/A	N/A	N/A
Contaminated sites, DEC recognized, non-Superfund, non-RCA	U04-01	B	N/A	N/A	High	N/A	N/A	N/A

Contaminant Source Type	Contaminant	Zone	Bacteria	Nitrates	VOC	Metals	SOC	OOB
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04-02	B	N/A	N/A	Low	N/A	N/A	N/A
Asbestos, disposed or stockpiled	X05-01	B	N/A	N/A	N/A	Low	N/A	N/A
Glycol (disposal or storage)	X07-03	B	N/A	N/A	N/A	Low	N/A	N/A
Glycol (disposal or storage)	X07-04	B	N/A	N/A	N/A	Low	N/A	N/A
Glycol (disposal or storage)	X07-05	B	N/A	N/A	N/A	Low	N/A	N/A
Glycol (disposal or storage)	X07-06	B	N/A	N/A	N/A	Low	N/A	N/A
Glycol (disposal or storage)	X07-07	B	N/A	N/A	N/A	Low	N/A	N/A
Glycol (disposal or storage)	X07-08	B	N/A	N/A	N/A	Low	N/A	N/A
PCB's (transformers)	X10-01	B	N/A	N/A	N/A	N/A	N/A	Very High
Airports	X14-01	B	N/A	Low	High	Low	Medium	Medium
Government vehicle maintenance facilities	X19-01	B	N/A	N/A	Medium	Low	N/A	Medium
Highways and roads, paved (cement or asphalt)	X20-13-34	B	Low	Low	Low	Low	N/A	Low
Firehouses	X38-01	B	N/A	N/A	Low	Low	N/A	High
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40-01	B	Medium	Low	Low	Low	Low	N/A
Medical/veterinary facilities (doctor or dentist offices, hospitals, nursing homes)	X40-02	B	Medium	Low	Low	Low	Low	N/A
Kennels	X49-01	B	Medium	Medium	N/A	N/A	N/A	N/A
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 several domestic wastewater collection systems, several Class V motor vehicle waste disposal injection wells, a Class II municipal landfill, residential areas, several residential septic systems, several wastewater holding tanks, two abandoned wells, paved highways and roads, medical/veterinary facilities, dog walking areas/foot trails, and kennels 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 residential septic systems, several wastewater holding tanks, two abandoned wells, cemeteries, an airport, paved highways and roads, medical/veterinary facilities, dog walking areas/foot trails, and kennels 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 an automotive body shop, several construction trade areas and materials, gasoline stations with and without repair shops, motor vehicle dealerships, motor vehicle supplies stores/repair shops, several domestic wastewater collection systems, several Class V motor vehicle waste disposal injection wells, a Class II municipal landfill, residential areas, residential septic systems, above ground heating oil tanks, above ground diesel tanks, above ground nonresidential heating oil tanks, wastewater holding tanks, accidental spill sites, ADEC recognized contaminated sites, open dumps, two abandoned wells, an airport, government vehicle maintenance facilities, paved highways and roads, an electric power generation station, a firehouse, and medical veterinary facilities located within the DWPA. VOCs have not been detected in samples collected in recent years. 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 an auto body shop, construction trade and materials sites, gasoline stations with and without repair shops, motor vehicle supplies stores/repair shops, domestic wastewater collection systems, Class V motor vehicle waste disposal injection wells, a Class II municipal landfill, residential areas, residential septic systems, underground gasoline tanks, above ground tanks of heating oil, wastewater holding tanks, open dumps, two abandoned wells, cemeteries, stockpiled or disposed asbestos, storage or disposal of glycol, an airport, and a government vehicle maintenance facility located within the DWPA. VOC's have not been detected in samples collected in recent years.

The contaminant category risk ranking for SOCs is **Very High**. This ranking is driven primarily by domestic wastewater collection systems, Class V motor vehicle waste disposal injection wells, a Class II landfill, residential areas, residential septic systems, open dumps, two abandoned wells, cemeteries, an airport, and medical/veterinary facilities located within the DWPA. This PWS has received an SOC Monitoring Waiver for compliance periods 2011-2013, 2005-2007 and 2002-2004.

The contaminant category risk ranking for OOCs is **Very High**. This ranking is driven primarily by an automotive body shop, several construction trade areas and materials, gasoline stations with and without repair shops, motor vehicle dealerships, motor vehicle repair shops, wastewater holding tanks, transformers with PCBs, a government vehicle maintenance facility, paved highways and roads, electric power generation stations, a firehouse, domestic wastewater collection systems, Class V motor vehicle waste disposal injection wells, a Class II landfill, residential areas, residential septic systems, open dumps, two abandoned wells, cemeteries, an airport and medical/veterinary facilities 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:

<i>Overall Vulnerability of the Drinking Water Source to Contamination = Natural Susceptibility + Contaminant Risks</i>
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Table 5 summarizes the overall vulnerability ratings for each of the six (6) contaminant categories.

Table 5: Overall Vulnerability	
<i>Category</i>	<i>Rating</i>
Bacteria and Viruses	<i>High</i>
Nitrates and/or Nitrites	<i>High</i>
Volatile Organic Chemicals	<i>High</i>
Heavy Metals, Cyanide, and Other Inorganic Chemicals	<i>High</i>
Synthetic Organic Chemicals	<i>High</i>
Other Organic Chemicals	<i>High</i>

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 Bethel City S/D 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 Bethel City S/D 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 Bethel City S/D WL001. 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>

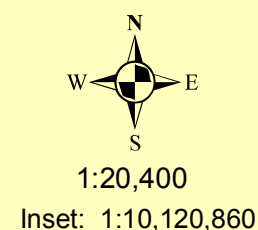
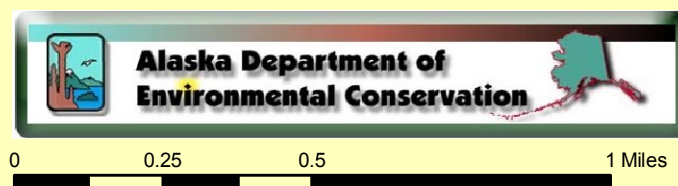
Appendices

- Bethel City S/D WL001 Drinking Water Protection Area Location Map (Map 1);
- Bethel City S/D 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.



Map 1 - Bethel-City S/D Water

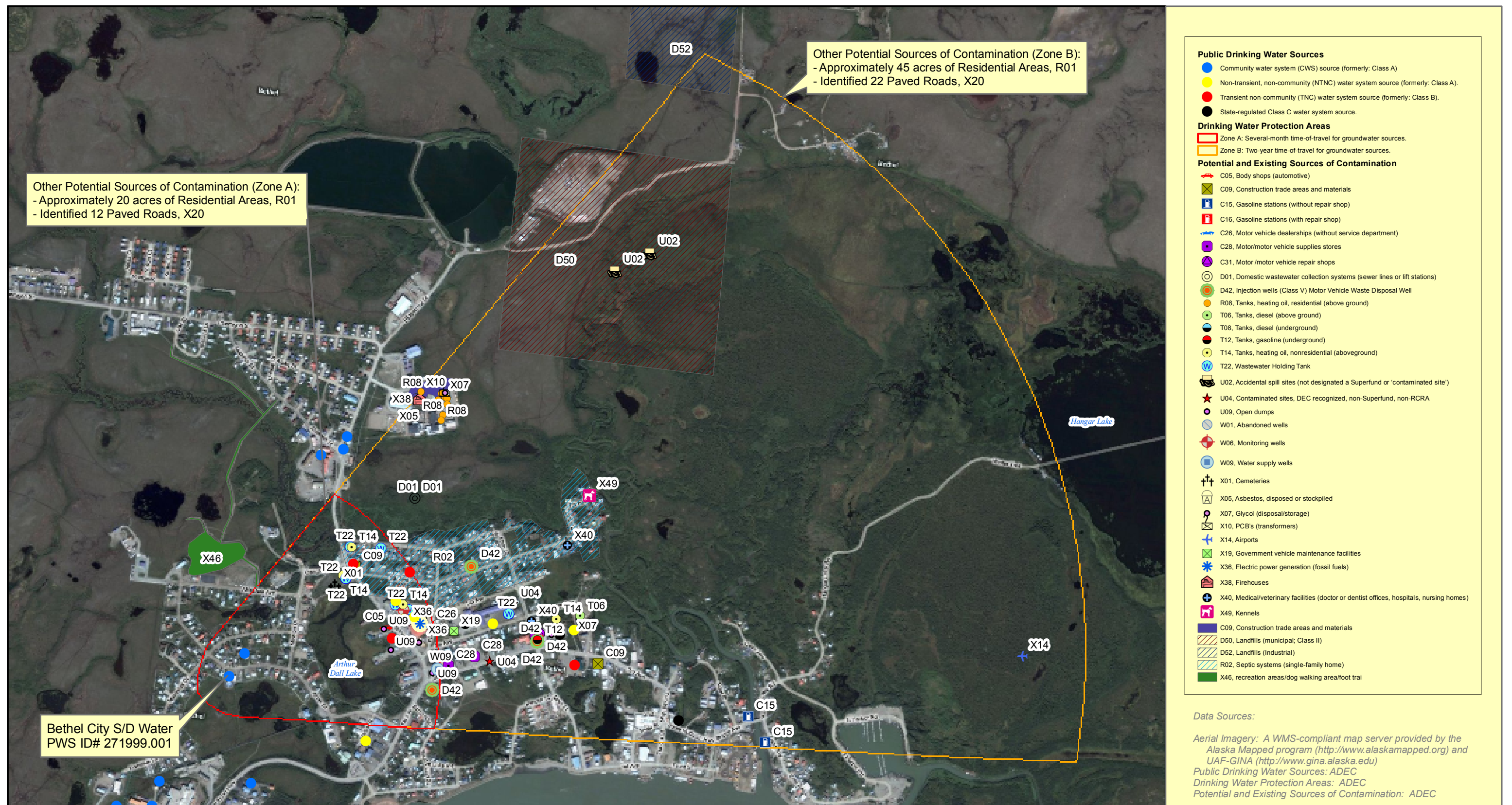
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- Public Drinking Water Sources**
- Community water system (CWS) source (formerly: Class A) Water (large scale) selection
- Drinking Water Protection Areas**
- Zone A: Several-month time-of-travel for groundwater sources.
 - Zone B: Two-year time-of-travel for groundwater sources.

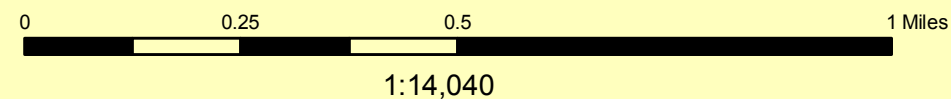
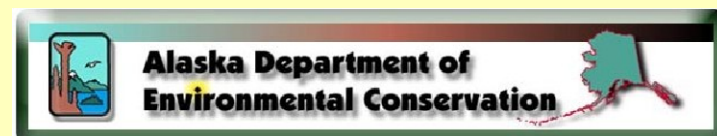
Data Sources:

Aerial Imagery: A WMS-compliant map server provided by the Alaska Mapped program (<http://www.alaskamapped.org>) and UAF-GINA (<http://www.gina.alaska.edu>)
 Public Drinking Water Sources: ADEC
 Drinking Water Protection Areas: ADEC



Map 2 - Bethel-City S/D Water

PWS ID# 271999.001



Anne Gleason 03/24/2011

