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# Source Water Assessment

A Hydrogeologic Susceptibility and  
Vulnerability Assessment for  
Midnight Sun Family Learning Center  
Drinking Water System,  
Wasilla, Alaska  
PWSID 220098

November 2006

DRINKING WATER PROTECTION REPORT Report 1595  
Alaska Department of Environmental Conservation

Source Water Assessment for Midnight  
Sun Family Learning Center Drinking  
Water System  
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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 (ADEC), 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 Program Coordinator of DWP, (907) 269-7521.

## CONTENTS

	Page		Page
Executive Summary	1	Inventory of Potential and Existing Contaminant Sources	2
Midnight Sun Family Learning Center Public Drinking Water System	1	Ranking of Contaminant Risks	2
Midnight Sun Family Learning Center Protection Area	1	Vulnerability of Midnight Sun Family Learning Center Drinking Water System	3
	1	References	6

## TABLES

TABLE	1. Definition of Zones	2
	2. Susceptibility	3
	3. Contaminant Risks	3
	4. Overall Vulnerability	3

## APPENDICES

APPENDIX	A. Midnight Sun Family Learning Center Drinking Water Protection Area (Map 1)
	B. Contaminant Source Inventory for Midnight Sun Family Learning Center (Table 1)
	Contaminant Source Inventory and Risk Ranking for Midnight Sun Family Learning Center – Bacteria and Viruses (Table 2)
	Contaminant Source Inventory and Risk Ranking for Midnight Sun Family Learning Center – Nitrates/Nitrites (Table 3)
	Contaminant Source Inventory and Risk Ranking for Midnight Sun Family Learning Center – Volatile Organic Chemicals (Table 4)
	Contaminant Source Inventory and Risk Ranking for Midnight Sun Family Learning Center – Heavy Metals, Cyanide, and Other Inorganic Chemicals (Table 5)
	Contaminant Source Inventory and Risk Ranking for Midnight Sun Family Learning Center – Synthetic Organic Chemicals (Table 6)
	Contaminant Source Inventory and Risk Ranking for Midnight Sun Family Learning Center – Other Organic Chemicals (Table 7)
	C. Midnight Sun Family Learning Center Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)

# Source Water Assessment for Midnight Sun Family Learning Center Source of Public Drinking Water, Wasilla, Alaska

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## Drinking Water Protection Alaska Department of Environmental Conservation

### EXECUTIVE SUMMARY

This source water assessment provides an evaluation of the vulnerability of the public water system serving the Midnight Sun Family Learning Center to potential contamination. This Class A (community) water system consists of one well off of Pittman Road in Wasilla. The well received a natural susceptibility rating of **Low**. This rating is a combination of a susceptibility rating of **Low** for the actual wellhead and a **Medium** rating for the aquifer in which the well is drawing water from. Identified potential and current sources of contamination for the Midnight Sun Family Learning Center public water system include: injection wells, construction trade areas, septic systems, and roads. These are considered as sources of bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals (VOCs), heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals (SOCs), and other organic chemicals (OOCs). Combining the natural susceptibility of the well with the contaminant risk, the public water system for Midnight Sun Family Learning Center received an overall vulnerability rating of **High** for nitrates and/or nitrites, bacteria and viruses, **Medium** for heavy metals, cyanide, and other inorganic chemicals, and **Low** for VOCs, OOCs, SOCs.

### MIDNIGHT SUN FAMILY LEARNING CENTER PUBLIC DRINKING WATER SYSTEM

Midnight Sun Family Learning Center public water system is a Class A (community) water system within the Meadow Creek Watershed. The system consists of one well off of the Parks Highway on Pittman Road.

The Meadow Creek watershed, located in south-central Alaska, lies within the Matanuska-Susitna Borough. The Borough encompasses 24,694 square miles and supports a population in 2000 of 59,322. The Borough's close proximity to Anchorage and its abundance of surface-water resources has helped contribute to rapid growth over the last two decades. The population has tripled since 1980. The projected growth rate is expected to be 3.3% per year, three times higher than the state rate (ADOL, 1999).

The Borough is contained within the watersheds of the Matanuska and Susitna Rivers which flow from the

glacier melt waters in the Alaska Range, Talkeetna Mountains, and the Chugach Mountains to tidewater in the Knik Arm of Upper Cook Inlet (Jokela, Munter and Evans, 1991). The area between the Matanuska and Susitna Valley is commonly referred to as the Mat-Su Valley. The Meadow Creek watershed contains 115 lakes, including Big Lake, and extends from an area northwest of Wasilla to the west end of Big Lake (Jokela, Munter and Evans, 1991).

Surface elevations in the Matanuska-Susitna Borough range from sea level where the Knik River and Matanuska River enter the Cook Inlet to well over 6,000 feet in the peaks that bound the area. Glacial moraine and outwash deposits primarily mantle the surface of the Mat-Su Valley.

The regional geology and ground water conditions of the Mat-Su Valley vary greatly depending on location. The terrain is dominated by distinctive landforms created by repeated glacial advances and retreats during the Pleistocene epoch (2 million to 10,000 years before present). The unconsolidated layers, layers of sediment that are not cemented together, are comprised of various mixtures of fine- to coarse-grained particles (clay to boulders). The majority of wells in the Mat-Su Valley are located in unconsolidated layers consisting of relatively well sorted sands and gravels. These unconsolidated layers vary substantially in size and distribution throughout the Valley. In general, the unconsolidated layers increase in thickness as you move towards Cook Inlet. (Jokela, Munter, Evans, 1991). Throughout the area numerous confining layers ranging from less than 1- to 60- feet thick separate the unconsolidated layers.

In the Mat-Su Valley, the groundwater is primarily recharged by snowmelt and precipitation infiltrating into the foothill slopes of the Talkeetna or Chugach Mountains and by direct precipitation and snowmelt throughout the study area.

Groundwater flow in the confined aquifer is generally, north to south in the central region of the valley, toward the Matanuska River in the eastern region and the slope is predominantly northeast to northwest in the western region. The groundwater flow direction in upper unconfined aquifers is more variable due to influence from surficial topography as well as its close connection with surface water bodies. (Jokela, Munter and Evans, 1991).

The Midnight Sun Family Learning Center public water system serves approximately 200 non-residents through 1 service connection.

**MIDNIGHT SUN FAMILY LEARNING CENTER DRINKING WATER PROTECTION AREA**

The pathways most likely for surface contamination to reach the groundwater are identified as the first step in determining a drinking water system’s risk. 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 area that contributes water to the well, the groundwater capture zone. The groundwater capture zone is located in the area circling the well (the area influenced by pumping) and also the area of the water table upgradient of the well, usually forming a parabola shape.

There are many different methods for calculating the size of capture zones. 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 capture zone is then drawn using a water table elevation map (if available) or a land surface elevation map of the area. The capture zone calculated by the DWP is an estimate using the available information and resources, and may differ slightly from the actual capture zone.

The parameters used to calculate the shape of this capture 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).

Because of uncertainties and changing site conditions, a factor of safety is added to the groundwater capture zone to form the drinking water protection area for the well.

The protection areas established for wells are usually separated into two zones, limited by the watershed. These zones correspond to times-of-travel (TOT) of the water moving through the aquifer to the well (plus the factor of safety).

The following is a summary of the two zones for wells and the calculated time-of-travel for each:

**Table 1. Definition of Zones**

<b>Zone</b>	<b>Definition</b>
A	Several months travel time
B	Less than 2 years time-of-travel

The time of travel for contaminants within the water varies with their unique physical and chemical characteristics.

The drinking water protection area outlined for the Midnight Sun Family Learning Center on Map 1 of Appendix A will serve as the focus for voluntary protection efforts.

**INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES**

Drinking Water Protection (DWP) has completed an inventory of potential and existing sources of contamination within the Midnight Sun Family Learning Center protection area. This inventory was completed through a search of agency records and other publicly available information. 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 A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic organic chemicals; and
- Other organic chemicals.

The sources are displayed on Map 2 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 each 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 combination of toxicity and volume associated with that source. Rankings include:

- Low
- Medium
- High
- Very High

Tables 2 through 7 in Appendix B contain the ranking of inventoried potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide and other inorganic chemicals, synthetic organic chemicals and other organic chemical

**VULNERABILITY OF MIDNIGHT SUN FAMILY LEARNING CENTER DRINKING WATER SYSTEM**

The vulnerability of public drinking water systems to regulated contaminants is determined by assessing the susceptibility of the wellhead, the susceptibility of the aquifer and the potential contaminant sources identified within the protection area.

The Drinking Water Protection developed a vulnerability assessment tool that assigns a vulnerability risk ranking based upon various factors associated with the well, aquifer and potential and existing contaminants identified within the protection area.

Factors contributing to the susceptibility of the wellhead are: whether the sanitary seal in place, protection from flooding, and if the well casing is properly grouted.

The wellhead for the Midnight Sun Family Learning Center received a **Low** susceptibility rating. Plan review information from 2004 indicates the well is capped with a sanitary seal, the land surface is sloped away from the well, and the well is grouted. A sanitary seal prevents potential contaminant 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.

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.

The aquifer the Midnight Sun Family Learning Center well is completed in received a **Medium** susceptibility rating. The material between the surface and aquifer is made up mostly of gravelly silt, which serves to moderately confine the aquifer and protect it from contaminants traveling through the soil from the surface. Table 2 summarizes the Susceptibility scores and ratings for Midnight Sun Family Learning Center.

**Table 2: Susceptibility**

	<b>Rating</b>
Susceptibility of the Wellhead	Low
Susceptibility of the Aquifer	Medium
Natural Susceptibility	Low

The Contaminant Risk has been 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.

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

**Table 3. Contaminant Risks**

<b>Category</b>	<b>Rating</b>
Bacteria and Viruses	Very High
Nitrates and/or Nitrites	Very High
Volatile Organic Chemicals	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	High
Synthetic Organic Chemicals	Low
Other Organic Chemicals	Low

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

$$\begin{aligned}
 &\text{Natural Susceptibility} \\
 &+ \\
 &\text{Contaminant Risks} \\
 &= \\
 &\text{Vulnerability of the} \\
 &\text{Drinking Water Source to Contamination}
 \end{aligned}$$

Table 4 contains the overall ratings for each of the six categories of drinking water contaminants.

**Table 4. Overall Vulnerability**

<b>Category</b>	<b>Rating</b>
Bacteria and Viruses	High
Nitrates and Nitrites	High
Volatile Organic Chemicals	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	Medium
Synthetic Organic Chemicals	Low
Other Organic Chemicals	Low

**Bacteria and Viruses**

Class V injection wells in the protection area represent the greatest risk for bacteria and viruses to the drinking water well. For a complete listing of potential sources for bacteria and virus contamination please see Table 2 in Appendix B.

Only a small amount of bacteria and viruses are required to endanger public health. Coliforms are found naturally in the environment and although they aren't necessarily a health threat, it is 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 (EPA, 2006). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2006). No samples have tested positive for coliforms in recent history.

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**

Class V injection wells in the protection area also represent the greatest risk to nitrates and nitrites for this source of public drinking water. For a complete listing of potential sources for nitrate and nitrite contamination please see Table 3 in Appendix B.

Nitrates are very mobile, moving at approximately the same rate as water. Nitrates have been detected at levels 25% of its maximum contaminant level (MCL=10mg/L) during recent sampling. In higher concentration nitrates/nitrites have been known to cause 'blue baby syndrome' in infants (EPA 2006).

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**

Septic systems represent the greatest identified risk for volatile organic chemical contamination to the well. For a complete listing of potential sources for bacteria and virus contamination please see Table 4 in Appendix B.

Volatile Organic Chemicals have not been detected within source waters. 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 low.

### **Heavy Metals, Cyanide, and Other Inorganic Chemicals**

Septic systems represent the greatest risk for inorganic chemicals to the well. For a complete listing of potential sources for bacteria and virus contamination please see Table 5 in Appendix B.

Arsenic was detected at 51% of its maximum contaminant level (MCL). The MCL for arsenic is 0.01 mg/L. In greater quantities, arsenic is known to cause skin damage, problems with circulatory systems, and

may create an increased risk of developing cancer (EPA, 2006).

After combining the contaminant risk for heavy metals, cyanide and other inorganic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is medium.

### **Synthetic Organic Chemicals**

Septic systems represent the greatest risk for synthetic organic chemicals to the well. For a complete listing of potential sources for bacteria and virus contamination please see Table 6 in Appendix B.

Synthetic organic chemicals have not been sampled for in this water system.

After combining the contaminant risk for synthetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

### **Other Organic Chemicals**

Septic systems represent the greatest risk for other organic chemicals to the well. For a complete listing of potential sources for bacteria and virus contamination please see Table 7 in Appendix B.

Other organic chemicals have not been sampled for in this water system.

After combining the contaminant risk for synthetic organic chemicals with the natural susceptibility of the well, the overall vulnerability of the well to contamination is low.

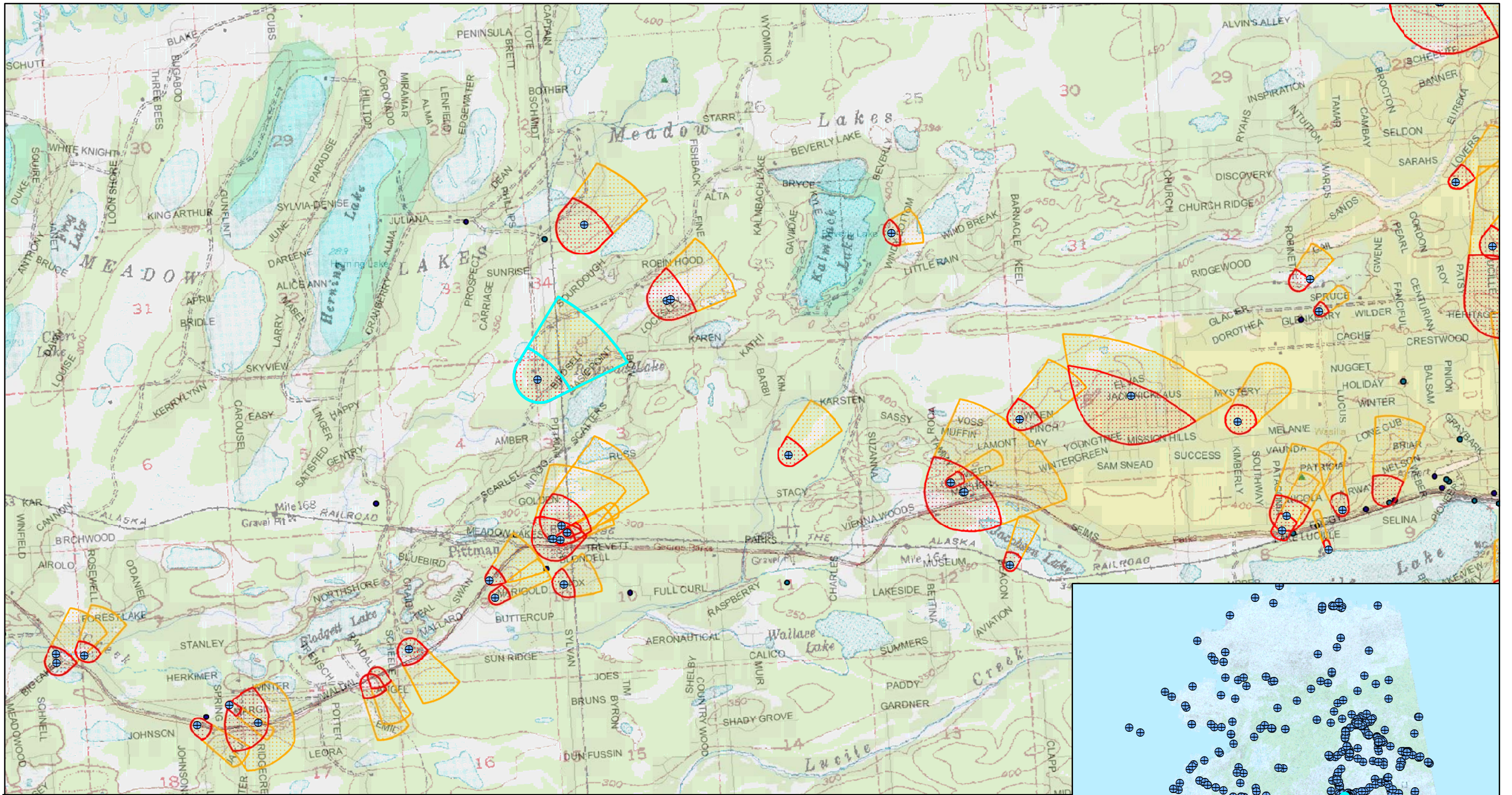
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## **APPENDIX A**

### **Midnight Sun Family Learning Center Drinking Water Protection Area Location Map (Map 1)**


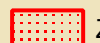
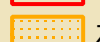


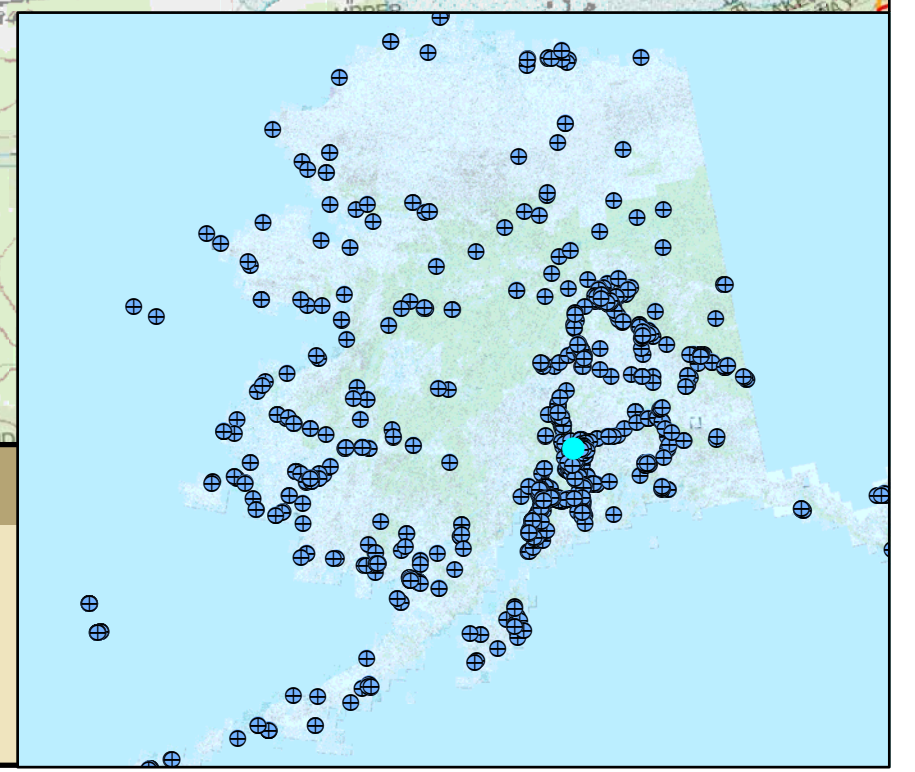
Map 1- Midnight Sun Family Learning and Surrounding Water Systems

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Data Sources:  
 Mat-Su Borough: Roads and parcels  
 Potential Sources of Contamination: ADEC

-  Public Water Sources
-  Zone A Protection Area
-  Zone B Protection Area



## **APPENDIX B**

### **Contaminant Source Inventory and Risk Ranking for Midnight Sun Family Learning Center (Tables 1-7)**

**Table 1**

**Contaminant Source Inventory for  
Midnight Sun Family Learning Center**

**PWSID 220098.001**

<b>Contaminant Source Type</b>	<b>Contaminant Source ID</b>	<b>CS ID tag</b>	<b>Zone</b>	<b>Map Number</b>	<b>Comments</b>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-2	A		
Septic systems (serves one single-family home)	R02	R02-1-5	A		Zone A has 5 residential septic systems
Highways and roads, dirt/gravel	X24	X24-1-2	A		2 roads
Construction trade areas and materials	C09	C09-1	B		
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B		Zone B has 1 large capacity septic systems
Septic systems (serves one single-family home)	R02	R02-6-35	B		Zone B has 29 residential septic systems
Highways and roads, dirt/gravel	X24	X24-3-5	B		2 roads

**Table 2**

*Contaminant Source Inventory and Risk Ranking for  
Midnight Sun Family Learning Center  
Sources of Bacteria and Viruses*

**PWSID 220098.001**

<b>Contaminant Source Type</b>	<b>Contaminant Source ID</b>	<b>CS ID tag</b>	<b>Zone</b>	<b>Risk Ranking for Analysis</b>	<b>Map Number</b>	<b>Comments</b>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-2	A	High		
Septic systems (serves one single-family home)	R02	R02-1-5	A	Low		Zone A has 5 residential septic systems
Highways and roads, dirt/gravel	X24	X24-1-2	A	Low		2 roads
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	High		Zone B has 1 large capacity septic systems
Septic systems (serves one single-family home)	R02	R02-6-35	B	Low		Zone B has 29 residential septic systems
Highways and roads, dirt/gravel	X24	X24-3-5	B	Low		2 roads

**Table 3**

*Contaminant Source Inventory and Risk Ranking for  
Midnight Sun Family Learning Center  
Sources of Nitrates/Nitrites*

**PWSID 220098.001**

<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>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-2	A	High		
Septic systems (serves one single-family home)	R02	R02-1-5	A	Low		Zone A has 5 residential septic systems
Highways and roads, dirt/gravel	X24	X24-1-2	A	Low		2 roads
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	High		Zone B has 1 large capacity septic systems
Septic systems (serves one single-family home)	R02	R02-6-35	B	Low		Zone B has 29 residential septic systems
Highways and roads, dirt/gravel	X24	X24-3-5	B	Low		2 roads

Table 4

*Contaminant Source Inventory and Risk Ranking for  
Midnight Sun Family Learning Center  
Sources of Volatile Organic Chemicals*

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<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>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-2	A	Low		
Septic systems (serves one single-family home)	R02	R02-1-5	A	Low		Zone A has 5 residential septic systems
Highways and roads, dirt/gravel	X24	X24-1-2	A	Low		2 roads
Construction trade areas and materials	C09	C09-1	B	Low		
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	Low		Zone B has 1 large capacity septic systems
Septic systems (serves one single-family home)	R02	R02-6-35	B	Low		Zone B has 29 residential septic systems
Highways and roads, dirt/gravel	X24	X24-3-5	B	Low		2 roads

Table 5

*Contaminant Source Inventory and Risk Ranking for  
Midnight Sun Family Learning Center  
Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

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<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>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-2	A	Low		
Septic systems (serves one single-family home)	R02	R02-1-5	A	Low		Zone A has 5 residential septic systems
Highways and roads, dirt/gravel	X24	X24-1-2	A	Low		2 roads
Construction trade areas and materials	C09	C09-1	B	Low		
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	Low		Zone B has 1 large capacity septic systems
Septic systems (serves one single-family home)	R02	R02-6-35	B	Low		Zone B has 29 residential septic systems
Highways and roads, dirt/gravel	X24	X24-3-5	B	Low		2 roads



**Table 6**

*Contaminant Source Inventory and Risk Ranking for  
Midnight Sun Family Learning Center  
Sources of Synthetic Organic Chemicals*

**PWSID 220098.001**

<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>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-2	A	Low		
Septic systems (serves one single-family home)	R02	R02-1-5	A	Low		Zone A has 5 residential septic systems
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	Low		Zone B has 1 large capacity septic systems
Septic systems (serves one single-family home)	R02	R02-6-35	B	Low		Zone B has 29 residential septic systems

**Table 7**

*Contaminant Source Inventory and Risk Ranking for  
Midnight Sun Family Learning Center  
Sources of Other Organic Chemicals*

**PWSID 220098.001**

<b>Contaminant Source Type</b>	<b>Contaminant Source ID</b>	<b>CS ID tag</b>	<b>Zone</b>	<b>Risk Ranking for Analysis</b>	<b>Map Number</b>	<b>Comments</b>
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-1-2	A	Low		
Septic systems (serves one single-family home)	R02	R02-1-5	A	Low		Zone A has 5 residential septic systems
Highways and roads, dirt/gravel	X24	X24-1-2	A	Low		2 roads
Construction trade areas and materials	C09	C09-1	B	Low		
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-3	B	Low		Zone B has 1 large capacity septic systems
Septic systems (serves one single-family home)	R02	R02-6-35	B	Low		Zone B has 29 residential septic systems
Highways and roads, dirt/gravel	X24	X24-3-5	B	Low		2 roads

## **APPENDIX C**

### **Midnight Sun Family Learning Center Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)**



Map 2- Midnight Sun Family Learning Potential Contaminant Sources

PWSID: 220098.001



0 1:5,717 Feet 1,480

Data Sources:  
 Mat-Su Borough: Roads and parcels  
 Potential Sources of Contamination: ADEC

	Zone A Protection Area
	Zone B Protection Area
	Public Water Sources
	Septics
	Construction Trade Area
	Roads