
# Source Water Assessment

## A Hydrogeologic Susceptibility and Vulnerability Assessment for Delta Junction IGA Public Drinking Water System, Delta Junction, Alaska PWSID # 372716.001

DRINKING WATER PROTECTION REPORT 1821

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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# APPENDICES

# Source Water Assessment for Delta Junction IGA Source of Public Drinking Water, Delta Junction, Alaska

**Drinking Water Protection**
**Alaska Department of Environmental Conservation**

## EXECUTIVE SUMMARY

The public water system for Delta Junction IGA is a Class B (transient/non-community) water system consisting of one well located on the Richardson Highway in Delta Junction, Alaska. The wellhead received a susceptibility rating of **Low** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **Medium** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Delta Junction IGA public drinking water source include: large-capacity septic systems, assumed septic systems, assumed heating oil tanks, Open Leaking Underground Fuel Storage Tank (LUST) sites, and roads. 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 Delta Junction IGA received a vulnerability rating of **High** for bacteria and viruses, **High** for nitrates and nitrites, and **Medium** 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 Delta Junction IGA to protect public health.

## DELTA JUNCTION IGA PUBLIC DRINKING WATER SYSTEM

Delta Junction IGA public water system is a Class B (transient/non-community) water system. The system consists of one well located on the Richardson Highway, about 0.4 miles north of the intersection with the Alaska Highway, in Delta Junction, Alaska (see Map A in Appendix A). Delta Junction is located about 95 miles southeast of Fairbanks, where the Alaska and Richardson Highways meet. Temperatures range from an average of -11 degrees Fahrenheit in January to an average of 69 degrees Fahrenheit in July. The area receives 12 inches of precipitation annually, including 37 inches of snowfall (ADCCED, 2009).

Homes in Delta Junction use individual wells and septic systems. Because business and homes are so spread out, a community water system is impractical. Refuse is transported by a private firm to a city-owned landfill. Electricity is provided by Golden Valley Electrical Association (ADCCED, 2009).

According to the well log, the well extends approximately 215 feet below the ground surface and is completed in a semi-confined aquifer. This system operates continuously and serves one hundred non-residents through one service connection.

## DELTA JUNCTION IGA 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 Delta Junction IGA 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 Delta Junction IGA 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 DELTA JUNCTION IGA 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 Delta Junction IGA received a **Low** susceptibility rating. The well log and other supporting documents for this system 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 Delta Junction IGA system draws water from a semi-confined aquifer overlain by 3 feet of clay and 50 feet of silt. The aquifer received a **High** susceptibility rating because of its semi-confined nature and the presence of other wells penetrating the vadose zone of the protection area. Because a semi-confined aquifer is partially recharged by surface water and precipitation that migrates downward from the surface, it is susceptible to contamination from outside sources. Furthermore, the presence of other wells penetrating the vadose zone of the protection area can allow contaminants to travel into the shared aquifer with precipitation and runoff.

Table 2 summarizes the Susceptibility scores and ratings for the Delta Junction IGA system.

**Table 2. Susceptibility**

| | Score | Rating |
|---|---|---|
| Susceptibility of the Wellhead | 0 | Low |
| Susceptibility of the Aquifer | 23 | Very High |
| Natural Susceptibility | 23 | Medium |

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 Delta Junction IGA system.

**Table 3. Contaminant Risks**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 50 | Very High |
| Nitrates and/or Nitrites | 50 | Very High |
| Volatile Organic Chemicals | 25 | Medium |

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 Delta Junction IGA system. Note: scores are rounded off to the nearest five.

**Table 4. Overall Vulnerability**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 75 | High |
| Nitrates and/or Nitrites | 75 | High |
| Volatile Organic Chemicals | 50 | Medium |

**Bacteria and Viruses**

The contaminant risk for bacteria and viruses is **Very High** with large-capacity septic systems , assumed septic systems, and 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).

Samples testing positive for bacteria and viruses increase the overall vulnerability of the drinking water source by indicating that the source is susceptible to bacteria and virus contamination. Only a small number of bacteria and viruses are required to endanger public health. Bacteria and viruses have not been detected during recent water sampling of the system at Delta Junction IGA (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 **High**.

**Nitrates and Nitrites**

The contaminant risk for nitrates and nitrites is **Very High** with large-capacity septic systems, assumed septic systems, and roads contributing to the risk to the drinking water well.

The sampling history for Delta Junction IGA well indicates that nitrates have been detected in the water within the last 5 years of sampling. The highest concentration of 0.294 mg/l was detected on 04/12/2005 (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 **High**.

**Volatile Organic Chemicals**

The contaminant risk for volatile organic chemicals is **Medium** with the large-capacity septic systems, assumed septic systems, heating oil tanks, and roads contributing to the risk to the drinking water well.

The drinking water at Delta Junction IGA 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 **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 Delta Junction IGA 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 Delta Junction IGA 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.

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

# APPENDIX A

## Delta Junction IGA
## Drinking Water Protection Area Location Map
## (Map A)

# Public Water Well System for PWS #372716.001 Delta Junction IGA


## Legend

Class B Public Water System

**Groundwater Protection Zones**

Zone A Protection Area - Several Months Travel Time

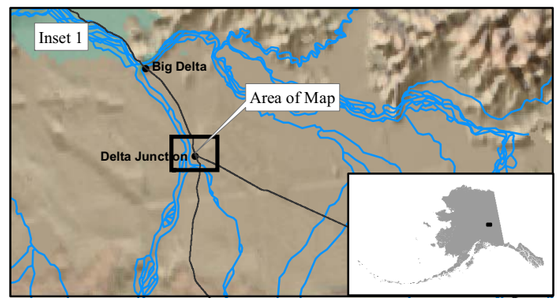
Zone B Protection Area - 2 Years Travel Time

**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**

**URS Corporation does not guarantee the accuracy or validity of the data provided.**

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Delta Junction IGA
PWS 372716.001

**Appendix A Map A**

# APPENDIX B

## Contaminant Source Inventory and Risk Ranking for Delta Junction IGA (Tables 1-4)

***Table 1***

# *Contaminant Source Inventory for* ***DELTA JUNCTION IGA***

***PWSID 372716.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Map Number* | *Comments* |
|---|---|---|---|---|---|
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-01 | A | C | |
| Septic systems (serves one single-family home) | R02 | R02 | A | C | 7 assumed septics |
| Tanks, heating oil, residential (above ground) | R08 | R08 | A | C | 7 assumed septics |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | C | 1 road |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-02 | B | C | |
| Septic systems (serves one single-family home) | R02 | R02 | B | C | 12 assumed septics |
| Tanks, heating oil, residential (above ground) | R08 | R08 | B | C | 12 assumed septics |
| Open Leaking Underground Fuel Storage Tank (LUST) Sites | U07 | U07-01 | B | C | |
| Open Leaking Underground Fuel Storage Tank (LUST) Sites | U07 | U07-02 | B | C | |
| Open Leaking Underground Fuel Storage Tank (LUST) Sites | U07 | U07-03 | B | C | |
| Open Leaking Underground Fuel Storage Tank (LUST) Sites | U07 | U07-04 | B | C | |
| Open Leaking Underground Fuel Storage Tank (LUST) Sites | U07 | U07-05 | B | C | |
| Open Leaking Underground Fuel Storage Tank (LUST) Sites | U07 | U07-06 | B | C | |
| Closed Leaking Underground Fuel Storage Tank (LUST) Sites | U08 | U08-01 | B | C | |
| Closed Leaking Underground Fuel Storage Tank (LUST) Sites | U08 | U08-02 | B | C | |
| Closed Leaking Underground Fuel Storage Tank (LUST) Sites | U08 | U08-03 | B | C | |
| Closed Leaking Underground Fuel Storage Tank (LUST) Sites | U08 | U08-04 | B | C | |
| Closed Leaking Underground Fuel Storage Tank (LUST) Sites | U08 | U08-05 | B | C | |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | B | C | 2 roads |

***Table 2***

# *Contaminant Source Inventory and Risk Ranking for DELTA JUNCTION IGA*

## *Sources of Bacteria and Viruses*

***PWSID 372716.001***

| ***Contaminant Source Type*** | ***Contaminant Source ID*** | ***CS ID tag*** | ***Zone*** | ***Risk Ranking for Analysis*** | ***Map Number*** | ***Comments*** |
|---|---|---|---|---|---|---|
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-01 | A | High | C | |
| Septic systems (serves one single-family home) | R02 | R02 | A | Low | C | 7 assumed septics |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | Low | C | 1 road |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-02 | B | High | C | |
| Septic systems (serves one single-family home) | R02 | R02 | B | Low | C | 12 assumed septics |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | B | Low | C | 2 roads |

***Table 3***

# *Contaminant Source Inventory and Risk Ranking for DELTA JUNCTION IGA Sources of Nitrates/Nitrites*

***PWSID 372716.001***

| ***Contaminant Source Type*** | ***Contaminant Source ID*** | ***CS ID tag*** | ***Zone*** | ***Risk Ranking for Analysis*** | ***Map Number*** | ***Comments*** |
|---|---|---|---|---|---|---|
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-01 | A | High | C | |
| Septic systems (serves one single-family home) | R02 | R02 | A | Low | C | 7 assumed septics |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | Low | C | 1 road |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-02 | B | High | C | |
| Septic systems (serves one single-family home) | R02 | R02 | B | Low | C | 12 assumed septics |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | B | Low | C | 2 roads |

***Table 4***

# *Contaminant Source Inventory and Risk Ranking for DELTA JUNCTION IGA*

## *Sources of Volatile Organic Chemicals*

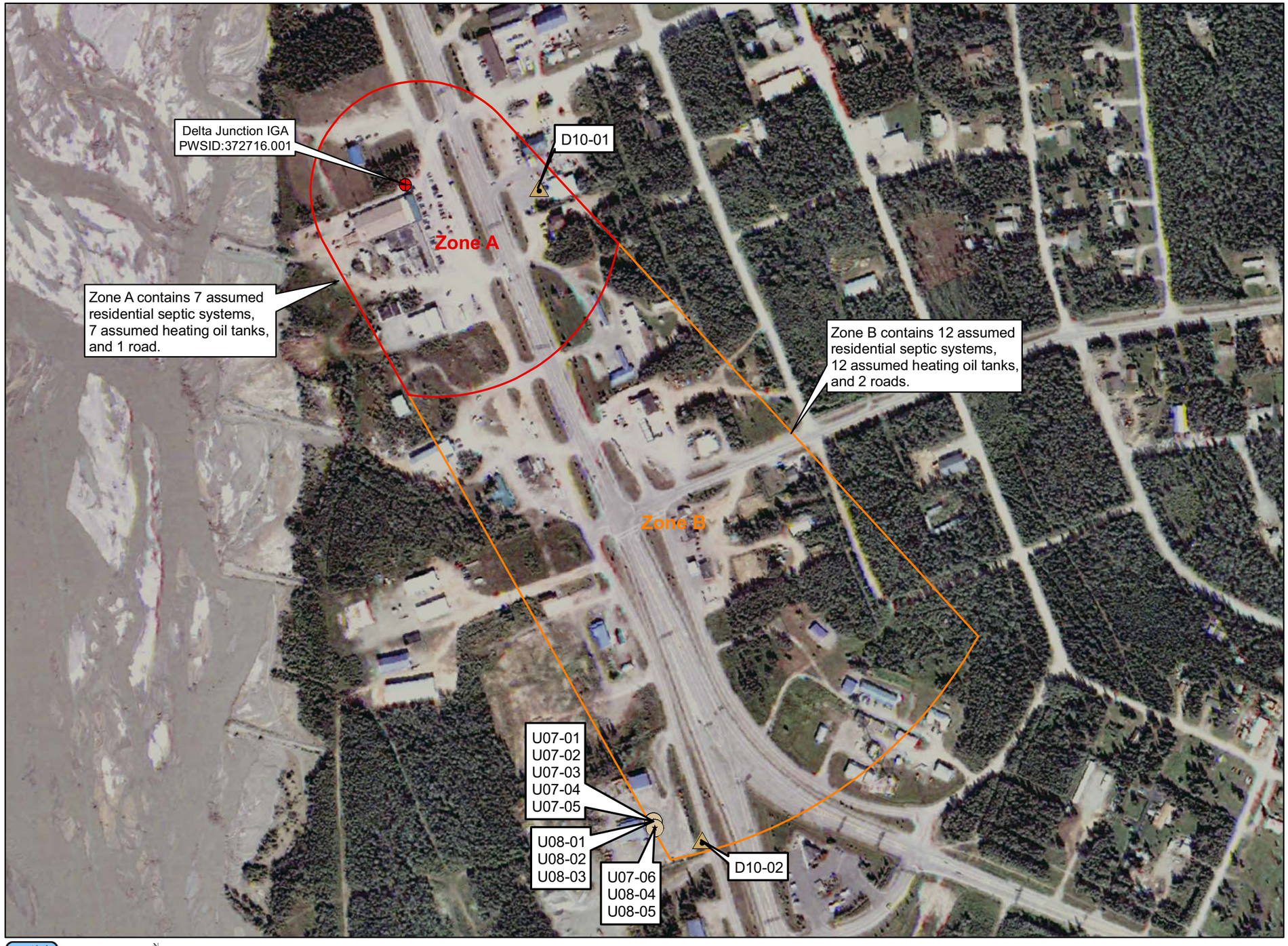
***PWSID 372716.001***

| *Contaminant Source Type* | *Contaminant Source ID* | *CS ID tag* | *Zone* | *Risk Ranking for Analysis* | *Map Number* | *Comments* |
|---|---|---|---|---|---|---|
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-01 | A | Low | C | |
| Septic systems (serves one single-family home) | R02 | R02 | A | Low | C | 7 assumed septics |
| Tanks, heating oil, residential (above ground) | R08 | R08 | A | Medium | C | 7 assumed septics |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | A | Low | C | 1 road |
| Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) | D10 | D10-02 | B | Low | C | |
| Septic systems (serves one single-family home) | R02 | R02 | B | Low | C | 12 assumed septics |
| Tanks, heating oil, residential (above ground) | R08 | R08 | B | Medium | C | 12 assumed septics |
| Highways and roads, paved (cement or asphalt) | X20 | X20 | B | Low | C | 2 roads |

# APPENDIX C

## Delta Junction IGA
## Drinking Water Protection Area
## and Potential and Existing Contaminant Sources
## (Map C)

# Public Water Well System for PWS #372716.001 Delta Junction IGA
# Showing Potential and Existing Sources of Contamination




## Legend

**Groundwater Protection Zones**

- Zone A Protection Area - Several Months Travel Time
- Zone B Protection Area - 2 Years Travel Time

**Existing or Potential Contaminant Sources**

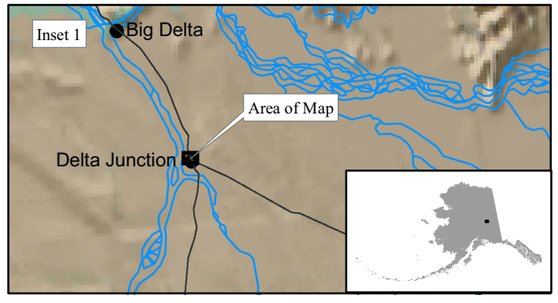
- *Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method) (D10)*
- *Open Leaking Underground Fuel Storage Tank (LUST) Sites (U07)*
- *Closed Leaking Underground Fuel Storage Tank (LUST) Sites (U08)*

**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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Delta Junction IGA
PWS 372716.001

**Appendix C Map C**