Achieving a healthy and affordable energy future, for itself and its fellow Alaskans, is Fairbanks' goal. Recognizing the probable negative ramifications of inaction—or wrong action—is what drives Fairbanks to pursue this goal.

# 4. FNSB Air Quality (PM 2.5)

Monitoring of particulate levels in urban areas within the Fairbanks North Star Borough continues to show daily exceedances of Federal limits, particularly during periods of temperature inversions. This chapter describes the status of the FNSB's particulate emissions issue.

## 4.1 Particulate Matter (PM) 2.5 Non-Attainment

The Fairbanks area is surrounded by hills on three sides and is susceptible to severe surface-based temperature inversions during the winter that stratify cold air near the ground. Coupled with low wind speeds, pollutants in the air get trapped up to weeks at a time and concentrate resulting in periods of poor air quality. Particulate matter is one of those pollutants. Fine particles that are 2.5 micrometers in diameter and smaller (PM 2.5) are unhealthy to breathe and have been associated with serious lung and heart problems. These particles are a mixture of microscopic solids and liquid droplets suspended in air. Sources of fine particles include all types of combustion activities (motor vehicles, power plants, wood burning, etc.) and certain industrial processes. Cold weather (near 0 degrees F and below) seems to increase the PM 2.5 levels in the Fairbanks area during temperature inversions.

In 1997, the EPA issued standards for PM 2.5 based on health studies and extensive peer review. The annual standard of 15 micrograms per cubic meter and 24-hour standard of 65 micrograms per cubic meter (µg/m3) is based on a three-year average of annual mean PM 2.5 concentrations. In September 2006, the EPA issued revised national air quality standards for PM 2.5. The daily PM 2.5 particle standard has been reduced from 65 to 35 µg/m3 of air.

In March 2007, EPA issued a rule defining requirements for states to clean the air in areas with levels of fine particle pollution that do not meet national air quality standards. EPA designates an area as "non-attainment" if it violates the fine particle standards over a three-year period. Once an area is designated as non-attainment, the Clean Air Act requires a state to submit an implementation plan to EPA within three years. This plan must include enforceable measures to reduce air pollutant emissions that form the fine particles in the atmosphere. The plan must also provide enforceable steps to attain the PM 2.5 standards and show how it will make reasonable progress toward meeting them.

States must meet the new PM 2.5 standard by 2010. In their 2008 implementation plans, states may propose an attainment date extension for up to five years. Those areas for which EPA approves an extension must achieve clean air as soon as possible, but no later than 2015.

In August 2007, the Alaska Dept. of Environmental Conservation (ADEC) published "Alaska's 2008 Air Monitoring Network Program." This document included the following statements concerning Fairbanks:

- "Fairbanks had consistently experienced the highest PM 2.5 values measured in the State."

- "Based on winter PM 2.5 levels, Fairbanks had been flirting with exceeding the annual fine particulate standard (set at 15 µg/sm3) for the past seven years. If [they are] exceeded, Fairbanks will need to control year-round PM pollution."

- "To address the needs of an Alaska PM 2.5 State Implementation Plan (SIP), the Fairbanks North Star Borough is expanding its monitoring network to better identify the magnitude, extent, and source of its winter PM 2.5 problems. This effort will see the addition of between three and five new monitoring sites operated during the winter months."

- "The 2007 PM 2.5 network so far only monitored the fine particles at the State Office Building."

### *4.1.1 FNSB Non-Attainment Boundary (PM 2.5)*

In December 2007, ADEC sent a letter to EPA recommending that, based on the past three years of ambient air monitoring data, EPA designate all areas of the State in attainment with the annual PM 2.5 standard of 15 µg/m3. The letter also stated that Fairbanks was the only Alaska community that had exceeded EPA's new 35 µg/m3 (24-hour) standard. Enclosed with the letter was supporting information that included a recommended boundary for a Fairbanks PM 2.5 (24-hour) non-attainment area. Following are excerpts from that document concerning the proposed PM 2.5 non-attainment boundary:

- "Ambient air monitoring has been conducted at one site in downtown Fairbanks since the PM 2.5 network was established in 1999. While this site does represent the level of fine particulates in the downtown area, there is nothing to confirm that PM 2.5 concentrations exceed State and Federal fine particulate standards outside of the urban center."

- "EPA recommends that states consider nine factors in making non-attainment boundary recommendations. These nine factors include: emission data, air quality data, population density and degree of urbanization (including commercial development), traffic and commuting patterns, growth rates and patterns, meteorology (weather/transport patterns), geography/topography (mountain ranges or other air basin boundaries), jurisdictional boundaries (e.g. counties, air districts, reservations, metropolitan planning organizations [MPOs]), and level of control of emission sources."

- "Based on a number of these factors, the department (ADEC), in consultation with the Fairbanks North Star Borough, has developed a recommended boundary for a PM 2.5 non-attainment area in Fairbanks. The proposed boundary captures the air shed most likely contributing to the exceedances in Fairbanks resulting in non-attainment of the health standard based on existing monitoring data and other factors listed above."

- "Because there is only one monitoring site in Fairbanks, the monitoring data and source characterization work derived from that site is most likely not representative of the source contributions throughout the entire area."

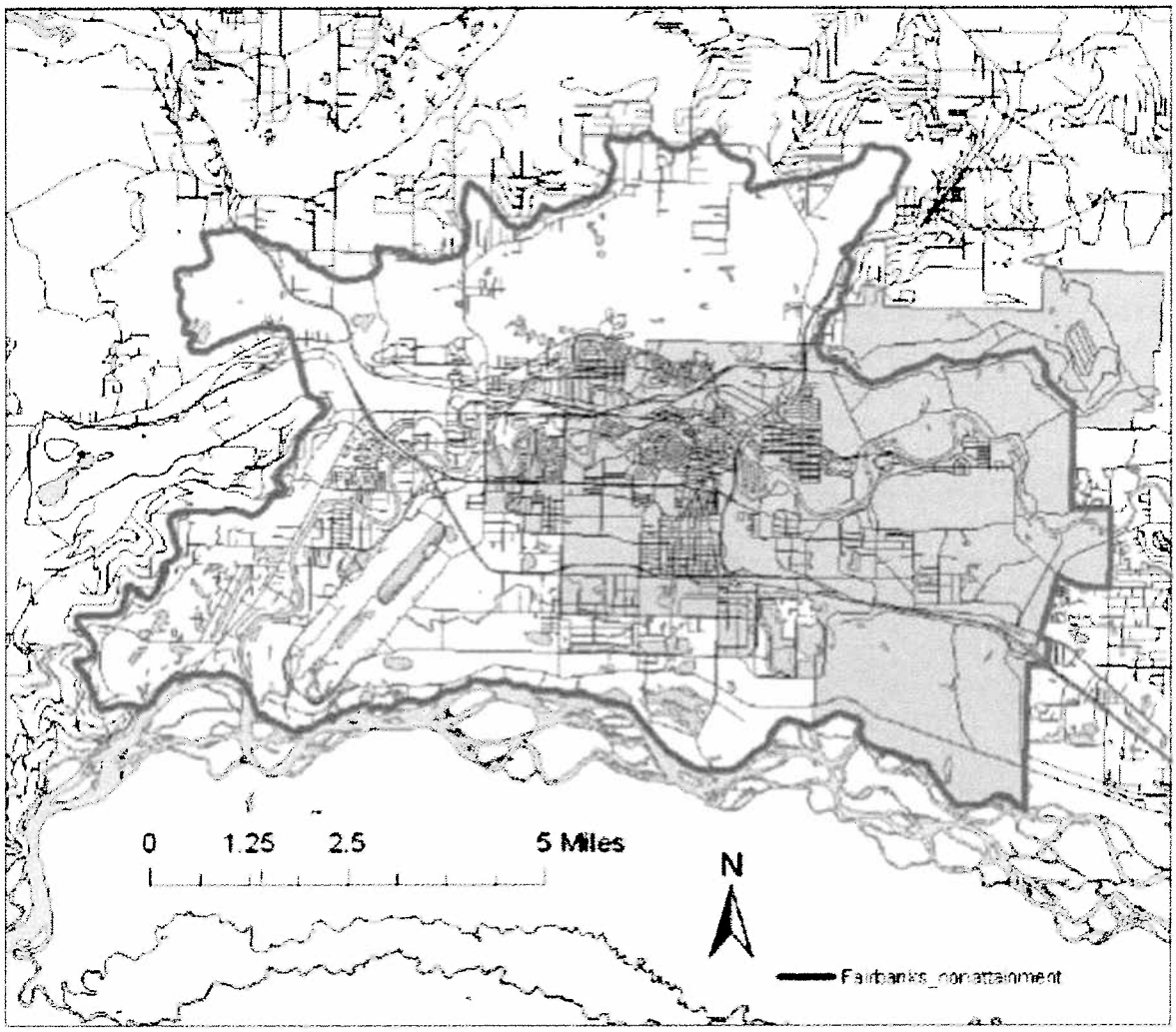
- "At this time, no monitoring data exist for the city of North Pole or other residential areas in the outlying valleys to the north of Fairbanks. At this time, there is insufficient information to suggest that North Pole or these other outlying populated areas have an air quality problem or are significantly contributing to the air quality violations occurring in downtown Fairbanks. Furthermore, some of the outlying populated areas are located at higher levels that are frequently above the inversion layer. Therefore, PM 2.5 concentrations are most likely lower than in downtown Fairbanks because areas above the inversion experience good exchange

with air masses aloft. For these reasons, they have been excluded from the proposed boundary."

- "As supplemental information and data are collected over the next several years, this boundary could be further refined. "

Figure 4-1 shows a map of the PM 2.5 non-attainment boundary originally proposed by ADEC and FNSB.

**Figure 4-1: FNSB's Proposed PM 2.5 Non-Attainment Boundary**




In 2007, FNSB installed a particle monitor at Nordale School and uses a mobile sniffer, known as the RAMS trailer, to gather air samples throughout the FNSB.

In April 2008, ADEC issued an updated "State Air Quality Control Plan." This document included the following statements concerning PM 2.5 emissions:

- "In a recent rulemaking with an effective date of December 18, 2006, EPA revised the level of the 24-hour PM 2.5 standard from 65 to 35 µg/m3. A review of monitoring data collected in Fairbanks in recent years shows summer values are generally low, approximately 7 µg/m3 (24-hour average), except when smoke from wildfires is transported into the downtown area (i.e., the location of the borough's PM 2.5 monitor). When this occurs, concentrations can become quite high (many multiples of the recently adopted 35 µg/m3 standard). Concentrations resulting from these conditions, however, can qualify as exceptional events. Winter values average approximately 23 µg/m3 (24-hour average), but episodically can exceed 50–60 µg/m3."

- "The entire State of Alaska is currently classified as in attainment of the PM 2.5 standard; however, barring a substantial change in wintertime concentrations, it is likely the State will recommend to EPA that Fairbanks be designated non-attainment of the revised 24-hour PM 2.5 standard in 2008/2009."

During the past three years, the Fairbanks area has exceeded the 2006 revised EPA PM 2.5 (24-hour) standard of 35 µg/m3 numerous days during the winter. Figure 4-2 shows the number of days the PM 2.5 (24-hour) standard was exceeded during the past five calendar years. The graph in Figure 4-3 shows the daily PM 2.5 (24-hour) levels in Fairbanks during the four winter months of November 2005 through February 2006.

**Figure 4-2: PM 2.5 Exceedances (2003-2008)**

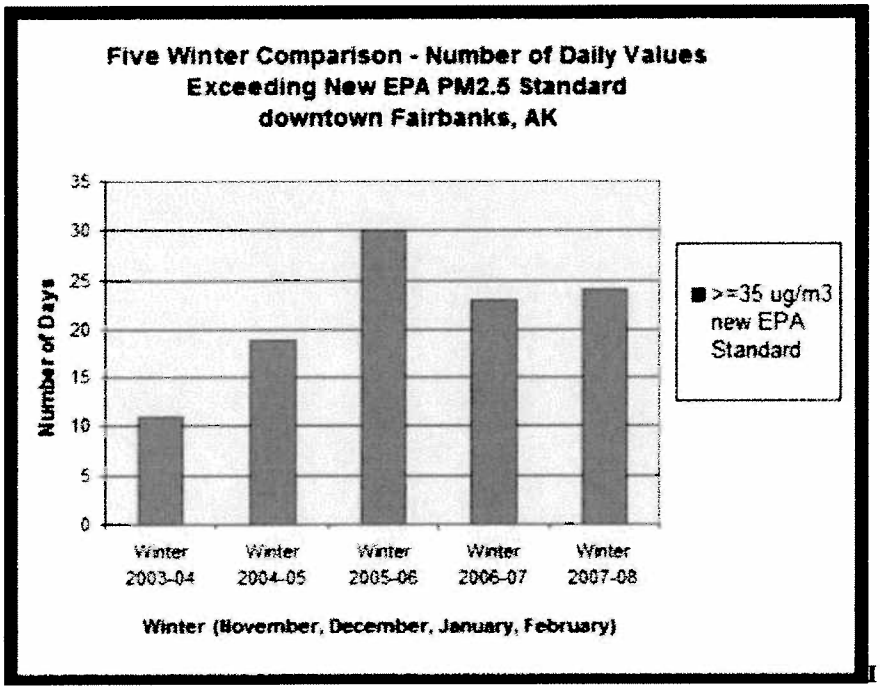
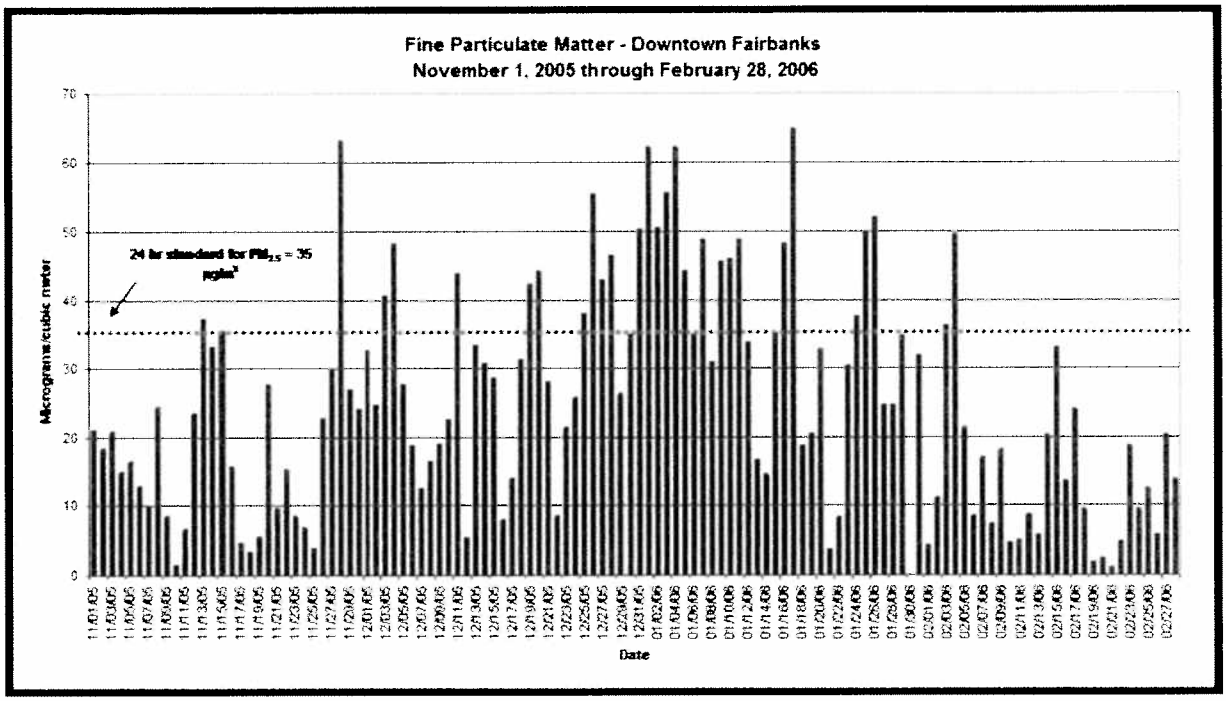
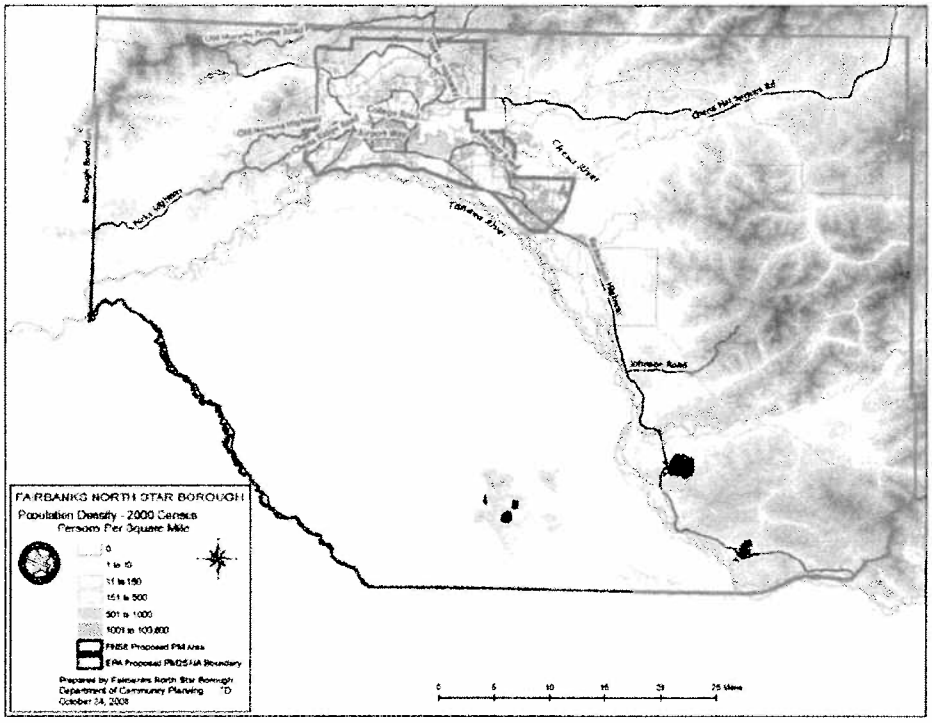



**Figure 4-3: Fairbanks Daily PM 2.5 Levels (Winter 2005-2006)**



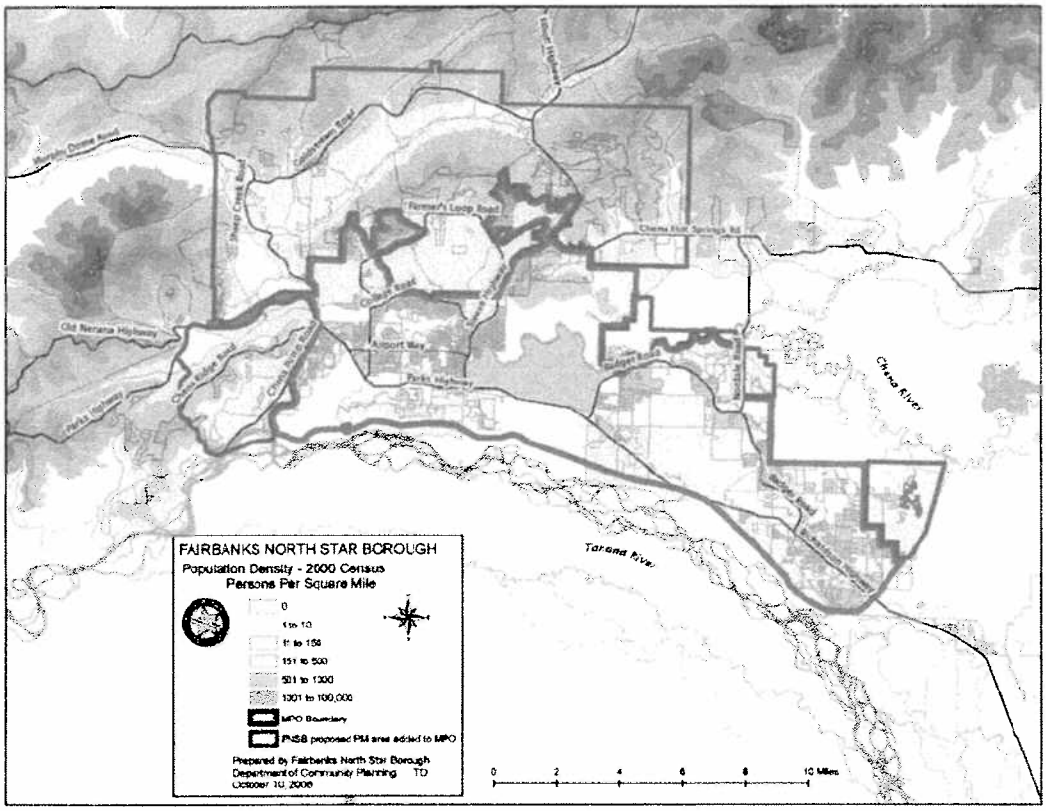

In August 2008, EPA sent a letter notifying the State of its intent to designate a portion of the Fairbanks North Star Borough (FNSB) as non-attainment and to modify Alaska's recommended FNSB non-attainment boundary. EPA encouraged the State to submit any additional information that EPA should consider concerning the FNSB PM 2.5 non-attainment boundary before October 20, 2008. Figure 4-4 shows EPA's proposed boundary. It encompasses a large area of the borough that has few or no people, such as the Tanana Flats. EPA plans to publish a notice in the Federal Register to solicit public comments on its decision and make final designation decisions for the 2006 PM 2.5 (24-hour) standard by December 18, 2008.

**Figure 4-4: EPA's Proposed PM 2.5 Non-Attainment Boundary**




In October 2008, the FNSB proposed a smaller PM 2.5 (24-hour) non-attainment boundary to EPA that is shown in Figure 4-5. An EPA decision on the non-attainment boundary is pending.

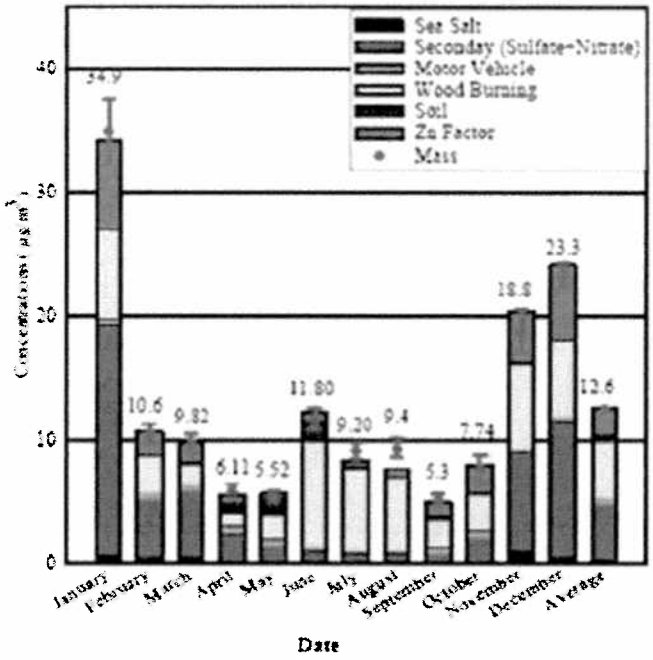
**Figure 4-5: FNSB's Adjusted PM 2.5 Non-Attainment Boundary**




## 4.2 PM 2.5 Particle Analysis

ADEC and FNSB have analyzed the samples collected in the ambient air monitors and identified possible sources of the PM 2.5 particles. They found that the winter samples contained about 40 to 55 percent of the fine PM 2.5 particles made of secondary sulfate and nitrate aerosols. Most of the remaining aerosol was contributed equally from wood burning emissions and an unknown zinc-related factor. Trace amounts were also identified as sea salt, motor vehicle emissions, and soil. Figure 4-6 summarizes these results.

**Figure 4-6: PM 2.5 Particle Analysis Results**




**Sulfite and Nitrate Aerosols:** The source of the sulfur and nitrate aerosols is most likely burning fuels that contain sulfur. Fairbanks vehicles burn significant amounts of gasoline and diesel fuel; however, the sulfur content of both fuels has been reduced dramatically in recent years. Low-sulfur diesel fuel contains 0.007 percent sulfur by weight. The sulfur content of fuel oil used for building heating contains about 0.22 percent sulfur. Although there are numerous sources in Fairbanks that burn fuel containing sulfur, the distillate fuel oils used in space heating could be a dominant source of the atmospheric sulfite and nitrate aerosols in Fairbanks during the winter.

**Wood Burning Emissions:** Heating fuel oil prices in Alaska have increased significantly during the past four years, and data from ADEC-sponsored building heating surveys show that more households and businesses have installed supplemental wood-burning heaters. The EPA estimates that wood stoves emit more pollutants than oil-fired furnaces—generally 30 to 250 times more particulates on a heat-equivalent basis.

**Zinc-based Emissions:** The source of the zinc found in the Fairbanks PM 2.5 particles is unknown at this time. Possible sources include burning of waste lubricating oils, motor vehicles burning lube oil, or distant sources of zinc mining and ore handling. Zinc is widely used as an additive in lubricating oils for diesel engines and, in lower concentrations, for gasoline-powered engines.

### *4.2.1 Expanded PM 2.5 Sampling Program*

Starting in 2007, the FNSB expanded monitoring to determine the extent of the elevated PM 2.5 emissions. This effort continued last winter (2007-08) with three new fixed monitoring sites, a re-locatable trailer, and a mobile monitor. One of the fixed sites was placed in the Hamilton Acres area to characterize the PM 2.5 in a neighborhood setting. The FNSB placed another fixed site downtown near the State Office Building, to support those monitors with new types of monitors

that will help differentiate the sources of the PM downtown such as mobile sources. The third fixed site is on south Peger Road and monitors the roadway contributions and the effect of mobile sources such as cars and commercial vehicles.

The trailer was placed in eleven different locations in and around the Fairbanks and North Pole areas, including varying altitudes to better assess the spatial extent and inversion/particulate layer height for PM 2.5 particles.

The mobile monitor drove extensively through neighborhoods and industrial areas throughout the Fairbanks and North Pole area as well as Goldstream Valley. FNSB is using these data to assess the spatial extent as well as the local effects of hot spots (outdoor wood boilers [OWBs], poorly running woodstoves, and high-emitting vehicles).

During 2008, the FNSB Air Quality Department refined and expanded its studies further with a new fixed site in North Pole and the addition of new "speciation" monitors that provide data on the chemical types within the collected PM particles. These new instruments will help apportion the source mixture of the PM and indicate the best way to reduce and maintain PM emissions in the future. The FNSB has also expanded its meteorological monitoring to help assess any transport of PM from outside the downtown area. New meteorological measuring equipment has been set up at the South Peger and Hamilton Acres sites, and will soon operate at the North Pole site.

These new "speciation" monitors will provide data to be input into the EPA's UNMIX model as well as a Chemical Mass Balance model to help differentiate between mobile source contributions and space heating. In addition to those analyses, the information from those monitors will be analyzed for key tracers of wood burning. This should allow us to separate the wood burning sources from the rest of the sources.

A better understanding of the Fairbanks basin microclimate and the meteorological patterns that cause severe inversions is necessary so we can prevent exceedances of the PM 2.5 by applying cost-effective emission reduction practices.

## 4.3 PM 2.5 Standard Non-Compliance Consequences

Areas that EPA classifies as non-attainment are subject to a Federal measure known as "transportation conformity." It requires local transportation and air quality officials to coordinate planning to ensure transportation projects (road construction, etc.) do not hinder an area's ability to achieve and maintain clean air standards. Non-attainment areas also become subject to "new source review" requirements, which is a Federal permitting program designed to ensure that pollution from new and modified industrial facilities does not impede progress toward clean air.

Some of the potential negative consequences for the Fairbanks North Star Borough of not meeting and maintaining EPA's PM 2.5 (24-hour) standard could include the following:

- Unhealthy air quality during winter inversion periods leading to increased health care costs for residents, also deterring future population growth in the Fairbanks area and discouraging new businesses from locating in the Interior

- Loss of Federal highway funds along with other Federal funding streams

- Denials on submitted projects to Federal review due to continuation of non-attainment days after program implementation

- Reduced military staffing at Fort Wainwright and Eielson Air Force Base

### *4.3.1 Fairbanks PM 2.5 Implementation Plan*

The FNSB, City of Fairbanks, City of North Pole, ADEC, and Alaska Department of Transportation and Public Facilities (DOT&PF) are working together to develop an implementation plan that will achieve and maintain the current EPA standards by reducing PM 2.5 air pollutant emissions by 2014. Population growth and increased fuel combustion in the Fairbanks area are most likely responsible for the area's PM 2.5 violations during winter months.

Following are some possible methods of reducing PM 2.5 (24-hour) levels during peak winter inversion periods:

**Reduce Open Burn Periods:** The FNSB currently bans open burning from November 1 through the last day of February in areas designated as Urban, Urban Preferred Commercial, Light or Heavy Industrial, or Perimeter area, with campfires as an exception. The length of the winter ban could increase and the affected area could be expanded to encompass the PM 2.5 boundary.

**Reduce Distillate Fuel Emissions:** The following could reduce particulate emissions from existing fuel oil-fired heating systems:

- Switch to a lower-sulfur fuel for all oil-fired building heating systems in the Fairbanks urban areas.

- Introduce annually required inspections and tune-ups on oil-fired furnaces similar to the I/M program to ensure optimum burning efficiency and low particulate emissions.

- Collaborate with other non-attainment northern tier communities across the U.S. to pursue subsidies, exceptions, waivers, retrofits, new regulatory requirements for manufacturers, etc., from Federal agencies. For example, as part of the process of reaching attainment for carbon monoxide (CO) standards in Alaska, Alaskan research conducted in the early 1980s documented that motor vehicle emissions reductions for CO were not achieved at cold temperatures because EPA tested vehicle emissions at room temperature ranges only. Efforts by Alaska and other local and state governments were successful in getting Congress to require EPA to test vehicular emissions at 20 degrees F to make sure auto manufacturers were improving combustion efficiency and the performance of pollution control devices to reduce CO emissions during cold starts. A similar effort could determine if the full benefits of the motor vehicle pollution control program are accrued at low temperatures for PM 2.5. Control of poorly tuned or broken vehicles may be necessary to address the hydrocarbon emissions that increase dramatically with low temperatures.

**Reduce Wood Stove Emissions:** Investigate methods of improving or restricting wood stove operation during winter inversion periods. EPA has published information on the efficiency and PM 2.5 emission rates of various wood stoves, summarized in the following two tables:

**Table 4-1: Efficiencies by Stove Type**

| Appliance Type | Efficiency |
|---|---|
| Conventional Cordwood Stove | 54% |
| Non-catalytic Cordwood Stove | 63% |
| Catalytic Cordwood Stove | 63% |
| Pellet Stove | 78% |

**Table 4-2: Cordwood and Pellet Stove PM 2.5 Emission Factors**

| | Conventional Woodstove (lb/ton) | Catalytic Certified Woodstove (lb/ton) | Non-catalytic Certified Woodstove (lb/ton) | Pellet Stove | |
|---|---|---|---|---|---|
| | | | | Exempt (lb/ton) | Certified (lb/ton) |
| AP-42 Emission Factors | 30.6 | 16.2 | 14.6 | 8.8 | 4.2 |

According to EPA, certified pellet stoves had the highest fuel efficiency and the lowest PM 2.5 emission rates. Conventional wood stoves were much less efficient with the highest PM 2.5 emission rates.

Following are potential wood stove strategies that could help reduce their PM 2.5 emissions:

**Restrict Wood Stoves:** Restrict the installation and use of wood-burning or waste-oil heating appliances during winter inversions. This would require more information to quantify their contribution to PM 2.5 emissions in the Fairbanks and surrounding area during winter.

**Wood Stove Buy-Out:** Rapidly develop a trade-out of older wood stoves through a locally bonded, State, or Federally funded program that provides affordable upgrading for residents who own older or unapproved new simple wood heaters or the non-EPA approved wood boilers. Through local education, it would create an incentive to trade out rather than not comply. A successful trade-out program in Libby, Montana, could be used as a model.

**Retrofit Wood Stoves:** Investigate possible improvements in modes of operation or equipment modifications that could retrofit existing wood stoves to produce fewer PM 2.5 emissions.

**Encourage Dry Wood Use:** Discourage late season harvesting of green standing trees. Wet wood burns inefficiently and could increase particulate emissions. The FNSB could work with the State to provide residents access to supplies of dry seasoned firewood.

**Reduce Waste Oil Heater Emissions:** Consider restricting the use of waste oil burners during winter inversions. More information will be needed to verify that burning waste oil is the actual source of zinc-based PM 2.5 emissions in the area during the winter. Investigate whether using micron filtration can remove zinc compounds and unwanted impurities from waste oils before they are burned in the heaters.

**Expand District Heating:** Aurora Energy provides district heat to downtown Fairbanks through buried steam and hot water heating systems from its power plant. Expanding the existing district steam and hot water heating systems could replace individual oil-fired furnaces throughout the downtown area and surrounding subdivisions and lower PM 2.5 emission levels.

**Expand Natural Gas Use:** Switch existing residential and commercial oil-fired building heaters in the urban area to natural gas to reduce PM 2.5 emission levels. Fairbanks Natural Gas (FNG) has been expanding its buried distribution system and is providing heat to many Fairbanks-area buildings.

In the short term (2008-2010), we expect that implementing a combination of the methods listed above will help the Fairbanks region move toward achieving the new EPA PM 2.5 (24-hour) emission standard. We also believe that switching existing building heaters to natural gas and expanding district heat would provide the FNSB a long term solution for achieving and maintaining its air quality in compliance with EPA's PM 2.5 standards.

## 5. Alternatives for Energy

Though this Report's primary focus is on the use of in-state natural gas, a brief review of other alternative energy sources is appropriate. Alternative energy options are likely to be considered by individual homeowners. The most obvious is residential space heating with wood or coal stoves, which has already increased substantially in Fairbanks. These are, however, causing increased PM 2.5 air pollution problems and will require replacement of inefficient units or improvement of smoke emissions if they are to address one problem without exacerbating the other. They also cannot be considered a 50-year solution until forestry and horticultural techniques are devised and implemented on a commercial scale that might ensure sustainable cultivation of dedicated biomass-for-energy crops.

Solar panels (both photo-voltaic and solar-hydronic) for Interior Alaska are in the trial stage at homes, businesses, and the Cold Climate Housing Research Center. The cost of solar panel production must drop by a factor of at least five to be economically competitive with other potential energy sources. .

Increased wind power may be a good prospect in some areas, if priced competitively, but cannot replace more than 20 percent of total electrical needs because of base load requirements and the unpredictability of wind. In some Alaska locations, wind-generated electricity can help heat homes and reduce overall diesel fuel usage but, like solar, we cannot rely on it as a sole solution.

Because of the above constraints, the introduction of alternative energy options will be incremental and evolutionary, and will not solve the energy shortages of Alaskans in the near to medium term (2014-2034). We believe from the 100-year perspective, however, electricity from hydroelectric, geothermal, and possibly nuclear reactors will heat residences and commercial buildings, and power transport vehicles. Other alternatives may also contribute, depending on the economics, but remain outside the bounds of this analysis.

In this section we discuss four major energy alternative scenarios (here defined as energy sources other than those predominating in a particular locality, such as Cook Inlet gas in Southcentral or oil in the Interior), which assumes that Alaska natural gas is not made available