Source Water Assessment

A Hydrogeologic Susceptibility and Vulnerability Assessment for Sterling Moose River Manor Well Public Drinking Water System, Sterling, Alaska PWSID# 249099.001

DRINKING WATER PROTECTION REPORT 1862

Alaska Department of Environmental Conservation

March, 2011

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The Drinking Water Protection (DWP) team 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 DWP staff at #1-866-956-7656.

March, 2011

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EXECUTIVE SUMMARY

The public water system for Sterling Moose River Manor Well is a Community Water System (CWS) consisting of one well. The well addressed by this report (WL001), is located on 34425 Sterling Highway, Sterling, Alaska. An assessment of the susceptibility of the wellhead and aquifer to contamination, and the vulnerability of the public water system to potential and existing contamination were evaluated as of March 2011. The wellhead 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. Identified potential and existing sources of contamination for the Sterling Moose River Manor Well public drinking water system include sewer lines, large-capacity septic systems, motor vehicle waste disposal wells, residential areas, residential septic systems, contaminated sites, roads, body shops, gasoline station, RV park and dump station, junk yard, quarries, lumber processing, underground storage tanks, airports, and pipelines. These are considered 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). Additionally, a presumably natural source of arsenic is also present.

Combining the natural susceptibility of the well with the six (6) contaminant risk categories, the public water system for Sterling Moose River Manor Well received an overall vulnerability rating of **High** for bacteria and viruses**,** nitrates and/or nitrites, VOCs, heavy metals, cyanide, and other inorganic chemicals, and OOCs, and **Medium** for SOCs.

STERLING MOOSE RIVER MANOR WELL PUBLIC DRINKING WATER SYSTEM

Sterling Moose River Manor Well public water system is a Community Water System. The system consists of one well; the well evaluated in this report is located at the Sumpter Subdivision, Block 2, Lot 2, Sterling, Alaska (T 5N, R 9W, Sec 12, Seward Meridian) (See Map 1 of Appendix A). Sterling is a community located near the confluence of the Moose and Kenai Rivers in the Kenai Peninsula Borough in Southcentral Alaska (Please see the inset of Map 1 in Appendix A for location). The Borough's current population is approximately 53,602, and Sterling's current population is approximately 5,348 (ADCCED 2009). Communities located within the Borough include: Anchor Point, Bear Creek, Beluga, Clam Gulch, Cohoe, Cooper Landing, Crown Point, Diamond Ridge, Fox River, Fritz Creek, Funny River, Halibut Cove, Happy Valley, Homer, Hope, Kachemak, Kalifornsky, Kasilof, Kenai, Lowell Point, Moose Pass, Nanwalek, Nikiski, Nikolaevsk, Ninilchik, Port Graham, Primrose, Ridgeway, Salamatof, Seldovia, Seldovia Village, Seward, Soldotna, Sterling, Sunrise, and Tyonek (ADCCED 2009). Many homes in this area are used only seasonally; occupied houses use fully plumbed individual water wells and septic tanks (ADCCED 2009). The Borough provides a refuse transfer facility at Mile 85 of the Sterling Highway (ADCCED 2009).

Sterling is located on the glaciated lowland plain of the Kenai Peninsula. The area has been subjected to repeated glacial advances from the surrounding mountains, including mountains on the west side of Cook Inlet. Past glacial advances have also blocked lower Cook Inlet, causing large lakes to form and inundate the Kenai Peninsula lowland plain (Karlstrom, T.N.V, 1964).

During Quaternary and Tertiary time, at least five major glaciations affected the Kenai Peninsula as indicated by moraine locations and stratigraphy of the sediments deposited. Clay, silt, sand, and gravel were deposited or moved by glaciers, streams, lakes, and wind throughout the area (Glass, R.L., 1996). Water in these sand and gravel deposits occurs under perched, unconfined, semi-confined, and confined conditions and varies considerably in composition over short distances in the Sterling area (Munter, J.A. and Maurer, M.A., 1994).

The U.S. Soil Conservation Service has mapped several soil associations in and around the Sterling Area. The Soldotna and Cohoe Silt Loam types predominate the area, with smaller areas of Kichatna, Coal Creek, Foreland, Killey and Moose River, Longmare, Naptowne, Salamatof and Slikok types. Sterling Moose River Manor Well is located within the Soldotna Silt Loam type.

According to the well log for the Sterling Moose River Manor Well, the depth of the well is estimated at 187 feet below land surface (bls) and was finished in a confined aquifer. The well casing is perforated from 180 feet to 185 feet bls with a static water level of 26 feet bls. This well penetrated two relatively impermeable zones of blue clay from 60 to 86 feet bls, and from 99 feet to 106 feet bls. The aquifer appears to be under hydrostatic pressure based on a high static water level relative to the depth of the aquifer. Based on this, the well is assumed to be completed in a confined aquifer, or an aquifer under hydrostatic pressure.

The Sterling Moose River Manor Well public water system serves approximately thirty-three (33) residents through two (2) approved service connections.

STERLING MOOSE RIVER MANOR WELL 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 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 area are general for the Kenai Peninsula area and were obtained from various United States Geological Survey (USGS) reports, area well logs, and the Groundwater textbook by Freeze and Cherry (1979).

The drinking water protection areas (DWPAs) 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 input parameters describing the attributes of the aquifer in this calculation were adopted from the State of Alaska Department of Natural Resources (*Munter, J.A. and Maurer, M.A., 1994*).

The confined aquifer levels in the area of the Sterling Moose River Manor Well water system are not well-understood, but ground water generally flows toward the Moose and Kenai Rivers. The protection areas were drawn based on the regional topography. Groundwater in the confined aquifer of this area likely generally flows west to southeast.

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

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 DWPA for the Sterling Moose River Manor Well found 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 Sterling Moose River Manor Well DWPA. 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 Community public water system assessments, the following six categories of drinking water contaminants were inventoried:

- 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

The time-of-travel for contaminants within the water varies and is dependent on the physical and chemical characteristics of each contaminant.

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 STERLING MOOSE RIVER MANOR WELL PUBLIC 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 DWPA.

Drinking Water Protection staff 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 DWPA.

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 Sterling Moose River Manor Well received a **Low** susceptibility rating. The well log for the Sterling Moose River Manor Well indicates that the well is properly grouted. Photographs of the area surrounding the well show that the well is capped with a sanitary seal and the land surface is sloped away from the well. 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.

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 other wells and bore holes are penetrating the aquifer and, if applicable, and the characteristics of the confining layer.

The Sterling Moose River Manor Well draws water from a confined aquifer overlain by layers of clay. It received a **High** susceptibility rating because of the presence of wells penetrating the vadose zone in the protection zone. 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 Sterling Moose River Manor Well.

Table 2. Susceptibility

	Rating
Susceptibility of the Wellhead	Low
Susceptibility of the Aquifer	High
Natural Susceptibility	Low

The Contaminant Risk was 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

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

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

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

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

Table 4. Overall Vulnerability

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

Bacteria and Viruses

The large-capacity septic systems and sewage lagoon in the protection area represent the greatest risk for bacteria and viruses to the drinking water well.

Only a small amount of bacteria and viruses are required to endanger public health. Coliform bacteria 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 coliform bacteria and E. coli which only come from human and animal fecal waste (EPA, 2002). Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2002). No total coliform or fecal coliform have been detected for this well. 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 large-capacity septic systems and sewage lagoon in the protection area represent the greatest risk for nitrates and nitrites to this source of public drinking water.

Nitrates are very mobile, moving at approximately the same rate as water. Sampling history of the Sterling Moose River Manor Well indicates that low concentrations of nitrate have been detected. On 05/02/2007, 0.133 milligrams per liter (mg/L) of nitrate and/or nitrite was detected. This is 1% of the Maximum Contaminant Level (MCL) of 10 mg/L. The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans. Nitrate concentrations in uncontaminated groundwater are typically less than 2 mg/L and are primarily from the decomposition of organic matter in soils (Wang, Strelakos, Jokela, 2000). The levels detected in source waters are very low and are considered safe to drink.

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 motor vehicle waste disposal wells, coal mining, contaminated sites, gasoline stations, underground storage tanks and airport represent the greatest risk for volatile organic chemicals (VOCs) to the well.

VOCs 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 **High**.

Heavy Metals, Cyanide, and Other Inorganic Chemicals

The motor vehicle waste disposal wells, coal mining, and junk yard in the protection area and natural sources represent the greatest risk for inorganic chemicals to the well.

Heavy metals and other inorganic chemicals were collected on several occasions back to 2007. Chromium was detected well below its maximum contaminant level (MCL). Arsenic was detected multiple times: at 75% of the MCL on 05/02/2007, and at 94% the MCL on 09/20/2010. Arsenic has no man-

made source in this area and is presumed to be naturally occurring. One possible explanation for naturally occurring arsenic in Sterling Moose River Well source water is that the aquifer near the Moose and Kenai Rivers contain arsenic-bearing river sediments derived from Tertiary-age or older rocks (Munter, J.A. and Maurer, M.A., 1994).

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 **High**.

Synthetic Organic Chemicals

The coal mining, junk yard, lumber processing and airport represent the greatest risk for synthetic organic chemicals (SOCs) to the well.

SOCs have not been sampled for this well. After combining the contaminant risk for SOCs with the natural susceptibility of the well, the overall vulnerability of the well to contamination is **Medium**.

Other Organic Chemicals

The coal mining, junk yard and pipelines represent the greatest risk for other organic chemicals (OOCs) to the well.

OOCs have not been sampled from this well. After combining the contaminant risk for OOCs 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 Sterling Moose River Manor Well 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 the Sterling Moose River Manor Well drinking water source.

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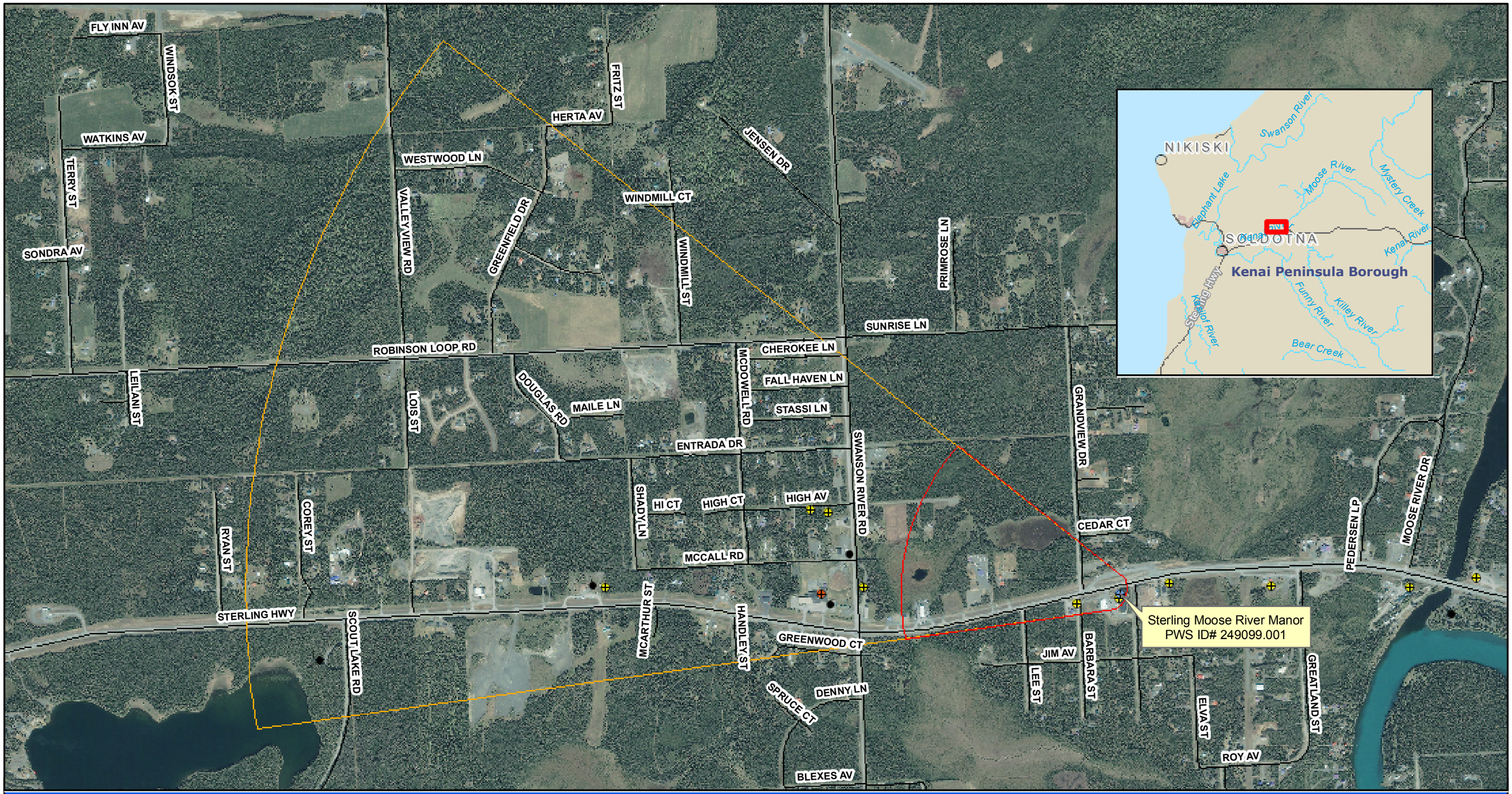
APPENDIX A

Sterling Moose River Manor Well
Drinking Water Protection Area Location Map
(Map 1)



Map 1 - Sterling Moose River Manor

PWS ID# 249099.001

Alaska Department of Environmental Conservation

0 0.125 0.25 0.5 Miles

N W E S

1:12,900

Public Water Systems

- Community water system (CWS) source (formerly: Class A)
- Non-transient, non-community (NTNC) water system source (formerly: Class A).
- Transient non-community (TNC) water system source (formerly: Class B).
- State-regulated Class C water system source.

Drinking Water Protections Areas

- Zone A: Several-month time-of-travel for groundwater sources.
- Zone B: Two-year time-of-travel for groundwater sources.

Data Sources:
Roads/Parcels: Kenai Peninsula Borough
Imagery: Alaska Mapped (SDMI and GINA)
Public Water Systems and Drinking Water Protection Areas: ADEC

Anne Gleason 08/11/2010

APPENDIX B

Contaminant Source Inventory and Risk Ranking for Sterling Moose River Manor Well (Tables 1-7)

Table 1

Contaminant Source Inventory for ***STERLING MOOSE RIVER MANOR***

PWSID 249099.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-04	A	2	Identified 4 sewerlines within Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01-03	A	2	Identfied 3 systems in Zone A
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01-02	A	2	Identified 2 Service Garages in Zone A
Coal mining (active)	E01	E01-01	A	2	Covers both Zones A and B
Residential Areas	R01	R01-01-10	A	2	Identified ~10 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-01-02	A	2	Identified 2 Singe Family Residences in Zone A
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	2	Swanson River Tank Setting 3-9 (Unocal) on Mi 17.5 Swanson River Rd., Sterling, AK 99672. Status: Active. Contaminants: BTEX, GRO. Source is flare stack sump. ETM Ranking for GW Ingestion is Future Exposure as of 5/8/2007.
Water supply wells	W09	W09-01	A	2	Depth: 90'; Sterling Highway
Water supply wells	W09	W09-02	A	2	Depth: 93'; Sterling Highway near Barbara Street
Highways and roads, paved (cement or asphalt)	X20	X20-01-04	A	2	Identified 4 roads within Zone A
Body shops (automotive)	C05	C05-01	B	2	Custom Automotive Refinishing @ 35970 Robinson Loop Rd, Sterling, AK 99672
Gasoline stations (without repair shop)	C15	C15-01	B	2	Zip Mart @ 38540 Swanson River Rd, Sterling, AK 99672
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-05-33	B	2	Identified 29 sewerlines within Zone B
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	2	Swanson River Road Sewage Lagoon - Kenai Pumping
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04-10	B	2	Identified 7 systems within Zone B
RV dump stations	D18	D18-01	B	2	35049 Sterling Hwy, Sterling, AK.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-03	B	2	Identified 1 Service Garage within Zone B
Scrap, salvage, or junk yards	D59	D59-01	B	2	Pit is inactive and used as a junkyard for 300 abandoned vehicles.
Quarries (sand, gravel, rock, other)	E10	E10-01	B	2	Pit is inactive and used as a junkyard for 300 abandoned vehicles.
Lumber processing and preservation	N04	N04-01	B	2	Alaskan Mountain Timber/Timber Quest Construction/Alaska Quality Log Homes @ 34325 Sterling Hwy
Residential Areas	R01	R01-11-478	B	2	Identified ~468 acres of residential area in Zone B

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-03-138	B	2	Identified 136 Single Family Residence Septic Systems within Zone B
Tanks, diesel (underground)	T08	T08-01	B	2	Zip Mart @ 38540 Swanson River Rd., Sterling, AK 99672
Tanks, gasoline (underground)	T12	T12-01	B	2	Zip Mart @ 38540 Swanson River Rd., Sterling, AK 99672
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	B	2	Swanson River Tank Setting 2-15 (Unocal) @ Mi. 17.5 Swanson River Rd., Sterling, AK. Status: Active. Contaminants: BTEX, DRO, Propylene Glycol. Source is pipe/line, flare stack sump. ETM Ranking for GW Ingestion is Future Exposure as of 05/08/2007.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-03	B	2	Chumley's Urethane @ 35840 Sterling Highway. Status: Cleanup Complete. Contaminant: DRO. Source: Diesel Fuel Releas, Fuel Dispensing System. ETM Ranking for GW Ingestion: Low Potential Exposure as of 3/4/2008 to De Minimis Exposure as of 5/21/2010.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	B	2	ZipMart Store - Sterling (Whittier Properties) @ 38525 Swanson River Rd, Sterling Heights Subd. Status: Active. Contaminants: BTEX, GRO. Source: UST Gasoline Release, UST. ETM Ranking for GW Ingestion: High Potential Exposure as of 03/13/2007.
Water supply wells	W09	W09-03	B	2	Depth: 75'; Sterling Highway and Swanson River Road
Water supply wells	W09	W09-04	B	2	Depth: 60'; Sterling Highway and Scout Lake Road
Water supply wells	W09	W09-05	B	2	Depth: 63'; Sterling Highway
Water supply wells	W09	W09-06	B	2	Depth: 270'; Sterling Highway and Swanson River Road
Water supply wells	W09	W09-07	B	2	Depth: 54'; McCall Road and Swanson River Road
Water supply wells	W09	W09-08	B	2	Depth: 81'; High Avenue and Swanson River Road
Water supply wells	W09	W09-09	B	2	Depth: 38'; Swanson River Avenue.
Water supply wells	W09	W09-10	B	2	Depth: 80'; High Avenue
Water supply wells	W09	W09-11	B	2	Depth: 74'; Sterling Highway
Airports	X14	X14-01	B	2	Landing Strip
Highways and roads, paved (cement or asphalt)	X20	X20-05-33	B	2	Identified 29 roads within Zone B
Pipelines (oil and gas)	X28	X28-01	B	2	12" and 16" Pipelines
Pipelines (oil and gas)	X28	X28-02	B	2	12" Pipeline
Campgrounds and RV Parks	X35	X35-01	B	2	Sterling Gifts & Campgrounds/Alaska Canoe & Campgrounds @ 35292 Sterling Hwy

Table 2

Contaminant Source Inventory and Risk Ranking for STERLING MOOSE RIVER MANOR Sources of Bacteria and Viruses

PWSID 249099.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-04	A	Medium	2	Identified 4 sewerlines within Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01-03	A	High	2	Identfied 3 systems in Zone A
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01-02	A	Low	2	Identified 2 Service Garages in Zone A
Residential Areas	R01	R01-01-10	A	Low	2	Identified ~10 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-01-02	A	Low	2	Identified 2 Singe Family Residences in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-01-04	A	Low	2	Identified 4 roads within Zone A
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-05-33	B	Medium	2	Identified 29 sewerlines within Zone B
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	High	2	Swanson River Road Sewage Lagoon - Kenai Pumping
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04-10	B	High	2	Identified 7 systems within Zone B
RV dump stations	D18	D18-01	B	Low	2	35049 Sterling Hwy, Sterling, AK.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-03	B	Low	2	Identified 1 Service Garage within Zone B
Residential Areas	R01	R01-11-478	B	Low	2	Identified ~468 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R02-03-138	B	Low	2	Identified 136 Single Family Residence Septic Systems within Zone B
Highways and roads, paved (cement or asphalt)	X20	X20-05-33	B	Low	2	Identified 29 roads within Zone B
Campgrounds and RV Parks	X35	X35-01	B	Low	2	Sterling Gifts & Campgrounds/Alaska Canoe & Campgrounds @ 35292 Sterling Hwy

Table 3

Contaminant Source Inventory and Risk Ranking for STERLING MOOSE RIVER MANOR Sources of Nitrates/Nitrites

PWSID 249099.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-04	A	Medium	2	Identified 4 sewerlines within Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01-03	A	High	2	Identfied 3 systems in Zone A
Residential Areas	R01	R01-01-10	A	Low	2	Identified ~10 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-01-02	A	Low	2	Identified 2 Singe Family Residences in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-01-04	A	Low	2	Identified 4 roads within Zone A
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-05-33	B	Medium	2	Identified 29 sewerlines within Zone B
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	High	2	Swanson River Road Sewage Lagoon - Kenai Pumping
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04-10	B	High	2	Identified 7 systems within Zone B
RV dump stations	D18	D18-01	B	Low	2	35049 Sterling Hwy, Sterling, AK.
Quarries (sand, gravel, rock, other)	E10	E10-01	B	Low	2	Pit is inactive and used as a junkyard for 300 abandoned vehicles.
Residential Areas	R01	R01-11-478	B	Low	2	Identified ~468 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R02-03-138	B	Low	2	Identified 136 Single Family Residence Septic Systems within Zone B
Airports	X14	X14-01	B	Low	2	Landing Strip
Highways and roads, paved (cement or asphalt)	X20	X20-05-33	B	Low	2	Identified 29 roads within Zone B
Campgrounds and RV Parks	X35	X35-01	B	Low	2	Sterling Gifts & Campgrounds/Alaska Canoe & Campgrounds @ 35292 Sterling Hwy

Table 4

Contaminant Source Inventory and Risk Ranking for STERLING MOOSE RIVER MANOR Sources of Volatile Organic Chemicals

PWSID 249099.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-04	A	Low	2	Identified 4 sewerlines within Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01-03	A	Low	2	Identfied 3 systems in Zone A
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01-02	A	High	2	Identified 2 Service Garages in Zone A
Coal mining (active)	E01	E01-01	A	High	2	Covers both Zones A and B
Residential Areas	R01	R01-01-10	A	Low	2	Identified ~10 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-01-02	A	Low	2	Identified 2 Singe Family Residences in Zone A
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-01	A	High	2	Swanson River Tank Setting 3-9 (Unocal) on Mi 17.5 Swanson River Rd., Sterling, AK 99672. Status: Active. Contaminants: BTEX, GRO. Source is flare stack sump. ETM Ranking for GW Ingestion is Future Exposure as of 5/8/2007.
Highways and roads, paved (cement or asphalt)	X20	X20-01-04	A	Low	2	Identified 4 roads within Zone A
Body shops (automotive)	C05	C05-01	B	Medium	2	Custom Automotive Refinishing @ 35970 Robinson Loop Rd, Sterling, AK 99672
Gasoline stations (without repair shop)	C15	C15-01	B	High	2	Zip Mart @ 38540 Swanson River Rd, Sterling, AK 99672
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-05-33	B	Low	2	Identified 29 sewerlines within Zone B
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	Low	2	Swanson River Road Sewage Lagoon - Kenai Pumping
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04-10	B	Low	2	Identified 7 systems within Zone B
RV dump stations	D18	D18-01	B	Low	2	35049 Sterling Hwy, Sterling, AK.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-03	B	High	2	Identified 1 Service Garage within Zone B
Scrap, salvage, or junk yards	D59	D59-01	B	Low	2	Pit is inactive and used as a junkyard for 300 abandoned vehicles.

Table 4 (continued)

Contaminant Source Inventory and Risk Ranking for STERLING MOOSE RIVER MANOR Sources of Volatile Organic Chemicals

PWSID 249099.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Quarries (sand, gravel, rock, other)	E10	E10-01	B	Low	2	Pit is inactive and used as a junkyard for 300 abandoned vehicles.
Lumber processing and preservation	N04	N04-01	B	Medium	2	Alaskan Mountain Timber/Timber Quest Construction/Alaska Quality Log Homes @ 34325 Sterling Hwy
Residential Areas	R01	R01-11-478	B	Low	2	Identified ~468 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R02-03-138	B	Low	2	Identified 136 Single Family Residence Septic Systems within Zone B
Tanks, diesel (underground)	T08	T08-01	B	High	2	Zip Mart @ 38540 Swanson River Rd., Sterling, AK 99672
Tanks, gasoline (underground)	T12	T12-01	B	High	2	Zip Mart @ 38540 Swanson River Rd., Sterling, AK 99672
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-02	B	High	2	Swanson River Tank Setting 2-15 (Unocal) @ Mi. 17.5 Swanson River Rd., Sterling, AK. Status: Active. Contaminants: BTEX, DRO, Propylene Glycol. Source is pipe/line, flare stack sump. ETM Ranking for GW Ingestion is Future Exposure as of 05/08/2007.
Contaminated sites, DEC recognized, non-Superfund, non-RCRA	U04	U04-03	B	Low	2	Chumley's Urethane @ 35840 Sterling Highway. Status: Cleanup Complete. Contaminant: DRO. Source: Diesel Fuel Releas, Fuel Dispensing System. ETM Ranking for GW Ingestion: Low Potential Exposure as of 3/4/2008 to De Minimis Exposure as of 5/21/2010.
Open Leaking Underground Fuel Storage Tank (LUST) Sites	U07	U07-01	B	Very High	2	ZipMart Store - Sterling (Whittier Properties) @ 38525 Swanson River Rd, Sterling Heights Subd. Status: Active. Contaminants: BTEX, GRO. Source: UST Gasoline Release, UST. ETM Ranking for GW Ingestion: High Potential Exposure as of 03/13/2007.
Airports	X14	X14-01	B	High	2	Landing Strip
Highways and roads, paved (cement or asphalt)	X20	X20-05-33	B	Low	2	Identified 29 roads within Zone B
Pipelines (oil and gas)	X28	X28-01	B	Medium	2	12" and 16" Pipelines
Pipelines (oil and gas)	X28	X28-02	B	Medium	2	12" Pipeline
Campgrounds and RV Parks	X35	X35-01	B	Low	2	Sterling Gifts & Campgrounds/Alaska Canoe & Campgrounds @ 35292 Sterling Hwy

Table 5

Contaminant Source Inventory and Risk Ranking for STERLING MOOSE RIVER MANOR

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

PWSID 249099.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-04	A	Low	2	Identified 4 sewerlines within Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01-03	A	Low	2	Identfied 3 systems in Zone A
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01-02	A	High	2	Identified 2 Service Garages in Zone A
Coal mining (active)	E01	E01-01	A	Very High	2	Covers both Zones A and B
Residential Areas	R01	R01-01-10	A	Low	2	Identified ~10 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-01-02	A	Low	2	Identified 2 Singe Family Residences in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-01-04	A	Low	2	Identified 4 roads within Zone A
Body shops (automotive)	C05	C05-01	B	Medium	2	Custom Automotive Refinishing @ 35970 Robinson Loop Rd, Sterling, AK 99672
Gasoline stations (without repair shop)	C15	C15-01	B	Low	2	Zip Mart @ 38540 Swanson River Rd, Sterling, AK 99672
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-05-33	B	Low	2	Identified 29 sewerlines within Zone B
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	Low	2	Swanson River Road Sewage Lagoon - Kenai Pumping
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04-10	B	Low	2	Identified 7 systems within Zone B
RV dump stations	D18	D18-01	B	Low	2	35049 Sterling Hwy, Sterling, AK.
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-03	B	High	2	Identified 1 Service Garage within Zone B
Scrap, salvage, or junk yards	D59	D59-01	B	High	2	Pit is inactive and used as a junkyard for 300 abandoned vehicles.
Lumber processing and preservation	N04	N04-01	B	Medium	2	Alaskan Mountain Timber/Timber Quest Construction/Alaska Quality Log Homes @ 34325 Sterling Hwy
Residential Areas	R01	R01-11-478	B	Low	2	Identified ~468 acres of residential area in Zone B

Contaminant Source Inventory and Risk Ranking for STERLING MOOSE RIVER MANOR

Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-03-138	B	Low	2	Identified 136 Single Family Residence Septic Systems within Zone B
Tanks, gasoline (underground)	T12	T12-01	B	Medium	2	Zip Mart @ 38540 Swanson River Rd., Sterling, AK 99672
Airports	X14	X14-01	B	Low	2	Landing Strip
Highways and roads, paved (cement or asphalt)	X20	X20-05-33	B	Low	2	Identified 29 roads within Zone B
Pipelines (oil and gas)	X28	X28-01	B	Low	2	12" and 16" Pipelines
Pipelines (oil and gas)	X28	X28-02	B	Low	2	12" Pipeline

Table 6

Contaminant Source Inventory and Risk Ranking for STERLING MOOSE RIVER MANOR Sources of Synthetic Organic Chemicals

PWSID 249099.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-04	A	Low	2	Identified 4 sewerlines within Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01-03	A	Low	2	Identfied 3 systems in Zone A
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01-02	A	Low	2	Identified 2 Service Garages in Zone A
Coal mining (active)	E01	E01-01	A	Medium	2	Covers both Zones A and B
Residential Areas	R01	R01-01-10	A	Low	2	Identified ~10 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-01-02	A	Low	2	Identified 2 Singe Family Residences in Zone A
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-05-33	B	Low	2	Identified 29 sewerlines within Zone B
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	Low	2	Swanson River Road Sewage Lagoon - Kenai Pumping
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04-10	B	Low	2	Identified 7 systems within Zone B
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-03	B	Low	2	Identified 1 Service Garage within Zone B
Scrap, salvage, or junk yards	D59	D59-01	B	Medium	2	Pit is inactive and used as a junkyard for 300 abandoned vehicles.
Lumber processing and preservation	N04	N04-01	B	Medium	2	Alaskan Mountain Timber/Timber Quest Construction/Alaska Quality Log Homes @ 34325 Sterling Hwy
Residential Areas	R01	R01-11-478	B	Low	2	Identified ~468 acres of residential area in Zone B
Septic systems (serves one single-family home)	R02	R02-03-138	B	Low	2	Identified 136 Single Family Residence Septic Systems within Zone B
Airports	X14	X14-01	B	Medium	2	Landing Strip

Table 7

Contaminant Source Inventory and Risk Ranking for STERLING MOOSE RIVER MANOR Sources of Other Organic Chemicals

PWSID 249099.001

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-04	A	Low	2	Identified 4 sewerlines within Zone A
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01-03	A	Low	2	Identfied 3 systems in Zone A
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01-02	A	Medium	2	Identified 2 Service Garages in Zone A
Coal mining (active)	E01	E01-01	A	High	2	Covers both Zones A and B
Residential Areas	R01	R01-01-10	A	Low	2	Identified ~10 acres of residential area in Zone A
Septic systems (serves one single-family home)	R02	R02-01-02	A	Low	2	Identified 2 Singe Family Residences in Zone A
Highways and roads, paved (cement or asphalt)	X20	X20-01-04	A	Low	2	Identified 4 roads within Zone A
Body shops (automotive)	C05	C05-01	B	Medium	2	Custom Automotive Refinishing @ 35970 Robinson Loop Rd, Sterling, AK 99672
Gasoline stations (without repair shop)	C15	C15-01	B	Low	2	Zip Mart @ 38540 Swanson River Rd, Sterling, AK 99672
Domestic wastewater collection systems (sewer lines or lift stations)	D01	D01-05-33	B	Low	2	Identified 29 sewerlines within Zone B
Domestic wastewater treatment plant disposal ponds/lagoons	D02	D02-01	B	Low	2	Swanson River Road Sewage Lagoon - Kenai Pumping
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-04-10	B	Low	2	Identified 7 systems within Zone B
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-03	B	Medium	2	Identified 1 Service Garage within Zone B
Scrap, salvage, or junk yards	D59	D59-01	B	High	2	Pit is inactive and used as a junkyard for 300 abandoned vehicles.
Quarries (sand, gravel, rock, other)	E10	E10-01	B	Low	2	Pit is inactive and used as a junkyard for 300 abandoned vehicles.
Lumber processing and preservation	N04	N04-01	B	Medium	2	Alaskan Mountain Timber/Timber Quest Construction/Alaska Quality Log Homes @ 34325 Sterling Hwy
Residential Areas	R01	R01-11-478	B	Low	2	Identified ~468 acres of residential area in Zone B

Contaminant Source Type	*Contaminant Source ID*	*CS ID tag*	*Zone*	*Risk Ranking for Analysis*	*Map Number*	*Comments*
Septic systems (serves one single-family home)	R02	R02-03-138	B	Low	2	Identified 136 Single Family Residence Septic Systems within Zone B
Airports	X14	X14-01	B	Medium	2	Landing Strip
Highways and roads, paved (cement or asphalt)	X20	X20-05-33	B	Low	2	Identified 29 roads within Zone B
Pipelines (oil and gas)	X28	X28-01	B	High	2	12" and 16" Pipelines
Pipelines (oil and gas)	X28	X28-02	B	High	2	12" Pipeline

APPENDIX C

Sterling Moose River Manor Well
Drinking Water Protection Area
and Potential and Existing Contaminant Sources
(Map 2)

Identified the following in Zone B:
- 29 Roads
- 136 Residential Septics
- 7 High Capacity Septics
- 468 Residential Acres

Identified the following in Zone A:
- 4 Roads
- 2 Residential Septics
- 3 High Capacity Septics
- 10 Residential Acres

Sterling Moose River Manor
PWS ID# 249099.001

HERTA AV
WESTWOOD LN
VALLEYVIEW RD
GREENFIELD DR
RIDGECREST CIR
WINDMILL CT
WINDMILL ST
X28
D02
C05
ROBINSON LOOP RD
CHEROKEE LN
D59
E10
FALL HAVEN LN
E01
LOIS ST
DOUGLAS RD
MAILE LN
MCDOWELL RD
STASSI LN
ENTRADA DR
SWANSON RIVER RD
HIGH AV
HI CT
HIGH CT
SHADYLN
U04
C15
T12
U07
MCCALL RD
X35
GRANDVIEW DR
COREY ST
N04
STERLING HWY
D18
SCOUT LAKE RD
MCARTHUR ST
HANDLEY ST
GREENWOOD CT
LEE ST
BARBARA ST
X14

Map 2 - Sterling Moose River Manor

PWS ID# 249099.001

Alaska Department of Environmental Conservation

Data Sources:
Roads/Parcels: Kenai Peninsula Borough
Imagery: Alaska Mapped (SDMI and GINA)
Public Water Systems, Drinking Water Protection Areas and Potential Sources of Contamination: ADEC

0 0.125 0.25 0.5 Miles

1:12,000

N W E S

Public Water Systems
- Community water system (CWS) source (formerly: Class A)
- Non-transient, non-community (NTNC) water system source (formerly: Class A).
- Transient non-community (TNC) water system source (formerly: Class B).
- State-regulated Class C water system source.

Drinking Water Protections Areas
- Zone A: Several-month time-of-travel for groundwater sources.
- Zone B: Two-year time-of-travel for groundwater sources.

Potential Sources of Contamination
- C05, Body shops (automotive)
- C15, Gasoline stations (without repair shop)
- D18, RV dump stations
- N04, Lumber processing and preservation
- T08, Tanks, diesel (underground)
- T12, Tanks, gasoline (underground)
- U04, Contaminated sites, DEC recognized, non-Superfund, non-RCRA
- U07, Open Leaking Underground Fuel Storage Tank (LUST) Sites
- X35, Campgrounds and RV Parks
- D10, Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)
- D42, Injection wells (Class V) Motor Vehicle Waste Disposal Well
- R02, Residential Septics
- D01, Sewerlines
- X28, Oil/Gas Pipelines
- D02, Domestic wastewater treatment plant disposa
- D59, Scrap, salvage, or junk yards
- E10, Quarries (sand, gravel, rock, other)
- U07, Open-Leaking Underground Storage Tank
- X14, Airports/Airstrips

Anne Gleason 02/22/2011