

Source Water Assessment

A Hydrogeologic Susceptibility and
Vulnerability Assessment for
Church of Jesus Christ of Latter-Day Saints
Public Drinking Water System,
Glennallen, Alaska
PWSID # 299033.001

DRINKING WATER PROTECTION REPORT 1779

Alaska Department of Environmental Conservation

January, 2009

Source Water Assessment for Church of Jesus Christ of Latter-Day Saints Public Drinking Water System Glennallen, Alaska PWSID# 299033.001

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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.

January, 2009

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Source Water Assessment for Church of Jesus Christ of Latter-Day Saints Source of Public Drinking Water, Glennallen, Alaska

Drinking Water Protection Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

The public water system for Church of Jesus Christ of Latter-Day Saints is a Class B (transient/non-community) water system consisting of one well located less than a mile from the Glenn Highway on 3rd Avenue in northern Glennallen, Alaska. The wellhead received a susceptibility rating of **Very High** and the aquifer received a susceptibility rating of **Very High**. Combining these two ratings produces a **Very High** rating for the natural susceptibility of the well. Identified potential and current sources of contaminants for Church of Jesus Christ of Latter-Day Saints public drinking water source include: assumed septic systems, assumed heating oil tanks, 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 Church of Jesus Christ of Latter-Day Saints received a vulnerability rating of **Very High** for bacteria and viruses, **High** for nitrates and nitrites, and **High** 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 Church of Jesus Christ of Latter-Day Saints to protect public health.

CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS PUBLIC DRINKING WATER SYSTEM

The Church of Jesus Christ of Latter-Day Saints public water system is a Class B (transient/non-community) water system. The system consists of one well located less than a mile from the Glenn Highway on 3rd Avenue in northern Glennallen, Alaska (see Map A in Appendix A). The community of Glennallen is located along the Glenn Highway at its junction with the Richardson Highway, 189 road miles east of Anchorage. The community has a population of 518. Total annual precipitation in Glennallen is 9 inches, including approximately 39 inches of snowfall. Glennallen is located in the continental climate zone, with long, cold winters, and relatively warm summers (ADCCED, 2009).

The community of Glennallen obtains most of their water supply from the community water system.

Some households have their own wells, but the water is often of poor quality. The majority of households are fully plumbed. Most residents have individual septic tanks, but many are connected to the piped sewage system. Glennallen residents rely on the Copper Valley Electric for electricity, which is hydro-power with diesel as a backup. Refuse collection and the landfill are operated by Copper Basin Sanitation (ADCCED, 2009).

The Glennallen area is in the southeastern portion of the Copper River basin, in southeastern Interior Alaska. The Copper River basin, ranging from 500 to over 4,000 feet above sea level, is an intermontane basin rimmed by peaks of the Chugach, Alaska, Talkeetna, and Wrangell mountains. The terrain of the basin can be divided into two physiographic sub-units: the rolling, hummocky Copper River basin piedmont surface, and the Copper River basin trough. The Copper River basin trough is generally flat and lacks the hummocky, rolling character of the piedmont surface (Nichols, 1956).

The terrain, geology of the unconsolidated deposits, and foundation materials of the Copper River basin are related to Pliocene and recent events. Glaciers from the Chugach, Wrangell, Talkeetna, and Alaska Ranges repeatedly invaded the basin, perhaps at times filling it and flowing across the divides to the north, west, east, and south. Such extensive glaciation has resulted in the deposition of large thicknesses of coarse glacial boulder clays (till) and coarse outwash gravel and sand on the piedmont surface, with finer till and outwash interbedded with lake deposits in the basin trough (Nichols, 1956).

Surface soils in the area generally consist of silt and clay with pebbles underlain by boulder clay with till, underlain by glacial outwash sand and gravel, underlain by boulder clay or till (Nichols, 1956). The Glennallen area is within the discontinuous permafrost zone (Nichols, 1956).

No well log or sanitary survey were available for this system, so based on information from nearby public water systems, it is assumed that the well extends approximately 94 feet below the ground surface and is completed in an unconfined aquifer. It is also assumed that a sanitary seal is not installed, the land surface is not sloped appropriately away from the well, and the well is not properly grouted according to DEC regulations.

This system operates continuously and serves 31 non-residents through one service connection.

CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS 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 Church of Jesus Christ of Latter-Day Saints 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

Drinking Water Protection has completed an inventory of potential and existing sources of contamination within the Church of Jesus Christ of Latter-Day Saints 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 CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS 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 Church of Jesus Christ of Latter-Day Saints received a **Very High** susceptibility rating. No sanitary survey is available for this system, therefore it is assumed that a sanitary seal is not installed, the land surface is not appropriately sloped away from the well, and the well is not properly 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 confining layer.

No well log is available for the Church of Jesus Christ of Latter-Day Saints system, so it is assumed to draw water from an unconfined aquifer, based on information

from a nearby public water system. It received a **Very High** susceptibility rating due to its unconfined nature and the presence of other wells penetrating the vadose zone of the protection area. Because an unconfined aquifer is 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 Church of Jesus Christ of Latter-Day Saints system.

Table 2. Susceptibility

	Score	Rating
Susceptibility of the Wellhead	25	Very High
Susceptibility of the Aquifer	25	Very High
Natural Susceptibility	50	Very High

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 Church of Jesus Christ of Latter-Day Saints system.

Table 3. Contaminant Risks

Category	Score	Rating
Bacteria and Viruses	50	Very High
Nitrates and/or Nitrites	12	Low
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:

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

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 Church of Jesus Christ of Latter-Day Saints system. Note: scores are rounded off to the nearest five.

Table 4. Overall Vulnerability

Category	Score	Rating
Bacteria and Viruses	100	Very High
Nitrates and/or Nitrites	60	High
Volatile Organic Chemicals	75	High

Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Very High** with risk resulting primarily from positive coliform sampling results. Septic systems and roads further contribute 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 been detected during recent water sampling of the system at the Church of Jesus Christ of Latter-Day Saints, with positive results confirmed on 01/11/2007 and 01/25/2007 (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 **Very High**.

Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Low** with the septic systems and roads contributing to the risk to the drinking water well.

The sampling history for the Church of Jesus Christ of Latter-Day Saints well 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 **High**.

Volatile Organic Chemicals

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

The drinking water at Church of Jesus Christ of Latter-Day Saints 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 **High**.

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 Church of Jesus Christ of Latter-Day Saints 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 Church of Jesus Christ of Latter-Day Saints 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.

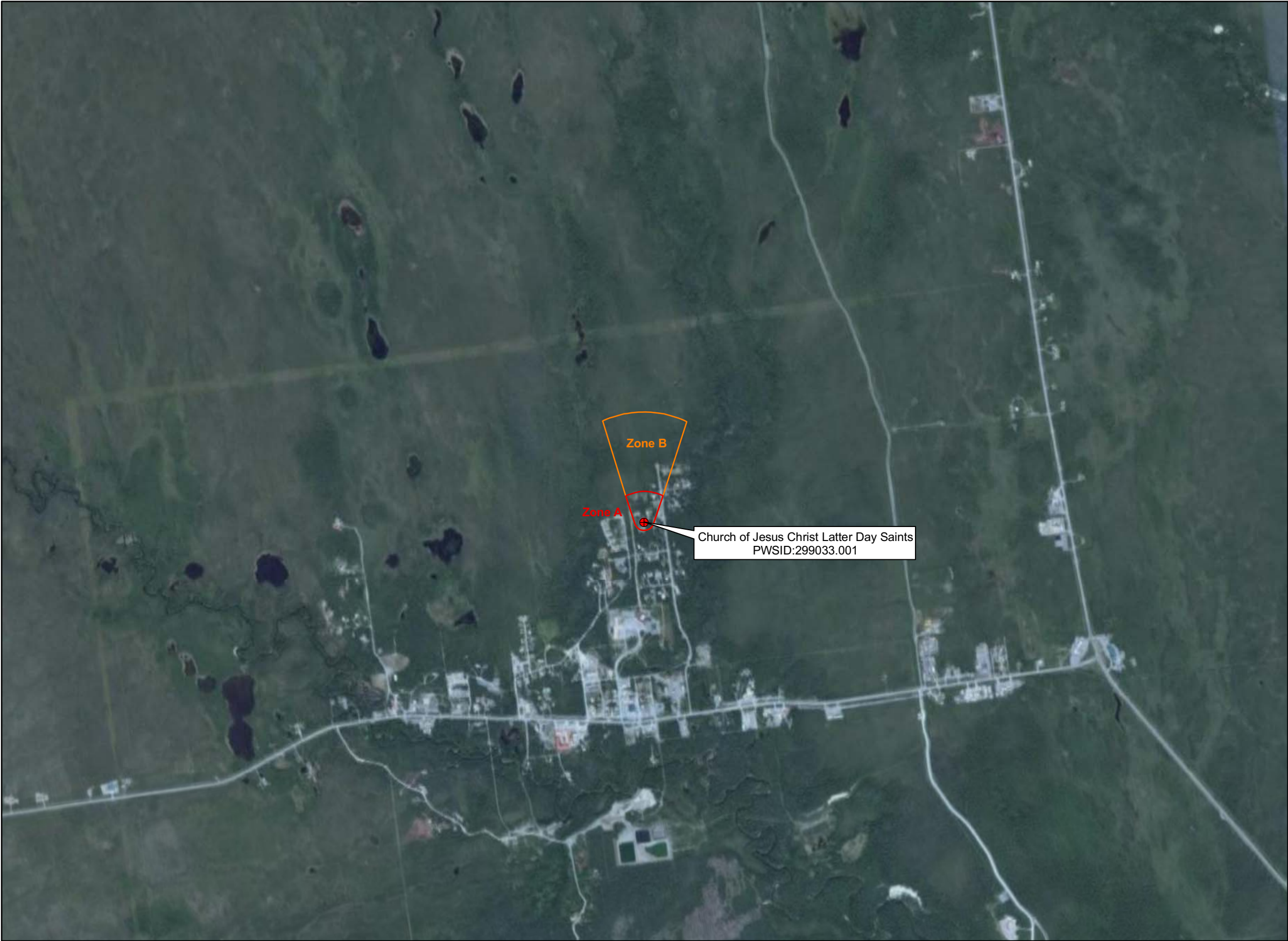
Nichols, Donald R, 1956. Information from Permafrost and Groundwater Conditions in the Glennallen area, Alaska, Open File Report 56-91, U.S. Geological Survey.

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

APPENDIX A

Church of Jesus Christ of Latter-Day Saints Drinking Water Protection Area Location Map (Map A)

Public Water Well System for PWS #299033.001 Church of Jesus Christ Latter Day Saints



Legend

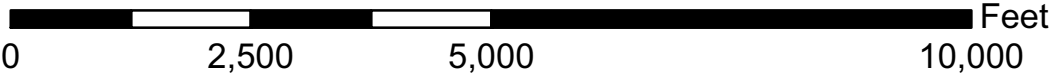
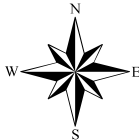
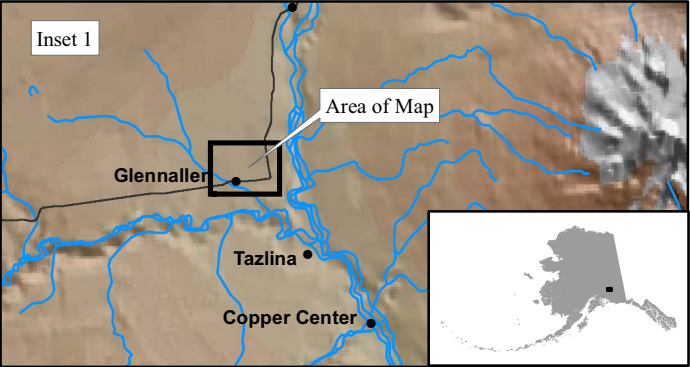
- Class B Public Water System
- Groundwater Protection Zones
 - Zone A Protection Area - Several Months Travel Time
 - Zone B Protection Area - 2 Years Travel Time

Data Sources:
Contaminant Sources, Public Water System Wells, Alaska Department of Environmental Conservation (ADEC)

All other data:
United States Geological Survey (USGS)

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 Church of Jesus Christ of Latter-Day Saints (Tables 1-4)

Table 1

Contaminant Source Inventory for
CHURCH OF JESUS CHRIST LATTER DAY SAINTS

PWSID 299033.001

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Map Number</i>	<i>Comments</i>
Septic systems (serves one single-family home)	R02	R02	A	C	5 assumed
Tanks, heating oil, residential (above ground)	R08	R08	A	C	5 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	A	C	1 road
Septic systems (serves one single-family home)	R02	R02	B	C	3 assumed
Tanks, heating oil, residential (above ground)	R08	R08	B	C	3 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	B	C	1 road

Table 2

*Contaminant Source Inventory and Risk Ranking for
CHURCH OF JESUS CHRIST LATTER DAY SAINTS
Sources of Bacteria and Viruses*

PWSID 299033.001

<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>
Septic systems (serves one single-family home)	R02	R02	A	Low	C	5 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road
Septic systems (serves one single-family home)	R02	R02	B	Low	C	3 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 road

Table 3

*Contaminant Source Inventory and Risk Ranking for
CHURCH OF JESUS CHRIST LATTER DAY SAINTS
Sources of Nitrates/Nitrites*

PWSID 299033.001

<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>
Septic systems (serves one single-family home)	R02	R02	A	Low	C	5 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road
Septic systems (serves one single-family home)	R02	R02	B	Low	C	3 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 road

Table 4

*Contaminant Source Inventory and Risk Ranking for
CHURCH OF JESUS CHRIST LATTER DAY SAINTS
Sources of Volatile Organic Chemicals*

PWSID 299033.001

<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>
Septic systems (serves one single-family home)	R02	R02	A	Low	C	5 assumed
Tanks, heating oil, residential (above ground)	R08	R08	A	Medium	C	5 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	A	Low	C	1 road
Septic systems (serves one single-family home)	R02	R02	B	Low	C	3 assumed
Tanks, heating oil, residential (above ground)	R08	R08	B	Medium	C	3 assumed
Highways and roads, paved (cement or asphalt)	X20	X20	B	Low	C	1 road

APPENDIX C

Church of Jesus Christ of Latter-Day Saints Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map C)

Public Water Well System for PWS #299033.001 Church of Jesus Christ Latter Day Saints
Showing Potential and Existing Sources of Contamination



Legend

● Class B Public Water System

Groundwater Protection Zones

□ Zone A Protection Area - Several Months Travel Time

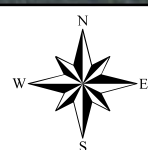
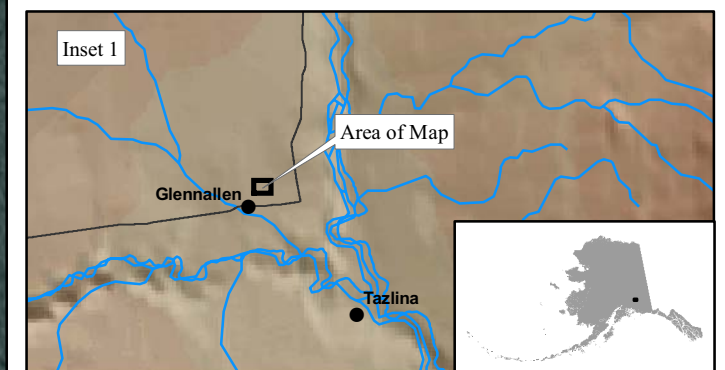
□ Zone B Protection Area - 2 Years Travel Time

Data Sources:
Contaminant Sources, Public Water System Wells, Alaska Department of Environmental Conservation (ADEC)

All other data:
Alaska Statewide Digital Mapping Initiative (SDMI)

Drinking Water Protection Areas based on "Alaska Drinking Water Protection Program - Guidance Manual for Class B Public Water Systems" published by ADEC

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



0 500 1,000 2,000 Feet

Church of Jesus Christ Latter Day Saints
PWS 299033.001

Appendix C Map C