4.0 Analyses of Individual Nonattainment Area

4.10 Region 10 Nonattainment Areas

4.10.1 Alaska

State of Alaska Area Designations For the 24-Hour Fine Particle National Ambient Air Quality Standard

The table below identifies the boroughs in Alaska that EPA has designated as not attaining the 2006 24-hour fine particle (PM2.5) standard.[1] A borough or as appropriate a part of it will be designated as nonattainment if it has an air quality monitor that is violating the standard or if the borough is determined to be contributing to the violation of the standard.

Area	**Alaska's Recommended Nonattainment Area**	**EPA's Intended Nonattainment Area**
City of Fairbanks	Part of Fairbanks North Star Borough (FNSB)	Part of Fairbanks North Star Borough (FNSB)
Mendenhall Valley, Juneau	Part of Juneau Borough (old PM_{10} nonattainment area boundary)	Part of Juneau Borough (old PM_{10} nonattainment area boundary)

EPA intends to designate the remaining boroughs in the state as "attainment/unclassifiable."

EPA Technical Analysis for the Fairbanks 24 Hour $PM_{2.5}$ Nonattainment Area

Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those nearby areas that contribute to violations. This technical analysis for Fairbanks identifies the boroughs with monitors that violate the 24-hour PM2.5 standard and evaluates the nearby boroughs that potentially contribute to fine particle concentrations in the area. EPA has evaluated these boroughs based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

We also used analytical tools and data such as pollution roses, fine particle composition monitoring data, back trajectory analyses, secondary precursor emission data, a Positive Matrix Factorization (PMF) analysis, speciation data, and a detailed climatological analysis to evaluate these areas.

Figure 1 is a map of the boroughs in the area and other relevant information such as the locations and design values of air quality monitors, the metropolitan area boundary and EPA's final designation boundary for the nonattainment area.

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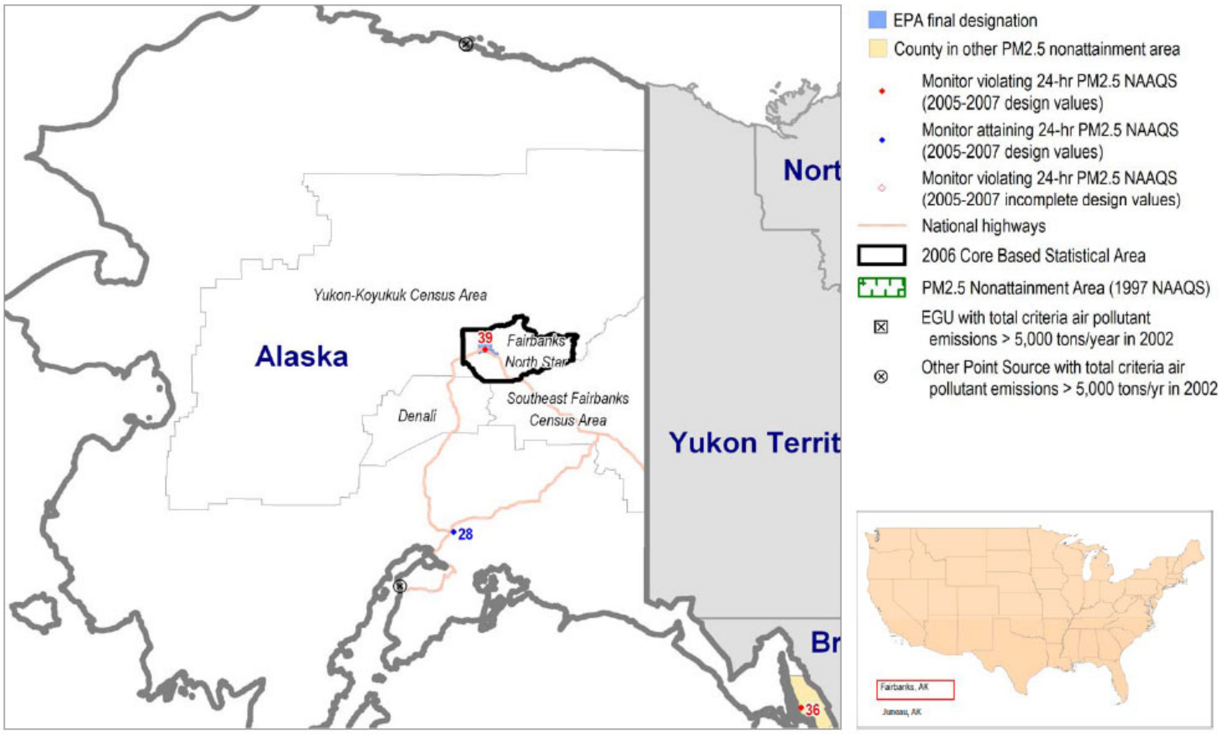
[1] EPA designated nonattainment areas for the 1997 fine particle standards in 2005. In 2006, the 24-hour $PM_{2.5}$ standard was revised from 65 micrograms per cubic meter (average of 98^{th} percentile values for 3 consecutive years) to 35 micrograms per cubic meter; the level of the annual standard for $PM_{2.5}$ remained unchanged at 15 micrograms per cubic meter (average of annual averages for 3 consecutive years).

Figure 1

Figure 5.16 Fairbanks, AK 24-hr PM2.5 Nonattainment Area



5-16

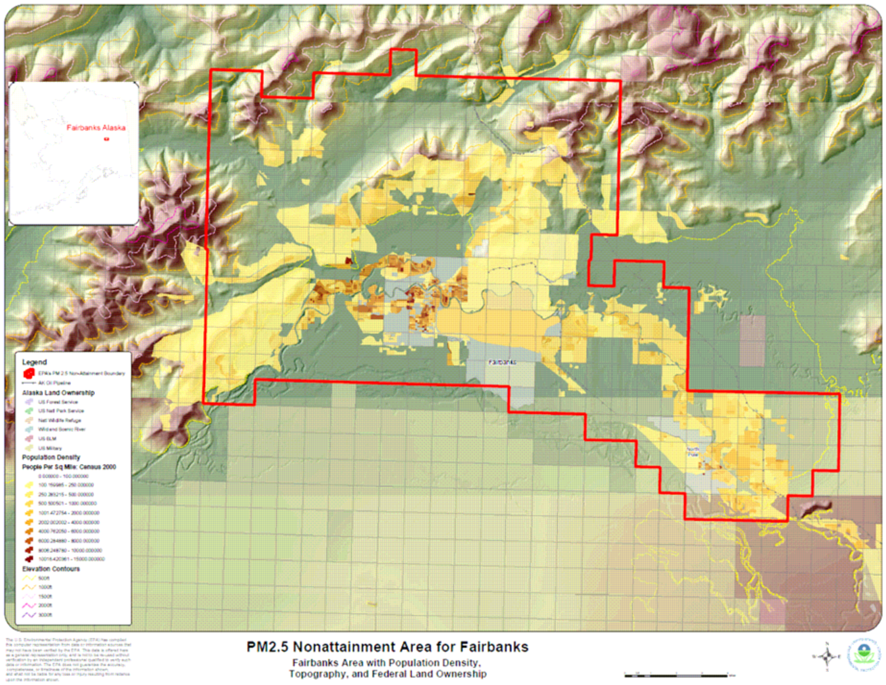
In a letter submitted to EPA on December 18, 2007, the Governor of the State of Alaska and the Alaska Department of Environmental Conservation (ADEC) recommended that City of Fairbanks and areas surrounding it, within the Fairbanks North Star Borough, be designated as nonattainment for the 2006 24-hour $PM_{2.5}$ NAAQS. These data are from FRM and FEM monitors within the City of Fairbanks. In August 2008, EPA notified Alaska of its intended designations. In this letter, EPA also requested that if the State wished to provide comments on EPA's intended designation, it should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g., partial county areas) provided by the state in making final decisions on the designations. The State of Alaska submitted substantial supplemental information to EPA to justify its recommendation for a nonattainment area.

Based on EPA's technical analysis described below, EPA has designated part of the FNSB as nonattainment for the 24-hour $PM_{2.5}$ air quality standard based on air quality data from 2005-2007 and other currently available information. These boroughs are listed in the table below.

Fairbanks Nonattainment Area	State-Recommended Nonattainment Boroughs	EPA-Final Designated Nonattainment Boroughs
Alaska	Part of FNSB	Part of FNSB

The map below, shown as Figure 2, represents EPA's designated nonattainment area for FNSB and the associated legal description.

Figure 2



<u>Township Range Delineated Boundary for the Fairbanks nonattainment area</u>

MTRS F001N001 - All Sections, MTRS F001N001E - Sections 2-11, 14-23, 26-34, MTRS F001N002 - Sections 1-5, 8-17, 20-29, 32-36, MTRS F001S001E - Sections 1, 3-30, 32-36, MTRS F001S001W - Sections 1-30, MTRS F001S002E - Sections 6-8, 17-20, 29-36, MTRS F001S002W - Sections 1-5, 8-17, 20-29, 32-33, MTRS F001S003E - Sections 31-32, MTRS F002N001E - Sections 31-35, MTRS F002N001 - Sections 28, 31-36, MTRS F002N002 - Sections 32-33, 36, MTRS F002S001E - Sections 1-2, MTRS F002S002E - Sections 1-17, 21-24, MTRS F002S003E - Sections 5-8, 18.

Factor 1: Emissions data

For this factor, EPA evaluated borough level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_x, are part of "$PM_{2.5}$ emissions total," they are not shown on the template or data spreadsheet as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration. Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1[2].

Though the Contributing Emissions Score (CES) is an analytical tool that was used for nearly all areas violating the 24-hour $PM_{2.5}$ NAAQS, EPA did not consider the CES for areas in Alaska due to unavailability of meteorological data to complete the analysis.

Table 1 shows estimated emissions of $PM_{2.5}$ and $PM_{2.5}$ precursors (given in tons per year) for potentially contributing boroughs in the Fairbanks area from the NEI database for 2005. It is evident from the emissions estimates that the direct and secondary precursor emissions are an order of magnitude higher in FNSB, than in the surrounding boroughs. In conjunction with other factors, the much higher emissions in this area suggest that most of the emission sources contributing to exceedances at the Fairbanks monitor are likely located within that area. Therefore we took some effort to better understand these sources. Furthermore, there are two major populated areas within the borough within close vicinity of the monitor, the City of Fairbanks and the City of North Pole. We identified and analyzed the locations and types of emission sources within Fairbanks North Star Borough with special attention to sources in these two cities.

Table 1. Component Emissions.

Borough	**State**	**Designated for NAA by State**	**PM2.5 emissions - total (tpy)**	**PM2.5 emissions - carbon (tpy)**	**PM2.5 emissions - other (tpy)**	**SO_2 emissions (tpy)**	**NO_x emissions (tpy)**	**VOC emissions (tpy)**	**NH_3 emissions (tpy)**
Fairbanks North Star	AK	Portions of FNSB.	2872	777	2096	5712	8630	4144	62
Yukon-Kayakuk	AK	No	471	135	337	287	1952	935	7
Denali	AK	No	127	30	96	167	325	318	2
Southeast Fairbanks	AK	No	366	74	293	73	494	614	9

Emissions Analysis for the FNSB

The State of Alaska submitted annual emissions for the Fairbanks North Star Borough for calendar year 2005 are shown in the Table 1.a. These estimates reflect refinement, in some cases, over the NEI database information provided to EPA by the states, as some of the state's information is from actual source emissions from FNSB in 2005. Emission sources are located primarily in the populated areas of the borough (i.e., the cities of Fairbanks and North Pole); however, there are two notable source categories that are either naturally occurring or not directly emitted within the urban areas. These sources are wildfire emissions, which dominate emissions overall in the area source category, and dust from unpaved roads, which dominate the particulate matter emissions in the non-road mobile source category. Neither of these sources, however, is active during the winter months when high concentrations of $PM_{2.5}$ occur so these emissions can be safely discounted from being able to contribute to any violations in the Fairbanks monitor in the winter.

[2] See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html.
[3] A more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C]

Table 1. a: Summary of Fairbanks Emissions in 2005 (tons/year)							
Source Category	VOC	NOx	SO_2	PM_{10}_PRI	$PM_{2.5}$_PRI	NH_3	CO
Point	67	5,829	4,565	460	NA	NA	1,087
Area	4,473	1,872	1,055	7,523	6,444	337	76,433
Mobile - Onroad	1,160	2,218	161	71	56	55	14,510
Mobile - Nonroad	1,241	543	34	19,245	3,398	0	6144
Total Emissions	**6,941**	**10,462**	**5,815**	**27,299**	**9,898**	**392**	**98,174**

Approximately 15 miles Southeast of Fairbanks is the City of North Pole, Alaska, with a 2006 population of over 1800 residents. It is the next largest populated center located near Fairbanks. Emissions in both Fairbanks and North Pole in the winter months are from sources dominated by industrial sources, home heating using sulfur-bearing fuel and residential wood combustion. At least two major point sources are located in North Pole as noted in the table below. Table 1.b provides a summary of the permitted major facilities that are actually located and operating within the City of Fairbanks and vicinity and their reported actual emissions for calendar year 2005.

Table 1.b: Reported Emissions in 2005 from Permitted Major Facilities Within EPA's Proposed Nonattainment Boundary (tons per year)					
Facility	VOC	NOx	SO_2	PM_{10}_PRI	CO
Aurora Energy LLC Chena Power Plant	0	629	248	353	459
Flint Hills Resources Alaska, LLC North Pole Refinery	35	215	13	15	33
Golden Valley Electric Association North Pole Power Plant	2	3,604	3,019	50	14
Golden Valley Electric Association Zehnder Facility	1	28	24	0	1
US Air Force Eielson Air Force Base	21	367	281	8	125
US Army Fort Wainwright	6	471	697	14	262
University of Alaska Fairbanks Campus Power Plant	2	509	280	7	187
Wilder Construction Company Asphalt Plant*	0	6	3	13	6
Total Point Source Emissions	**67**	**5,829**	**4,565**	**460**	**1,087**

*Asphalt plant does not operate in winter when violations occur

EPA also examined data from the Eielson Air Force Base (EAFB) and training areas located to the South and East of the City of Fairbanks. EAFB submitted data demonstrating that the principal source of emissions at the base is the Central Heat and Power Plant (CHPP). The 2007 values presented in that submission are quite similar to those presented in Table 1.b [RST1]and reflect the benefits of the recently installed full-stream bag houses. A comparison between the NOx and SO_2 values emitted by the CHPP and the totals presented in Table 1 show its share of precursor emissions at or below 5[RST2]% for both pollutants.

For the one-year period between June 2007 and May 2008, data submitted for the Blair Lakes Range Facility, a training range located approximately 23 miles south of Fairbanks, showed emissions of 4.6 tons of PM_{10} and 35 tons of SO_2. The range's share of the totals presented in Table 1 is well below 1% for both pollutants. Additional information on winter training activity within both the Blair Lakes and Stewart Creek Ranges found that low level sorties (i.e., those most likely to impact ambient concentrations of $PM_{2.5}$) are flown at a rate of approximately one sortie every four days. Both facilities are located approximately 25 miles from Fairbanks. A submission from Fort Wainwright provides information on winter activity within two training areas located to the south of the Tanana River: the Tanana Flats Training Area (TFTA) and the Yukon Training Area (YTA). While no estimate of emissions was provided, the information demonstrated that winter activity within these facilities is limited. [RST3]Based on this information, emissions from EAFB, the military reservations and training ranges are a very small fraction of the available emissions in the area. The potential of these emissions to contribute to the violating monitor is small and this can be further assessed after a combined review of all factors.

Positive matrix factorization (PMF)[RST4]

The State of Alaska's Department of Environmental Conservation (ADEC) performed and submitted the results of a positive matrix factorization (PMF) analysis of $PM_{2.5}$ speciation data, collected at a site in downtown Fairbanks. This PMF analysis supplements and corroborates the direct use of emissions and speciation data and is particularly informative in our evaluation of the Fairbanks $PM_{2.5}$ pollution problem because, as explained above and distinct from most other areas in the country we have evaluated, the CES tool was not available for the area. Additionally, and as explained above, our determination is based on a myriad of factors and various analyses, only one of which is a PMF analysis. Taken together with other data and facts analyzed and explained in detail elsewhere in this document, it helps make an informed decision about sources which cause or contribute to $PM_{2.5}$ pollution in the Fairbanks area.

Positive matrix factorization (PMF)[4] is a recent development in the class of data analysis techniques called factor analysis, in which the fundamental problem is to resolve the identities and contributions of components in an unknown mixture. PMF has been used extensively for source apportionment of ambient particulate matter (PM), to resolve the mixture of sources that contributes to PM samples. PMF is especially applicable to working with environmental data because it incorporates the variable uncertainties often associated with measurements of environmental samples, and forces all of the values in the solution profiles and contributions to be nonnegative, which is more realistic than solutions from previously used methods like principal components analysis.

PMF is one of the receptor models that EPA's Office of Research and Development has developed to provide scientific support for current ambient air quality standards and for implementation of those standards by identifying and quantifying contributions for source apportionment. This model draws from ambient air quality data sets and receptor model algorithms to compute profiles and relative contributions from different source categories – http://www.epa.gov/heasd/products/pmf/pmf.htm

Based on ADEC's preliminary analysis, verified by EPA[5] the principal sources of PM appear to be:

- secondary aerosol-related (sulfate and nitrate),
- wood burning related emissions,
- an unidentified zinc-related source, and
- mobile emissions.

Sulfate from sulfur-bearing sources appears to be much more important than nitrate (see figures [RST5]3 and 4 below). Figure 3 represent regression plots of sulfate mass and $PM_{2.5}$ concentrations and Figure 4 does the same with nitrate mass. From the plots it is clear that the SO_4 mass is more directly correlated to $PM_{2.5}$ mass with a R^2 of 0.85. Based on the inventory, the principal source of sulfates seems to be the combustion of sulfur-bearing fuel for space heating, which results in sulfur dioxide emissions. Additionally, there are at least 4 major industrial sources in the City of Fairbanks with significant emissions of direct and secondary precursors of $PM_{2.5}$ based on information from the EPA AIRS/AFS database and the state's supplemental data. A small fraction (less than five percent) of the sulfur oxides emitted from fuel burning sources may also be directly emitted as sulfate particles.

Sources of wood burning emissions in Fairbanks include residential wood stoves and other appliances, and external wood boilers. Survey data and other evidence suggest that wood burning may have increased in recent years. External wood boilers are a relatively new and substantially uncontrolled $PM_{2.5}$ source that has the potential to cause high localized concentrations of $PM_{2.5}$ and may be a significant air pollution nuisance as well as a potential health threat at smaller scales. There are a variety of methods for measuring $PM_{2.5}$ emissions from wood burning, including new methods [RST6]that have a degree of selectivity for wood smoke.

One major uncertainty in the aforementioned Fairbanks PMF analysis is that the source of the zinc factor is unknown. Possible sources include burning of waste lubricating oil in and around Fairbanks, burning of lubricating oil by motor vehicles, other local trace sources, or distant sources of zinc mining and ore handling. The state submitted some research that shows that burned lubrication oil used in automobiles could potentially contribute Zn

[4] A. Reff et al, "Receptor Modeling of Ambient Particulate Matter Data Using Positive Matrix Factorization: Review of Existing Methods," Journal of the Air and Waste Management Association, 57:146-154, February 2007.

[5] This PMF analysis done by Sierra Research for ADEC was verified by EPA Region 10 and submitted to the docket as Fairbanks Receptor Modeling Report 8-20-07.pdf.

particles in the nano-size range. Although this research has not been independently verified, the research suggests the motor vehicle contribution to $PM_{2.5}$ may be much greater than shown from the PMF analysis.

Figure 3: $PM_{2.5}$ Mass vs. Sulfate Mass

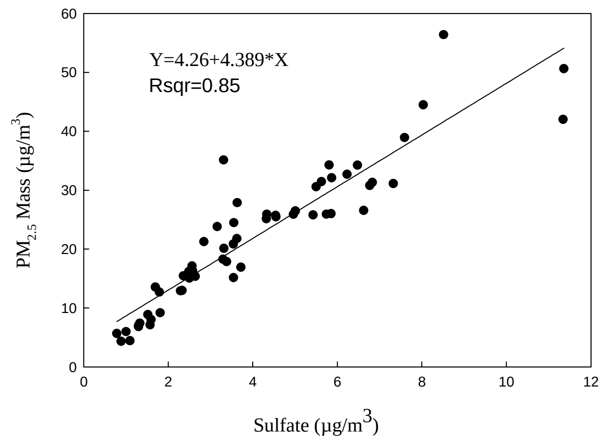
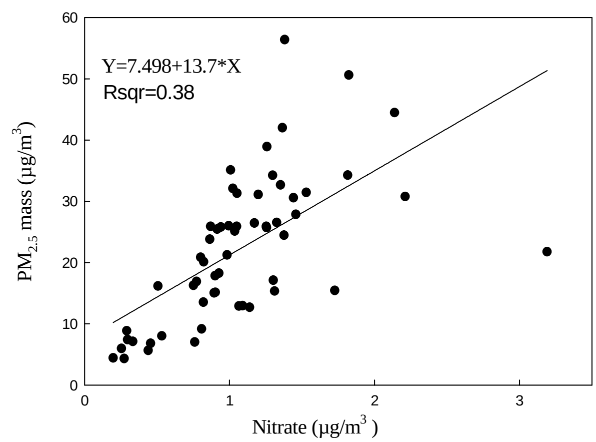


Figure 4: $PM_{2.5}$ Mass vs. Nitrate Mass



Summary: Due to the size of the surrounding boroughs and the lower order of magnitude of emissions from those areas, they are not significant contributors from an emissions standpoint. Data submitted by EAFB and Fort Wainwright and verified by establishes that activities to the south and east of Fairbanks and the EAFB do not contribute to high levels of $PM_{2.5}$ in Fairbanks. More detail on this analysis and EPA's analysis is in the response to state and public comments to Alaska. As the rest of FNSB has no sources, the other areas in the borough also do not contribute to the high values in Fairbanks. Based on emission data for the North Star Borough, it seems likely that exceedances are caused by sources in Fairbanks and North Pole.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in µg/m^3) for air quality monitors in Fairbanks, Alaska based on data for the 2004-2006 and the 2005-2007 period. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98th percentile values are 35µg/m^3 or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for the $PM_{2.5}$ monitors in Fairbanks, AK are shown in Table 2. The monitor shows the 24-hour $PM_{2.5}$ standard being violated based on both the 2004-2006 and the 2005-2007 monitoring data.

Therefore, the Fairbanks North Star Borough (FNSB) is a candidate for being designated nonattainment. This factor, combined with the emissions analysis indicates that sources within the City of Fairbanks and the City of North Pole are contributors to the $PM_{2.5}$ exceedances in the Fairbanks North Star Borough. Sources do not exist in most other parts of FNSB and the few other sources in FNSB are not potential contributors to the violations in Fairbanks due to their lower magnitude of emissions. The City of North Pole does not have a $PM_{2.5}$ monitor within the city boundaries. Therefore, this factor does not provide evidence to exclude or include the City of North Pole as a contributor to the violating monitor in Fairbanks. Of the surrounding boroughs, none have an FRM or FEM monitor for $PM_{2.5}$.

Table 2:

Borough	State Recommended Nonattainment?	24-hr Design Values 04-06 (μg/m^3)	24-hr Design Values 2005-07 (μg/m^3)
Fairbanks, AK	Yes	43	39

[Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with a FRM or FEM monitor. All data from Special Purpose Monitors (SPM) using an FRM, FEM, or Alternative Reference Method (ARM) which has operated for more than 24 months is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.]

Summary: A combination of the above two factors establishes that the boroughs surrounding FNSB have very low emissions and do not have $PM_{2.5}$ monitors. Further they also establish that the emissions in the vicinity of the monitor are significant and proximate, and that scant emissions even in the remote part of FNSB are very small.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2006 population for each Borough in the area being evaluated, as well as the population density for each Borough in that area. Population data give an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

From the tables and the population density maps, it is evident that the analysis needs to focus on the Fairbanks North Star Borough. The population and population densities indicate that the majority of the population of this area resides within Fairbanks North Star Borough and more specifically in and around the Cities of Fairbanks and North Pole. This supports the inference that violations in the area are the result of contributions from emissions and activity in this area. Therefore, any reasonable boundary that attempts to captures emission sources that could contribute to the violations at the Fairbanks $PM_{2.5}$ monitor should include the Cities of Fairbanks and North Pole and populated areas around those cities, at a minimum.

Table 3: Population

Borough	State Recommended Nonattainment?	2006 Population	2006 Population Density (pop/sq mile)
Fairbanks North Star	Yes (portion)	94803	10
City of Fairbanks	Yes (portion)	31142	973
City of North Pole	No	1828	446
Yukon-Kayakuk	No	5844	0
Denali	No	1846	0.1
Southeast Fairbanks	No	6773	0.2

Sources: http://www.census.gov/popest/boroughs/CO-EST2006-03.html for 2006 populations; http://www.census.gov/population/censusdata/90den_stco.txt for size.

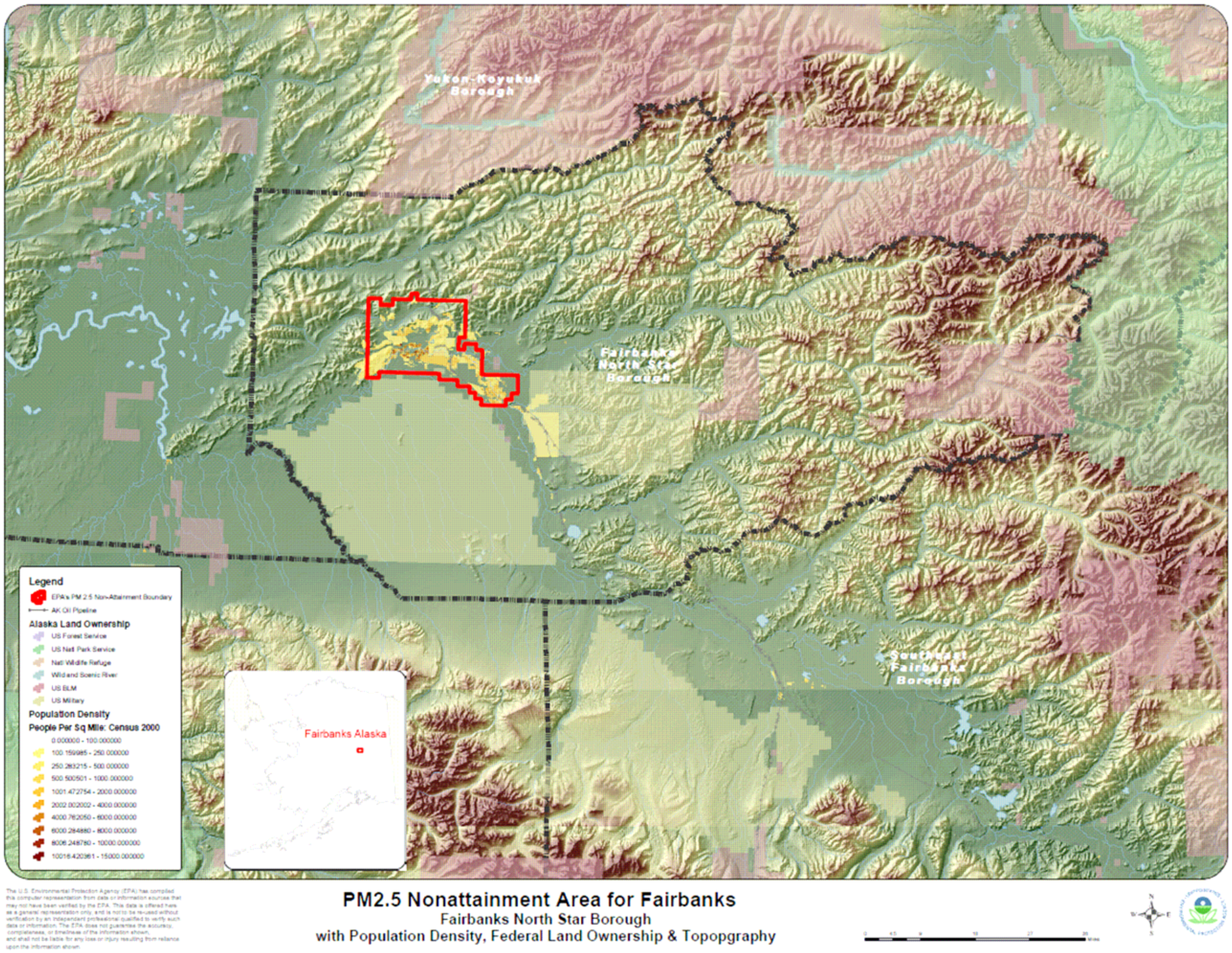


Figure 5: Population density for the $PM_{2.5}$ NAA for FNSB

Factor 4: Traffic and commuting patterns

This factor, combined with Factor 5, growth rates and patterns, considers the number of commuters in each Borough who drive to another Borough, as well as the total Vehicle Miles Travelled (VMT) for each Borough. A Borough with numerous commuters would generally indicate that it is an integral part of an urban area and a possible contributor to the $PM_{2.5}$ levels in the violating county or borough.

Updated data recently submitted by the State of Alaska reported 723 million miles of travel in 2006 in FNSB. Roughly 58% of the travel (i.e., 418.7 million miles) occurred within the FMATS area. The listing of boroughs on Table 5 reflects a ranking based on the number of people commuting to other boroughs.

Table 4:

Borough	State Recommended Non-attainment?	2005 VMT (Millions)	Commuting from Fairbanks to borough (#)	Commuting from Fairbanks to other boroughs (%)	Commuting from other boroughs to Fairbanks (#)	Commuting from other boroughs to Fairbanks (%)
Fairbanks North Star	Yes (partial)	723	39563	100	39563	100
Denali	No	20	159	0.5	77	0
Yukon-Koyukuk	No	66	32	0	55	0
Southeast Fairbanks	No	71	53	0	74	0

Source: EPA TTN 2005_vmt_borough_level-1.xls, and the State of Alaska.

The 2005 VMT data used for table 5 and 6 of the 9-factor analysis have been derived using methodology such as that described in "Documentation for the 2005 Mobile National Emissions Inventory, Version 2," December 2008, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: ftp://ftp.epa.gov/EmisInventory/2005_nei/mobile_sector/documentation/2005_mobile_nei_version_2_report.pdf

Summary: It is evident from the data in Table 4 that very few commuters commute to and from Fairbanks North Star Borough from others Boroughs surrounding it. In addition, Factor 1 indicates that surrounding boroughs are not contributing emissions to the Fairbanks North Star Borough. Factor 3 also indicates the population density in FNSB is in the order of 10 /sqmi except in the cities of Fairbanks and North Pole. Low population densities in the surrounding boroughs and in most of FNSB indicate very low traffic and commute related emissions. Commutes to other areas within the borough are likely to be minimal if at all, especially during times when these exceedances occur. Densely populated areas within FNSB, and traffic in those areas could cause commute based emissions that could contribute to the violations at the Fairbanks monitor and therefore justify inclusion in the nonattainment area.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2006 and growth in vehicle miles traveled for 1996-2005 for boroughs in Alaska, as well as patterns of population and VMT growth. A borough with rapid population or VMT growth is generally an integral part of an urban area and could be an appropriate area for implementing mobile-source and other emission-control strategies, thus warranting inclusion in the nonattainment area.

[RST7]**Table 5: Population and VMT Growth**

Borough	**State Recommended Nonattainment?**	**2006 Population**	**Population Growth 2000-2006 (%)**	**2005 VMT (Millions)**	**% VMT Growth 1996-2005**
Fairbanks North Star	Yes (portion)	94803	6	723[1]	9[3]
City of Fairbanks	Yes	31142	6	419[1]	45[2]
City of North Pole	Yes	1828	16		
Southeast Fairbanks	No	6773	5	71	25
Yukon-Kayakuk	No	5844	(6)	66	10
Denali	No	1846	(4)	20	11

1. From public comments submitted by ADOT & PF; Letter from Leo von Scheben, Commissioner, ADOT&PF submitted to EPA Docket No. EPA-HQ-OAR—2007-0562, dated October 2, 2008.
2. Based on State of Alaska supplemental information, October 20, 2008.
3. Based on data from the Air Quality/Transportation Plan Conformity Fairbanks Maintenance Area FFY06-08 TIP and LRTP (submitted to docket).

Since 1985, population levels in the Fairbanks area have remained relatively stable. Increase in military activity due to the addition of a light infantry division to Fort Wainwright acted to offset a reduction in state and local governmental spending due to declining oil revenues. These factors resulted in a 1990 Borough population of 77,720. According to the Census,[i] [RST8]the Borough population experienced little change between 1990 and 2000, with an overall growth rate of 0.6% per year. During that same time period, the Census data indicate that the population within the cities of Fairbanks and North Pole also declined slightly by about 0.16% per year. From 2000 to 2006, the population [RST9]increased by 0.7% (combined) and this trend is not expected to change very much with population forecasts for the 2006-2015 period estimated to be in the range of about 1% each year.

Based on all the above factors it is clear that emission sources, monitored air quality problems, high population density and growth in population are focused in FNSB and more specifically withing the metropolitan areas of Fairbanks and Northpole. This coincides well with the Fairbanks Metropolitan Area Transportation System (FMATS) Planning Area. It also seems that the growht in VMT in FNSB is driven by the growth in FMATS VMT.

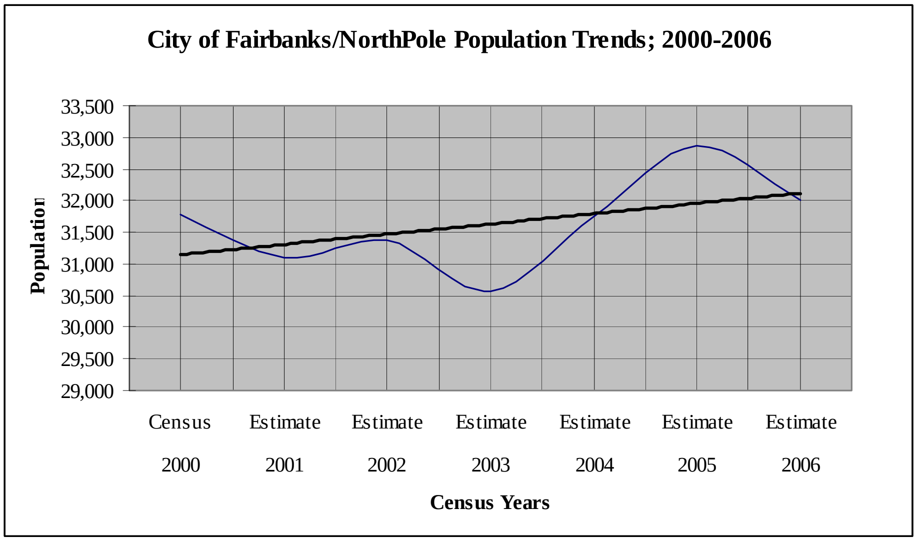


Figure 6: Source: http://www.census.gov/popest/cities/tables/SUB-EST2006-04-02.xls

Growth in Vehicle Travel

VMT estimates and projections are taken from the Fairbanks Metroploitan Area Transportion System (FMATS) Long Range Transportion Plan (LRTP). This estimate includes the City of Northpole [RST10]but is a sound basis to understand the growth in vehicle travel in the area.

Despite the slight reduction in population recorded from 1990 to 2000, Fairbanks and North Pole experienced a modest increase in travel (1.1% per year)during these periods. From 2002-2004 VMT growth was reported as 1.2 % per year and this is expected to continue to 2015 at a growth rate of approximately 1.4%. With a relatively stable population and slow growth in VMT, the FMATS transportation network has relatively low levels of congestion and excess transportation capacity. FMATS routinely considers and implements projects that will assist in reducing congestion such as signalization improvements at intersections. The Fairbanks North Star Borough also has a transit system that provides a good level of service for a relatively spread out community.

Table 5 a. VMT growth in the City of Fairbanks and North Pole from 2000 – 2015

2000 VMT (millions)	**2006 VMT (millions)**	**Percent change**	**2010**	**Percent Change**	**2015**	**Percent Change**
272	315	16	335	6	361	8

<u>Summary</u>: Although the historical and projected VMT growth rates are small in magnitude, Postive Matix Factorization and the emission inventory indicates that vehicle emissions can be a factor to high $PM_{2.5}$ concentrations in the Fairbanks area. However, all the the preceding factors indicate that rather than the surrounding counties and even other areas within FNSB, growth in vehcile traffic in the FMATS area shows the highest potential to contribute.

Factor 6: Meteorology (weather/transport patterns)

For Fairbanks, Alaska, as in many areas in the Northwest, these two factors combine together to create unique effects that cause violations in highly localized areas within a county or in a micro-air shed as in a mountain-valley. To understand how the interactions of terrain and meteorology affect the cause and nature of violations in such areas, it is beneficial to examine these two factors together.

For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on "high $PM_{2.5}$ days" for each of two seasons (an October-April "cold" season and a May-September "warm" season). These high days are defined as days where the[RST11] FRM or FEM air quality [RST12]monitor had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a “pollution rose” to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour $PM_{2.5}$ values by color; days exceeding 35 $\mu g/m^3$ are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

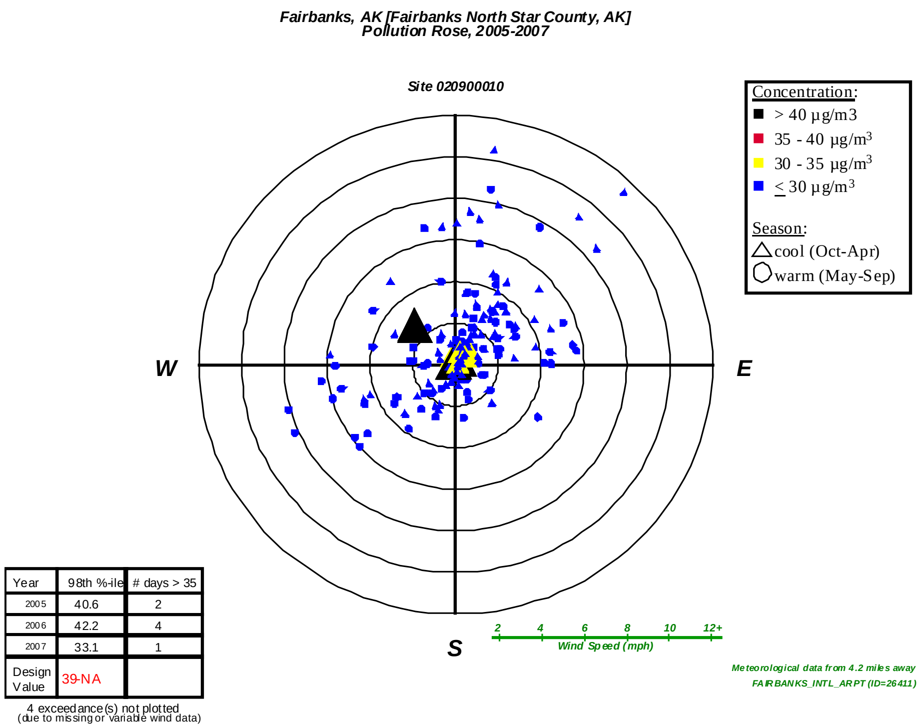


Figure 7: Fairbanks Pollution Rose[RST13]

As shown in the pollution rose in Figure 2, the average prevailing surface wind direction for high $PM_{2.5}$ days in the City of Fairbanks is from the Northwest for one event and calm from many of the other high days. The pollution roses show that 24-hour $PM_{2.5}$ concentrations are influenced by emissions from any direction at various times, but these data also suggest that emissions from some directions relative to the violation are more likely to contribute to the violation than emissions from other directions.

As in many areas in the West, Fairbanks exhibits a confluence of factors which include locally available sources of pollution, topography, and meteorology which complement each other to provide the necessary ingredients for the contribution and buildup of pollutants concentrations that violate the NAAQS.

> Available Sources of Pollution: The PMF study submitted by ADEC shows that secondary aerosol, primarily sulfate and nitrate makes up about 40-55% of the monthly average mass concentrations on $PM_{2.5}$, with the highest percentage in January (the coldest month with an average temperature of about -10 °F. The remaining mass is attributed to wood burning, an unknown source of Zinc and other smaller source categories of sea salt and motor vehicles. For cold winter days, with severe inversions, the use of wood and sulfur bearing distillate fuels for heating is expected to be generally high. These are presumably the principal sources of SO_2 emissions. The usage of these fuels and subsequently the emissions will be especially high for severely cold winter days in December, January, and February. There are also local industrial sources within the City of Fairbanks and the City of North Pole that are classified as major sources in the EPA AIRS/AFS database that contribute direct PM and precursor gases that can contribute to secondary aerosol formations (CO, PM, SO_2 and NO_x). A preliminary reporting also indicates that there are major stationary sources to the North, South, and East of the City of Fairbanks.

Topography: At 440 ft ASL, the City of Fairbanks lies on the winding Chena River near its confluence with the Tanana River, which occurs just south of town. The city is surrounded by ridges on the northeast, north, and west, which rise to about 600 feet ASL; further ridges beyond the first ring of ridges reach 2500 feet ASL. The low elevation of the city center with respect to the surrounding ridges causes air pollution build up within the "bowl" during stagnation episodes. The Chatinika, Chena, and Salcha River drainages define the area surrounded by rolling hills to the north, east and west of the urban centers. The Tanana River Valley flats border the city to the south and southeast.

The nearby city of North Pole lies about 15 miles to the southeast of Fairbanks on the valley floor in a less topographically confined region, with the closest hills lying to the east at a greater distance from the North Pole city center than the hills surrounding downtown Fairbanks . The terrain from Fairbanks to North Pole exhibits a gentle rise from 440 ft in Fairbanks to about 480 ft in North Pole.

Additional Analysis:

Preliminary data analysis suggested that the exceedances in Fairbanks were characterized by very low temperatures and inversions that were extremely severe. To understand this further, EPA conducted further analysis of the severity of inversions, the diurnal variation of the mixing heights, and wind speeds and direction, and effect of these on air masses in and around the City of Fairbanks. Below is a summary of the analysis.

Mean annual wind direction frequency distribution (%) for non-calm observations.

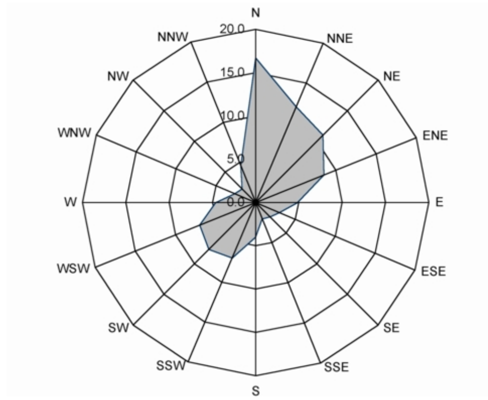


Figure 8: Annual percentage of calm and non-calm observations
Analyses are based on hourly observations for the period 1971 – 2000)
(Source: http://climate.gi.alaska.edu/Climate/Wind/Direction/Fairbanks/FAI.html)

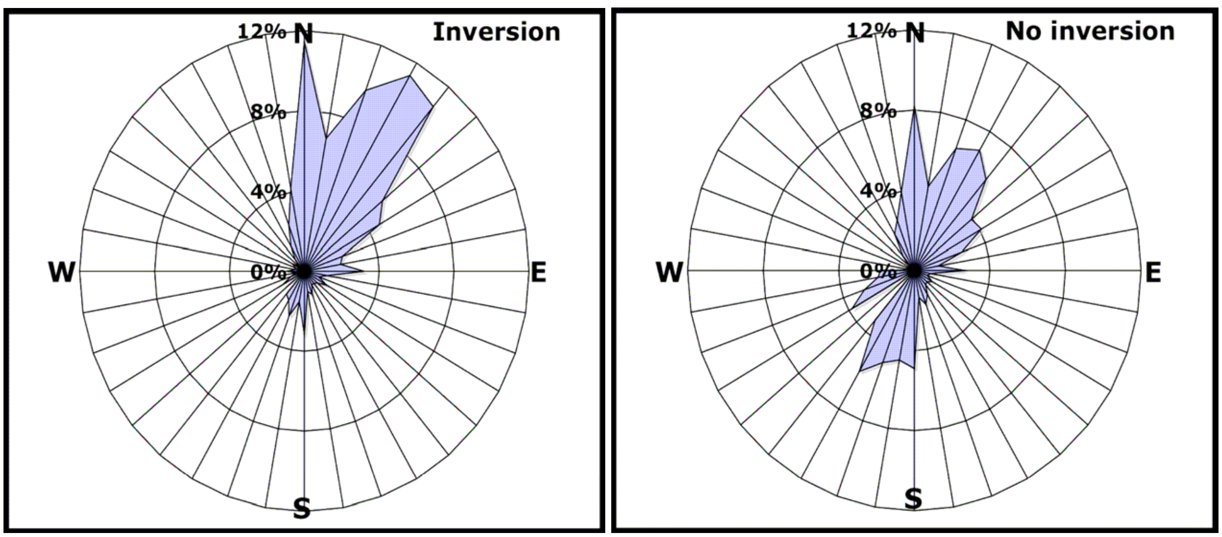


Figure 9: Frequency distribution of surface winds for surface inversion and no surface inversion cases for Fairbanks (Source: http://ams.confex.com/ams/pdfpapers/84504.pdf)

Meteorology: Fairbanks winters are dominated by a pattern of cold, stable air that shows little movement that supports the buildup of available air pollutants. Temperatures typically range between -20° and +20° F, with several periods of - 40° F each winter. Occasionally, temperatures can extend colder temperatures (e.g. -66° F). A combination of high albedo and the low solar elevation that occurs in northern latitudes during the winter months creates little heating of the ground and weak vertical mixing between the surface and elevated layers. Fairbanks frequently experiences ground-based inversions of considerable strength (40° F/100m) topped by weaker inversion zones such that the layer of inverted lapse rates range as high as 1-2 kilometers. This condition together with local emissions of $PM_{2.5}$ and its precursors (especially sulfur dioxide) can cause episodes of elevated $PM_{2.5}$ concentrations.

A closer analysis of winter inversions has been done by Hartmann, et al. at the Alaska Geophysical Institute [RST14](http://ams.confex.com/ams/pdfpapers/84504.pdf) shows that during winter inversion conditions the winds are from the North and Northeast, with no significant return flow components. A no-inversion wind rose shows a small return flow from the SSW-SW direction. This directionality suggests a flow from the direction of the Denali Range and warmer air which descends the leeside of the range (adiabatic heating), which perhaps contributes to a warming at the surface and a weaker surface inversion. An annual wind rose also shows that surface winds are predominantly from the N-ENE, but follows the no-inversion wind rose with a small return flow from the S-WSW direction. (See Figure 8)[RST15]

A climatological analysis conducted by EPA using climate data from the Fairbanks International Airport supports the above studies. This analysis is summarized below. In the analysis[RST16], EPA initially analyzed the relationship between temperature and $PM_{2.5}$ concentrations.

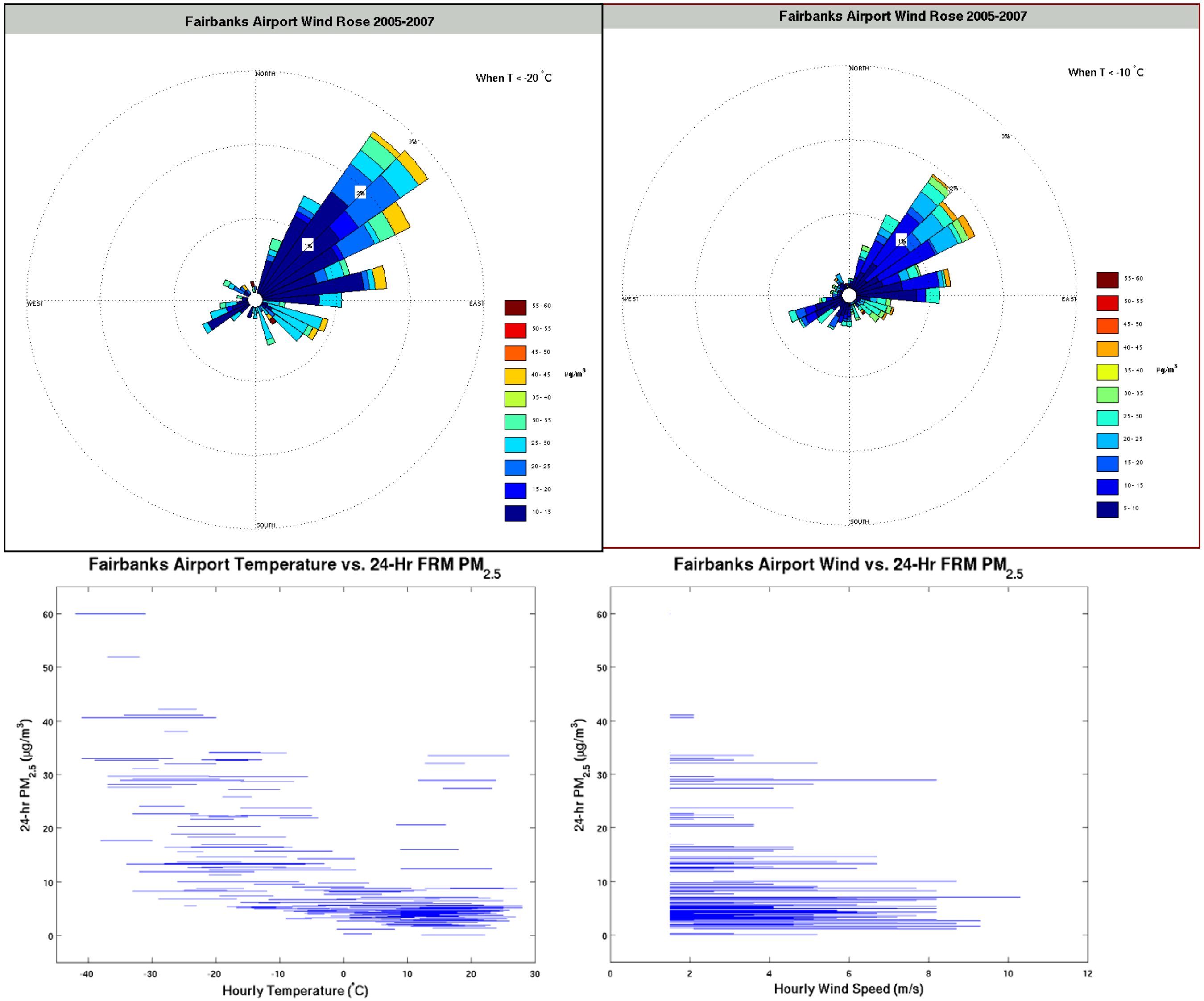


Figure 10: Temperature and pollution rose plots form Fairbanks, 2005-2007.

Summary of EPA's Analysis:

As shown in the plot of hourly temperature versus $PM_{2.5}$ concentrations, the concentrations show an inverse relationship with temperature. Further there seem to be no exceedances of the $PM_{2.5}$ standard for temperatures above -20 °C. An analysis of concentrations against wind speed also shows an inverse relationship, with high values of $PM_{2.5}$ (above 30 μgm^{-3}) occurring at low wind speeds or calm conditions.

Based on this information, EPA constructed concentrations roses [RST17](Figure 10) for days when the temperatures were below -20 °C and -10 °C, as all exceedances of the $PM_{2.5}$ standard occurred during these temperature regimes. The more significant plot, for days with temperatures lower than -20 °C, the wind direction is primarily from the NE with small components from the SW and SE. Both the wind speed and direction support a katabatic flow from the ridges to the North of town and to the NE of the airport. On these days, it is presumable that the extreme temperatures with snow on the ground sets up very strong surface inversions with accompanying stable air and limited mixing in the layer near the surface. Under these conditions, it is foreseeable that additional fuel is required for residential heating in and around the city of Fairbanks. If there are residential areas on the ridges above the City, heating from these residences could also contribute to the emissions, which potentially drain down the ridges into town.

Under these low temperatures and mixing regimes with very stable conditions, most of the organics may already be in the aerosol phase and there may be enough liquid water content in the air mass to enable all modes of wet deposition – aqueous phase solution, acting as condensation nuclei, and scavenging due to larger droplets, all of which is measured as $PM_{2.5}$ in the filters.

Consideration of Meteorological Factors to assess contribution from regional sources: According to the state climatologist at the University of Alaska at Fairbanks[6], the topography of the Fairbanks area with a broad and flat river valley to the south and hills to the north give rise nearly to a katabatic or gravity driven flow during the winter. At this time of year winds are light and Fairbanks is frequently cut off from the free atmosphere with the predominant low-level temperature inversion. An interesting exception to this is for areas south of Fairbanks in the path of the so-called 'Tanana Jet' in which the wind is funneled by the highlands surrounding the Tanana River valley, primarily around the Delta Junction area.

The Tanana Valley Jet (TVJ) is a winter season wind phenomenon that commonly occurs in this area, with particular impact on the community of Delta Junction. The TVJ is a cold katabatic wind blowing down the Tanana Valley from southeast to northwest. The pressure gradient force down the valley is the primary driver of the TVJ. The area covered by the TVJ then extends westward down the valley until the wind dissipates over the Tanana Flats south of Fairbanks and Nanana. The TVJ occasionally wanders out of the boundary of this zone to affect Eielson AFB and Nanana, but does not impact Fairbanks.

The availability of primary sources of emissions and gaseous precursors, temperature and wind regimes conducive to reactivity, and a stable air mass, which keeps pollutants in the area provide conditions that create elevated levels of $PM_{2.5}$ in the valley. However, the analysis also reveals that there is interplay of complex mechanisms that contribute to the elevated $PM_{2.5}$ levels.

EPA and the State of Alaska and the FNSB initiated a study in the Fairbanks area in 2007 entitled "Evaluation and possible modification of the Community Multiscale Air Quality (CMAQ) Model to simulate $PM_{2.5}$ in Fairbanks, Alaska, where high concentrations of $PM_{2.5}$ are observed under cold, dark, and stable conditions". The study design envisions collecting speciated monitoring data and emissions data to understand pollutant formation mechanisms and meteorological influences that affect the Fairbanks areas and eventually adapt EPA models to perform better in the extreme conditions in Fairbanks. Preliminary data from a monitoring study completed in the winter of 2007 in support of this effort[7], in Fairbanks and North Pole, indicates that high $PM_{2.5}$ readings are phenomenon that occurs in the densely populated areas of the Borough. To better understand this issue, the State of Alaska submitted a detailed analysis of a prolonged event last winter in its supplemental information package on October 20, 2008.

[6] Email from Alaska State Climatologist submitted to docket.
[7] Analysis_of_Sniffer_Lite_Memo_082008.pdf, submitted to docket.

The analysis clearly establishes that high $PM_{2.5}$ days in Fairbanks are the result of very cold surface temperatures and shallow temperature inversions, calm winds creating stagnant conditions that inhibit the transport and/or dispersion of pollutants. Local emissions in each community simultaneously increase local air pollution levels and $PM_{2.5}$ concentrations high enough to exceed the standard in some areas.

Summary: These analyses in combination with the other factors indicate that the emission sources contributing to high pollution concentrations in Fairbanks are fairly localized to the City of Fairbanks and North Pole and the populated areas around these cities. The large distances between the military ranges and the populated areas of Fairbanks, combined with an absence of southerly winds during $PM_{2.5}$ episodes, demonstrate that the limited emissions from these facilities do not contribute to exceedances recorded in Fairbanks. Similarly, data collected at Eielson show there is no transport of its emissions into Fairbanks prior to or during episodes except for brief periods of southeasterly flow that is shown to be part of drainage flow along the Tanana. All the analysis demonstrates that the dominant flow prior to and during episodes is from the northeast and there is little evidence of any flow from the west. These findings, in addition to other factors, dictate a nonattainment area boundary around the cities of Fairbanks and North Pole and populated areas surrounding these cities.

Factor 7: Geography and Topography

Fairbanks, Alaska is located at an elevation of approximately 440 feet above sea level (ASL) and is bordered on the west, north, and east by mountain ridges, such as Ester Dome and Cranberry Ridge (Figure 11), ranging in height from 1,000 feet to nearly 2,500 feet; on the south, it is bordered by the Tanana River Flat. The mountains create a clear barrier between the Fairbanks area and neighboring valleys, limiting the extent to which emissions in those valleys could impact Fairbanks. This fact is especially relevant under strong, low-level temperature inversion conditions that limit the vertical mixing of air to hundreds of feet, well below the nearest ridge heights. However, because of its low elevation relative to its surroundings, Fairbanks is the pooling area for some of the drainage flows coming down out of the mountainous regions, as indicated by the red lines in Figure 11. As a result, some valleys to the west and north of Fairbanks, namely Ester Valley and Goldstream Valley could have an impact on Fairbanks. Valleys beyond Ester and Goldstream are separated by ridges of at least 1,500 feet, which are more than sufficient to prevent air flow between those distant valleys and the valleys proximate to Fairbanks that drain into its basin. Therefore, valleys beyond Ester and Goldstream are not included in the nonattainment area.

Another type of drainage flow shown in Figure 11 is that along the Tanana River. Due to gradual descent in elevation from the east toward the west, air above the river will tend to flow in the same direction as the river and draw air from the adjacent land.

The wind flow arrows shown in Figure 11 are a depiction of typical flows that develop under strong high pressure patterns, when large-scale, synoptically forced winds are not a factor and wintertime $PM_{2.5}$ concentrations are most likely to increase. It is important to note that even with the drainage flows, winds in the predominately flat areas of Fairbanks and areas to its east can be calm to light and variable. As a result, the drainage flows can be limited to the valleys and mountain faces and may not extend much beyond the base of the mountains.

Summary – The mountains to the west, north, and east of Fairbanks create clear barriers from neighboring valleys which limit the exchange of emissions. However, because of its low elevation relative to the valleys located to the west and the north, it is likely that drainage flows coming out of those valleys could have an impact on Fairbanks. Conversely, drainage flow from mountainous areas to the east of Fairbanks are not likely to have much of an impact on Fairbanks because emissions in those areas are minimal to zero and the winds commonly decrease to calm once the flows exit the valleys and spread out across the flat, open areas.

Figure 11
Topography and Drainage Flows in Fairbanks Area

Factor 8: Jurisdictional boundaries (e.g., existing PM and ozone areas)

In evaluating the jurisdictional boundary factor, consideration should be given to existing boundaries and organizations that may facilitate air quality planning and the implementation of control measures to attain the standard. Areas designated as nonattainment (e.g. for $PM_{2.5}$ or 8-hour ozone standard) represent important boundaries for state air quality planning.

Given that no areas in the State of Alaska State violated the 1997 $PM_{2.5}$ standards, our analysis of jurisdictional boundaries focused on new information gathered for FNSB to determine if the implementation of controls in a potential nonattainment area can be carried out in a cohesive manner.

The Fairbanks North Star Borough is located in the heart of Interior Alaska at approximately 64.833330° North Latitude and -147.716670° West Longitude. The area encompasses 7,361.0 sq. miles of land and 77.8 sq. miles of water (an area larger than either Delaware or Rhode Island). The Borough seat is located in the city of Fairbanks. A less densely urbanized area extends from Fairbanks along the Richardson Highway corridor through the city of North Pole to the southeast. The Borough also contains other smaller outlying residential areas (i.e., Ester, Fox, etc.) as well as two military bases (Fort Wainwright and Eielson Air Force Base). Fairbanks has a metropolitan planning organization, FMATS (Fairbanks Metropolitan Area Transportation System), whose boundary includes both Fairbanks and North Pole and extends further into population areas within the vicinity of both communities.

Figures 22 through 24 are maps of the borough, cities, and FMATS boundaries. Information submitted by the military shows that it has jurisdiction over the large training facilities located to the south and east of Fairbanks.

The analysis of jurisdictional boundaries considered the planning and organizational structure of the FNSB and ADEC to determine if the implementation of controls in a nonattainment area can be carried out in a cohesive manner.

Figure 12: City Boundaries within the Fairbanks North Star Borough

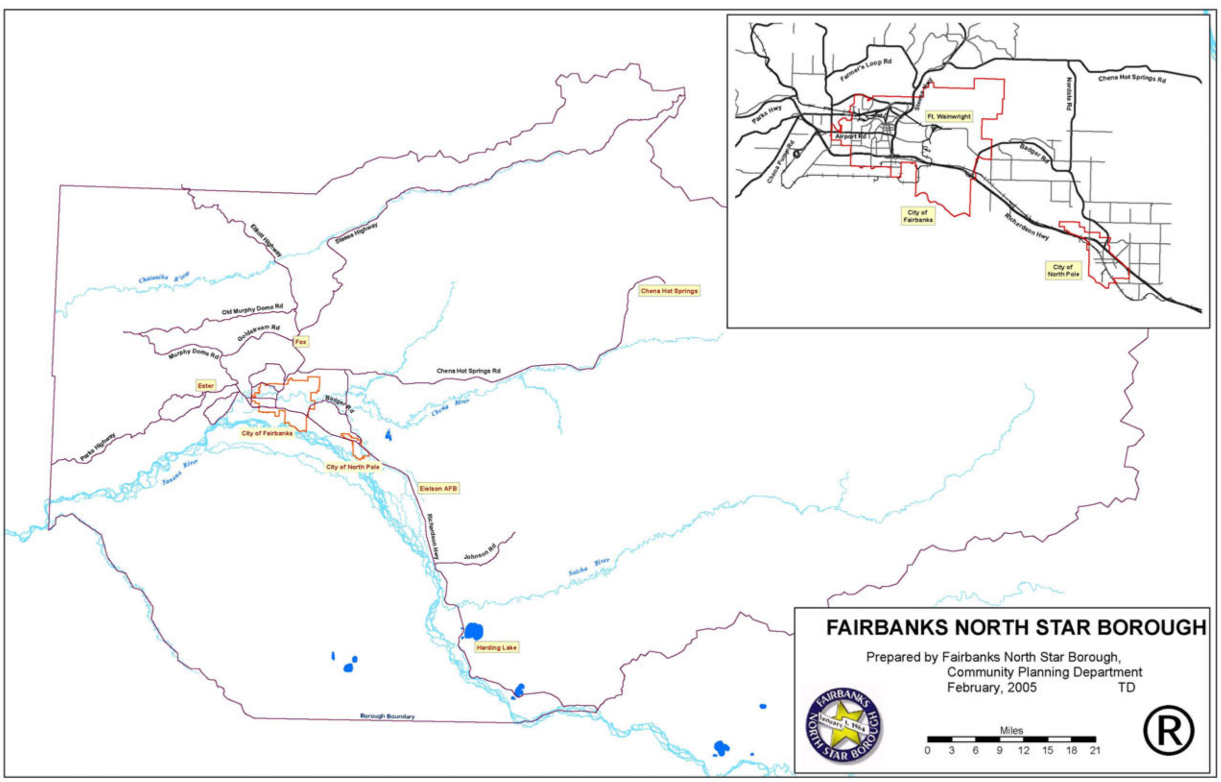
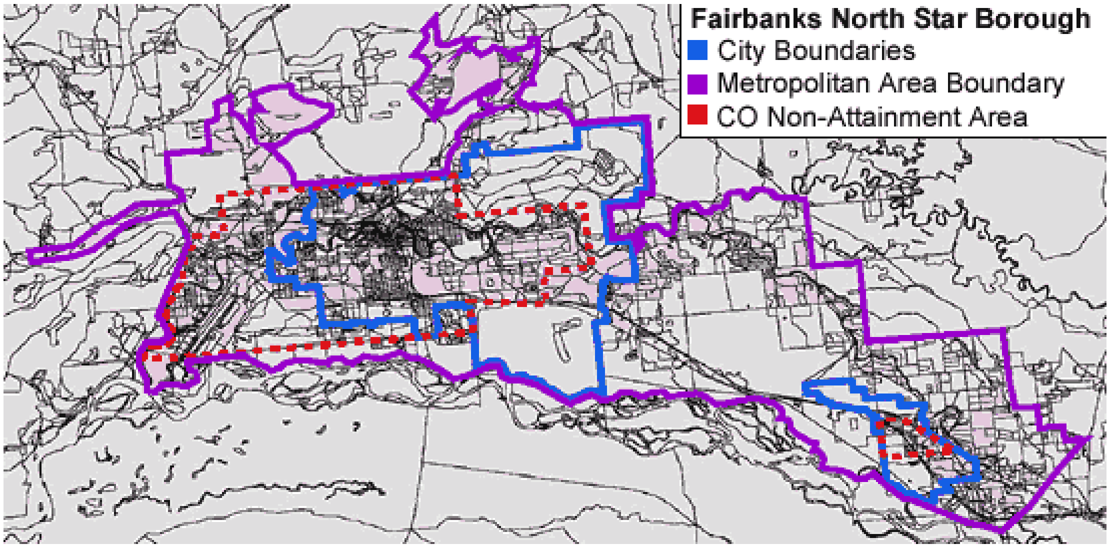


Figure 13: Planning Boundaries in the vicinity of the City of Fairbanks



The proposed boundary submitted by the state of Alaska intersects several planning boundaries as shown in the figures above. In this instance, the area contributing to the violation of the $PM_{2.5}$ NAAQS appears to be larger than those for CO, and larger than the city or metropolitan area boundaries.

Factor 9: Level of control of emission sources

This factor considers emission controls currently implemented for major sources in the Fairbanks area. The emission estimates on Table 1 (under Factor 1) include any control strategies implemented by the states in the Fairbanks before 2005 that may influence emissions of any component of $PM_{2.5}$ emissions (i.e., total carbon, SO_2, NO_x, and crustal $PM_{2.5}$).

While no Fairbanks area sources have been specifically targeted for control of fine particulates at this time, there are some existing controls in place, as summarized below.

- Major stationary sources are controlled through the Alaska Department of Environmental Conservation’s permitting program. With regard to particulate matter, it should be noted that the coal-fired power plants in Fairbanks are controlled with bag houses.

- Mobile sources are controlled by federal fuel and emission rules that limit particulate matter and pre-cursor pollutants. It is not known how effective these controls are at the extreme cold temperatures found in Fairbanks, but improvements should continue to be made as the vehicle fleet turns over.

- Fairbanks has an extensive network of electrical plug-ins powered at 20° F that allows citizens to use engine block heaters to keep their motor vehicle engines warm during cold temperatures. This program significantly reduces CO emissions from cold starting vehicles, but it is not known how much benefit may exist for fine particulate emissions from the use of engine pre-heating.

- The Fairbanks North Star Borough operates a transit program that provides some benefits through reduced VMT from mobile sources.

- A local wood-burning control program exists under the carbon monoxide maintenance plan. To the extent that high $PM_{2.5}$ days occur on days with high CO concentrations, this control program could provide some benefit. It is more likely that a different program will be needed to fully address $PM_{2.5}$ emissions from wood-burning stoves.

- Open burning is prohibited from November 1 through the end of February within the areas of the Borough designated as Urban, Urban preferred commercial, Light or Heavy Industrial, or Perimeter area, with camp fires being an exception.

- Prescribed fire for burns over 40 acres is managed by the Alaska Department of Environmental Conservation through a permitting process and a smoke management plan.

- The Alaska Railroad switched to ultra low sulfur Diesel fuel in 2007, 5 years in advance of EPA's 2012 mandate.

Conclusion:

EPA has reviewed all sources of information made available in this designation process in making a determination for the Fairbanks $PM_{2.5}$ nonattainment area. EPA finds emissions sources in the cities of Fairbanks and North Pole as the primary contributors to elevated $PM_{2.5}$ levels in the Fairbanks violating monitor. In doing so, EPA has designated a $PM_{2.5}$ boundary that captures emission sources that are contributing to violations of the $PM_{2.5}$ standards in Fairbanks, AK. The surrounding boroughs were considered in an examination of many of the factors but the level of emissions, the population densities, and the level of growth in those boroughs, in addition to meteorology and topography eliminated those boroughs as contributors.

Although emission sources are available in the rest of FNSB, their location, magnitude and meteorology makes contribution from those sources virtually impossible during high $PM_{2.5}$ days in Fairbanks. A majority of the borough other than the cities of Fairbanks and North Pole have extremely low population density and are devoid of sources that could contribute to the violations of the $PM_{2.5}$ standard at the Fairbanks $PM_{2.5}$ monitor. Additionally, the metrological and climatological data during the exceedances indicate that transport of air masses is not feasible due to extreme stagnation conditions with calm winds. Even if there were emission sources in the rest of the borough, it would be difficult to transport emissions over long distance, under these meteorological conditions.

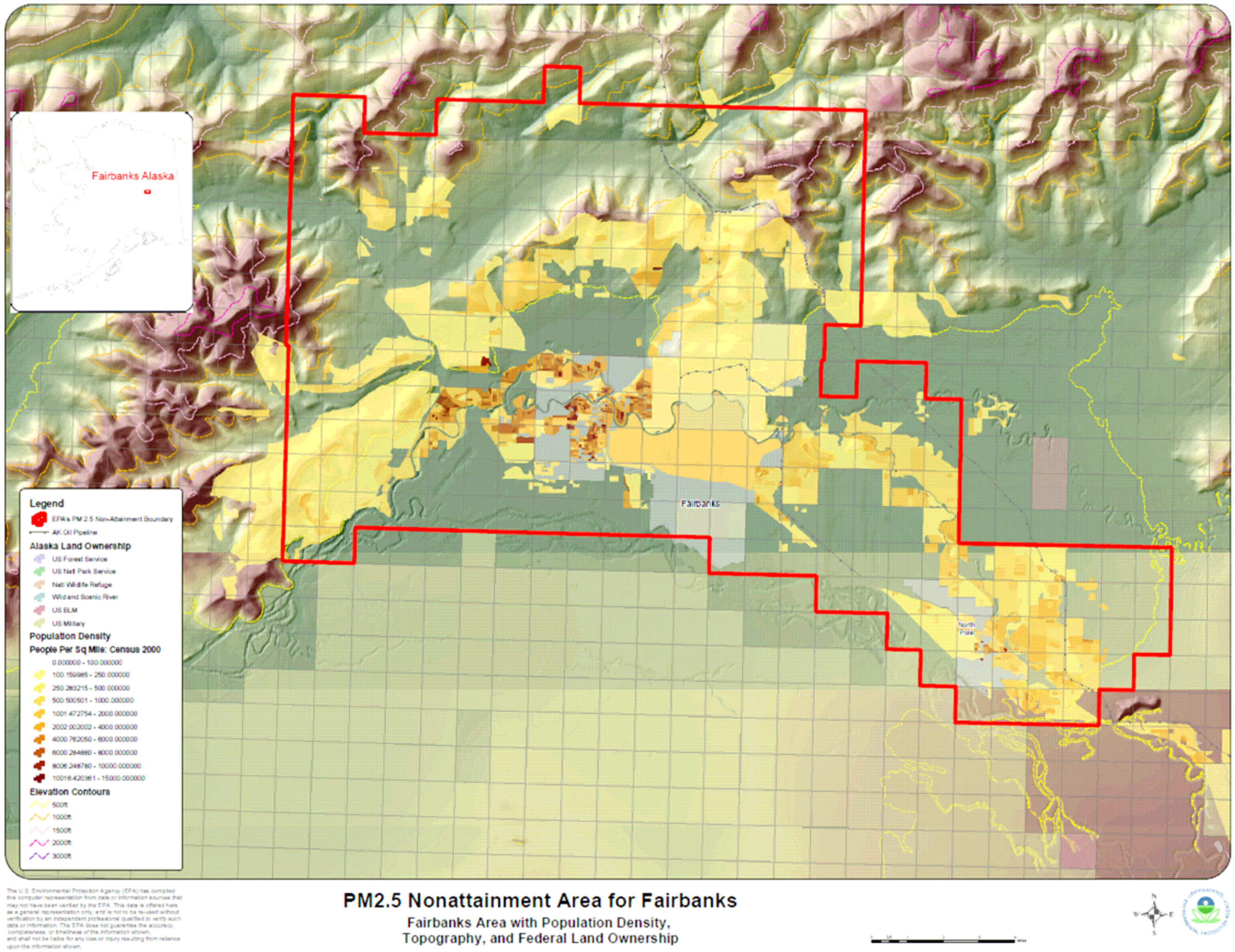
Preliminary data from a monitoring study[8] completed in the winter of 2007 in Fairbanks and North Pole indicate that high $PM_{2.5}$ readings are phenomenon that occurs in the densely populated areas of the Borough. This in addition to the fact that major point and areas sources are available locally in the vicinity of the monitor points to the fact that they are key contributors to elevated $PM_{2.5}$ levels. Additional analysis of weather during episodes of high $PM_{2.5}$ values and found that severe weather and the availability of a mix of sources create an ideal environment for primary and secondary particulates to contribute to high $PM_{2.5}$ levels. Additionally during the high value days in the winters from 2005-2007, the winds are very calm and predominantly drain from the NW, N and NE. Further because there are major sources to the North of the City of Fairbanks, EPA's boundary includes these sources and all residential areas around the City of Fairbanks and the City of North Pole. A text description of EPA's boundary and a map showing EPA's final nonattainment area is shown below in Figure 14.

Township Range Delineated Boundary for the Fairbanks PM2.5 Nonattainment Area

MTRS F001N001 - All Sections, MTRS F001N001E - Sections 2-11, 14-23, 26-34, MTRS F001N002 - Sections 1-5, 8-17, 20-29, 32-36, MTRS F001S001E - Sections 1, 3-30, 32-36, MTRS F001S001W - Sections 1-30, MTRS F001S002E - Sections 6-8, 17-20, 29-36, MTRS F001S002W - Sections 1-5, 8-17, 20-29, 32-33, MTRS F001S003E - Sections 31-32, MTRS F002N001E - Sections 31-35, MTRS F002N001 - Sections 28, 31-36, MTRS F002N002 - Sections 32-33, 36, MTRS F002S001E - Sections 1-2, MTRS F002S002E - Sections 1-17, 21-24, MTRS F002S003E - Sections 5-8, 18.

[8] Analysis_of_Sniffer_Lite_Memo_082008.pdf, submitted to docket.

Figure 14


Fairbanks Alaska
Fairbanks
Legend
EPA's PM 2.5 Non-Attainment Boundary
AK Oil Pipeline
Alaska Land Ownership
US Forest Service
US Nat'l Park Service
Nat'l Wildlife Refuge
Wild and Scenic River
US BLM
US Military
Population Density
People Per Sq Mile: Census 2000
0.000000 - 100.000000
100.159985 - 250.000000
250.283215 - 500.000000
500.500501 - 1000.000000
1001.472754 - 2000.000000
2002.002002 - 4000.000000
4000.762050 - 6000.000000
6000.284880 - 8000.000000
8006.248780 - 10000.000000
10016.420361 - 15000.000000
Elevation Contours
500ft
1000ft
1500ft
2000ft
3000ft
PM2.5 Nonattainment Area for Fairbanks
Fairbanks Area with Population Density,
Topography, and Federal Land Ownership

EPA Technical Analysis for Juneau 24 hour $PM_{2.5}$ Nonattainment Area

Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those nearby areas that contribute to violations. This technical analysis for Juneau identifies the boroughs with monitors that violate the 24-hour PM2.5 standard and evaluates the nearby boroughs that potentially contribute to fine particle concentrations in the area. EPA has evaluated these boroughs based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

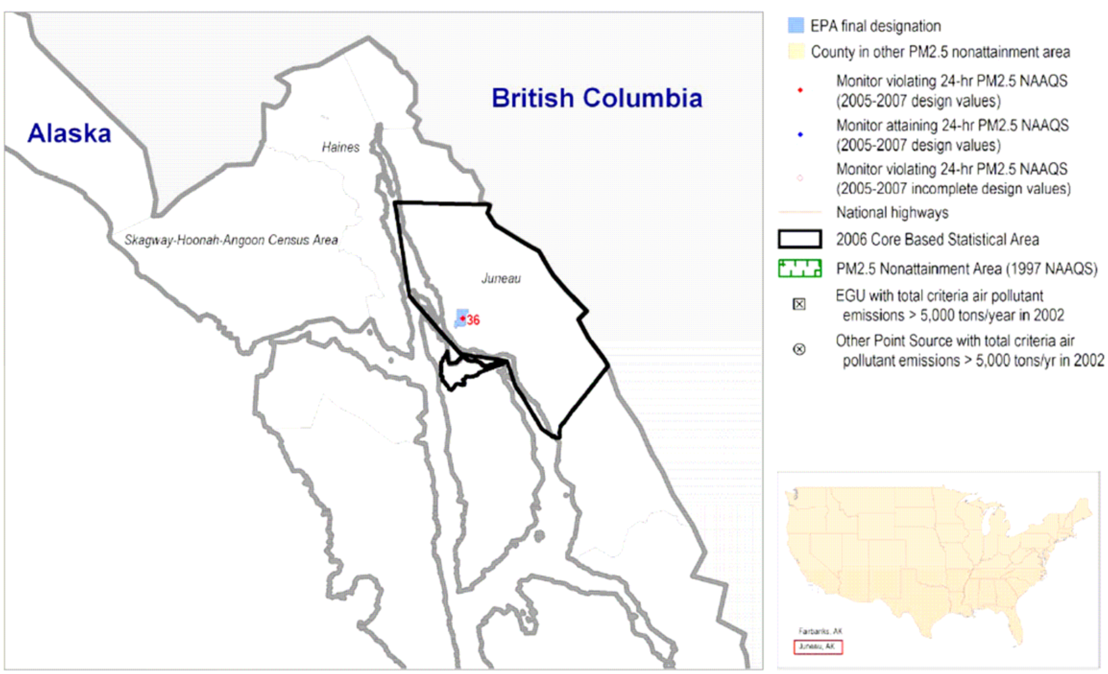
- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

We also used analytical tools and data such as pollution roses, secondary precursor emission data, and a detailed climatological analysis to evaluate these areas.

Figure 1 is a map of the boroughs in the area and other relevant information, such as the locations and design values of air quality monitors, the borough boundary, and EPA's final designated nonattainment area boundary.

Figure 1

Figure 5.24 Juneau, AK 24-hr PM2.5 Nonattainment Area



5-24

On April 17, 2008, EPA informed a designee of the Governor of Alaska that preliminary data from the Mendenhall Valley monitor indicated the area being in violation of the 24 hour $PM_{2.5}$ standard and invited the designee to make recommendations for designations and a boundary. In a letter dated June 2, 2008, a designee of the Governor of Alaska informed EPA that the Mendenhall Valley monitor was potentially in violation of the 2006 24-hr $PM_{2.5}$ standards based on preliminary 2005-2007 design values using data from FRM or FEM monitors in Mendenhall Valley, Juneau. EPA subsequently determined that the air quality monitor at Mendenhall Valley in Juneau, Alaska, was in violation of 2006 24-hr $PM_{2.5}$ standards based on 2005-2007 data, which was certified in July 2008. As the state of Alaska had limited time to prepare a detailed 9 factor analysis for this area, the state submitted the previous PM_{10} boundary as a recommended starting point as they proceeded to refine their boundary recommendation.

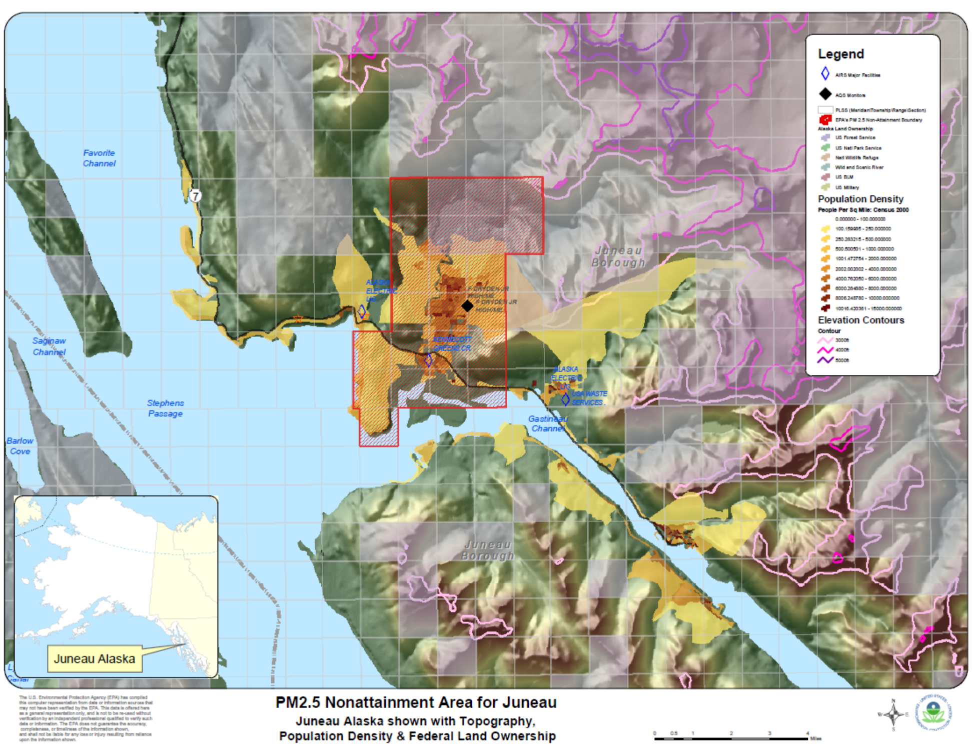
In August 2008, EPA notified the State of Alaska of its intended designations for this area. In this letter, EPA also informed the state if the State of Alaska wished to provide comments on EPA's intended designation, they should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g. partial borough areas) provided by the state in making final decisions on the designations. The State of Alaska submitted substantial supplemental information to EPA to justify its recommendation for a nonattainment area.

Based on EPA's technical analysis described below, EPA has designated the area surrounding Mendenhall Valley in the City and Borough of Juneau as nonattainment for the 24-hour $PM_{2.5}$ air-quality standard, based upon currently available information. These boroughs are listed in the table below.

Juneau Nonattainment Area	**State-Recommended Nonattainment Area**	**EPA-Final Designated Nonattainment Area**
Alaska	Previous PM_{10} Nonattainment area boundary for Juneau	City and Borough of Juneau (partial)

The map below, shown as Figure2, represents EPA's designated nonattainment are for Juneau and the associated legal description.

Figure 2 and Legal Description



Boundary shown above is comprised of the following Township/Range Sections:

MTRS C040S066E32, MTRS C040S065E36, MTRS C040S065E26, MTRS C041S066E04, MTRS C041S066E05, MTRS C040S065E25, MTRS C040S065E13, MTRS C040S066E17, MTRS C040S065E24, MTRS C040S065E12, MTRS C040S066E05, MTRS C040S066E20, MTRS C040S065E35, MTRS C040S066E08, MTRS C040S065E01, MTRS C040S066E29, MTRS C040S066E04, MTRS C040S066E09, MTRS C040S066E31, MTRS C040S066E30, MTRS C040S066E19, MTRS C040S066E18, MTRS C040S066E06, MTRS C040S066E07.

The following is a technical analysis for the Juneau area.

Factor 1: Emissions data

For this factor, EPA evaluated borough level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_x, are part of "$PM_{2.5}$ emissions total," they are not shown on the template or data spreadsheet as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration. Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1[9].

In making 2006 $PM_{2.5}$ nonattainment designations in most areas of the country, EPA also considered the Contributing Emissions Score (CES) for each borough. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of boroughs in and near an area. Note that this metric is not the exclusive way for consideration of data for these factors[10]. A summary of the CES is included in attachment 3. However, because meteorological data to complete this analysis was not available for areas in Alaska, EPA did not consider the CES for the Juneau area.

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) for violating and potentially contributing boroughs in the Juneau nonattainment area. The City and Borough of Juneau was not designated as nonattainment for the 1997 $PM_{2.5}$ NAAQS.

Boroughs adjacent to Juneau are the Haines Borough to the northwest and west, and the Skagway-Hoonah-Angoon (SHA) Census Area, to the south and southwest. Juneau shares its eastern border with the Canadian province of British Columbia to the northeast and east.

Table 1. $PM_{2.5}$ Related Emissions

Borough	State Recommended Nonattainment?	$PM_{2.5}$ emissions total (tpy)	$PM_{2.5}$ emissions carbon (tpy)	$PM_{2.5}$ emissions other (tpy)	SO_2 (tpy)	NOx (tpy)	VOCs (tpy)	NH_3 (tpy)
Juneau	Yes, Partial	306	99	207	413	1278	1979	25
Haines	No	157	26	131	22	106	290	3
SHA	No	208	46	162	46	178	515	4

[9] See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html.
[10] A more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C

The state submitted annual emissions for the City and Borough of Juneau, Alaska for calendar year 2005, which is presented below. These emissions are generally more reliable as they are based on inventory of permitted sources and latest area source data available to the state.

Based on this data, emission sources are located primarily in the populated areas of the borough. Because of Southeast Alaska's complex terrain and the fact that Juneau can be accessed from outlying areas only by boat or plane, emissions from sparsely populated neighboring areas are not contributing factors to emissions in Juneau. With the exception of wildfire smoke transporting into Juneau during the summer fire season, the emissions contributing to pollution in Juneau are the result of local activities. Wintertime area source particulate matter emissions are dominated by wood smoke from residential wood burning. Dust from paved and unpaved roads dominates the particulate matter emissions in the non-road mobile source category. Dust from roads is generally a seasonal source, which is observed primarily on dry days in the springtime.

Table 1.a Summary of City & Borough of Juneau Emissions in 2005 (tons/year, TPY)

Source Category	VOC	NOx	SO_2	PM_{10}_PRI	$PM_{2.5}$_PRI	NH_3	CO
Point	68	1,275	744	162	NA	NA	176
Area	420	74	7	104	64	0	448
Mobile - Onroad	817	716	17	19	15	27	8,794
Mobile – Nonroad[a]	266	156	16	2,791	673	0	2,504
Total Emissions	**1,571**	**2,221**	**784**	**3,076**	**752**	**27**	**11,922**

[a] Please note that emissions from cruise ships and other large ocean going vessels are not included in this inventory summary. These emissions occur seasonally during the summer months in downtown Juneau and do not impact the wintertime particulate matter concentrations in the Mendenhall Valley.

Table 1.b below provides a summary of reported actual emissions for calendar year 2005 for permitted major facilities that are actually located in and operating within the City & Borough of Juneau. The two mines, Kensington and Greens Creek, are remote and off the road system. Greens Creek is over 20 miles to the southwest on Admiralty Island and Kensington is 35 miles to the northwest across Berner's Bay from the terminus of Glacier Highway. As shown in Figure 3, neither mine is in proximity to the populated areas of town or the proposed nonattainment area. The Kensington mine is not fully permitted or operational at this time and recently scaled back its development operations pending the outcome of on-going litigation. Given the location of the mines in relation to the Mendenhall Valley and based on the meteorological information provided later in this document, transport of emissions from these facilities cannot be directly contributing to violation of the standard in Juneau nonattainment area through either primary emissions or secondary formation.

Table 1.b Annual Emissions from Permitted Major Facilities in the City and Borough of Juneau

Facility	2005 Emissions, TPY				
	VOC	NOx	SO_2	PM_{10}_PRI	CO
Alaska Electric Light & Power Auke Bay Standby Generation Station	0	3	1	0	0
Alaska Electric Light & Power Lemon Creek Standby Generation Station	0	9	2	1	4
Coeur Alaska Inc. Kensington Mine Project	3	49	3	3	12
Kennecott Greens Creek Mining Company Kennecott Greens Creek Mine	65	1,214	738	158	160
Total Emissions	68	1,275	744	162	176

Based on information provided by the state, there is limited industrial activity and few permitted stationary sources within the populated areas of Juneau. Juneau is not on a power grid and electricity is generated at a hydroelectric project southeast of town. The local power company, Alaska Electric Light & Power (AEL&P), has two facilities that provide standby or backup power in the event that the community's hydroelectric power is compromised or cannot meet demands. The two backup power generating facilities are located in the Lemon Creek Valley and at

Auke Bay (figure 4). In addition, there is a permitted asphalt plant located at the southern end of the Mendenhall Valley, but this facility is a minor source and does not operate during the winter months when $PM_{2.5}$ concentrations are of concern in the Mendenhall Valley.

Figure 3: Location of Kensington and Kings Creek Mines

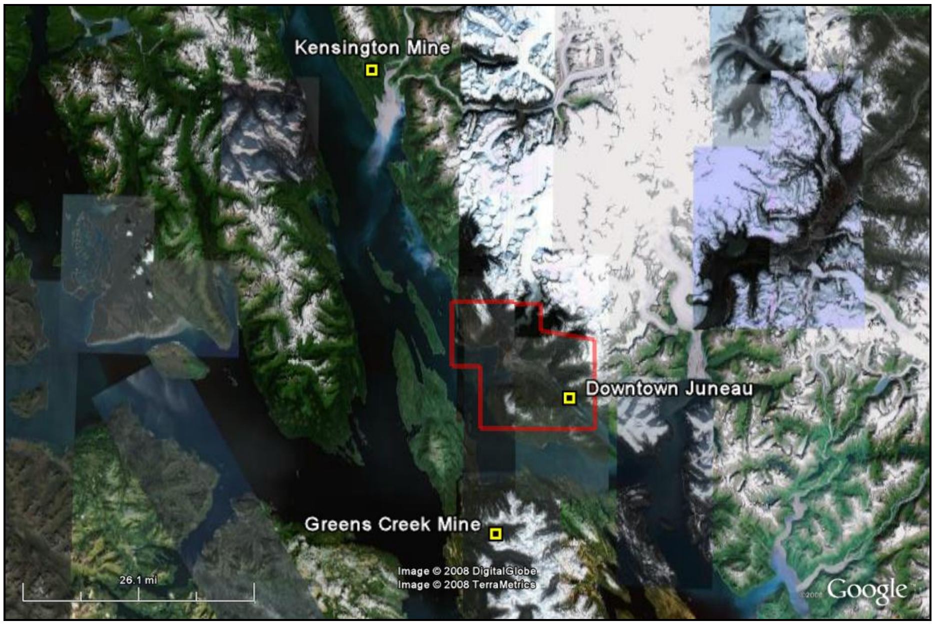


Figure 4: Location of Standby Generators in Juneau

Summary –There are two point sources located within CBJ that appear to be responsible for a significant portion of primary and precursor emissions to $PM_{2.5}$ (primarily NOx and SO_2). Both of these point sources—the Kensington and Greens Creek mines—are remote, off the road system, and separated from populated areas of the community by bodies of water and mountains and as such, do not contribute to high PM2.5 values in the Mendanhall Valley monitor. Actual emissions from the two remaining standby generating stations, located in Auke Bay and Lemon Creek, are very low (in the single digits in tpy). Actual emissions from the standby generators account for 1% of the aggregate NOx and 7% of the SO_2 emitted in Juneau in 2005. Emissions from woodstoves in the Mendenhall Valley area seem to be the primary and most significant contributor to violations of the standard with some emissions also resulting from mobile on-road sources.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in µg/m^3) for air quality monitors in boroughs in the Juneau area based on data for the 2005-2007 period. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98th percentile values are 35 µg/m^3 or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for boroughs in the Juneau area are shown in Table 2. There are no FRM, FEM or alternative monitors in any of the adjacent boroughs.

Table 2. Air Quality Data

Borough	State Recommended Nonattainment?	24-hr $PM_{2.5}$ Design Values, 2004-2006 (µg/m^3)	24-hr $PM_{2.5}$ Design Values, 2005-2007 (µg/m^3)
Juneau	Yes, partial	32	36
Haines	No	No data available	No data available
SHA	No	No data available	No data available

[Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with a FRM or FEM monitor. All data from Special Purpose Monitors (SPM) using an FRM, FEM, or Alternative Reference Method (ARM) which has operated for more than 24 months is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.]

The Alaska Department of Environmental Conservation (ADEC) expressed concerns about the calculation of the $PM_{2.5}$ 24-hour design value for the Mendenhall Valley monitoring site in Juneau, Alaska. The State acknowledged that this monitoring site can approach 35 µgm^{-3} during wintertime inversion episodes; however, the calculation of the design value for this site was biased to a higher value as a result of inclusion of additional sample days. EPA reviewed the entire set of monitoring data submitted by Alaska, recalculated the Design Value and found that the 24-hr $PM_{2.5}$ Design Values for 2005-2007 at the Mendenhall Valley monitor violated the standard. A more detailed response to this is included in EPA's response to state comments.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each borough in the area being evaluated, as well as the population density for each borough in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

As can be seen in Table 3 and the associated population density and topography maps below (figures 5 and 6), Juneau Borough is very sparsely populated and the surrounding boroughs are even more so. Population based emissions are likely to be very limited from areas of Juneau Borough other than the cities of Juneau and Douglas. The State of Alaska has not submitted any information that indicates above average commercial growth or major new or planned expansions of industrial facilities in the area. Although, SHA has emissions comparable to Juneau, the population density for SHA is very low. This supports exclusion of other boroughs from the proposed NAA boundary.

Figure 5: EPA designated $PM_{2.5}$ Nonattainment Area for Juneau Showing Population Densities at the NAA Scale

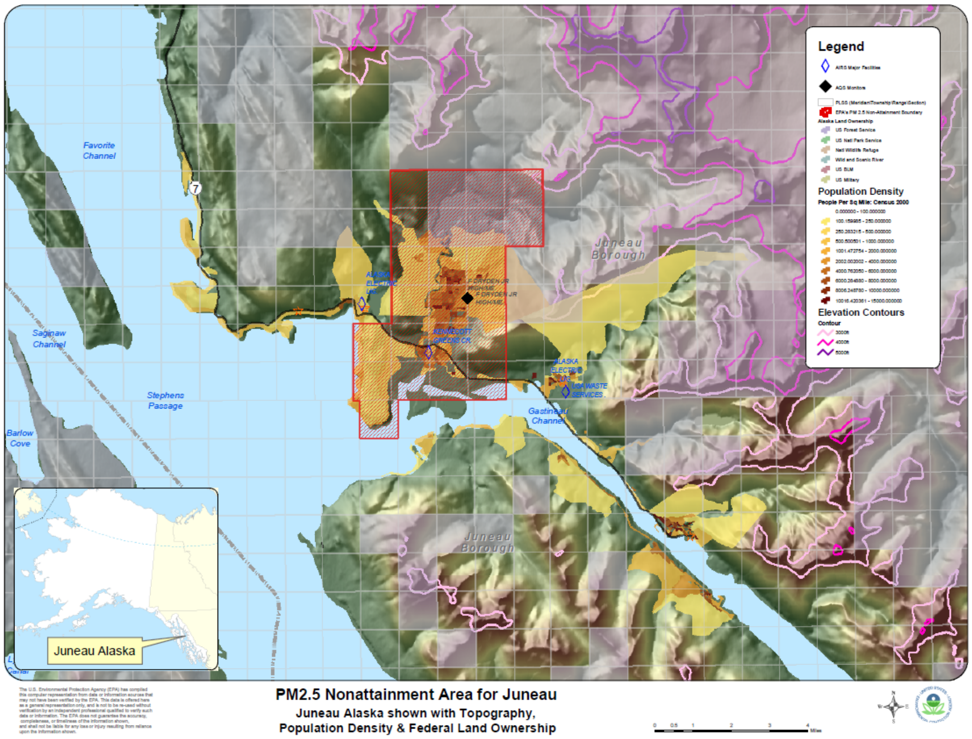


Figure 5: EPA designated $PM_{2.5}$ Nonattainment Area for Juneau Showing Population Densities at the Borough Scale

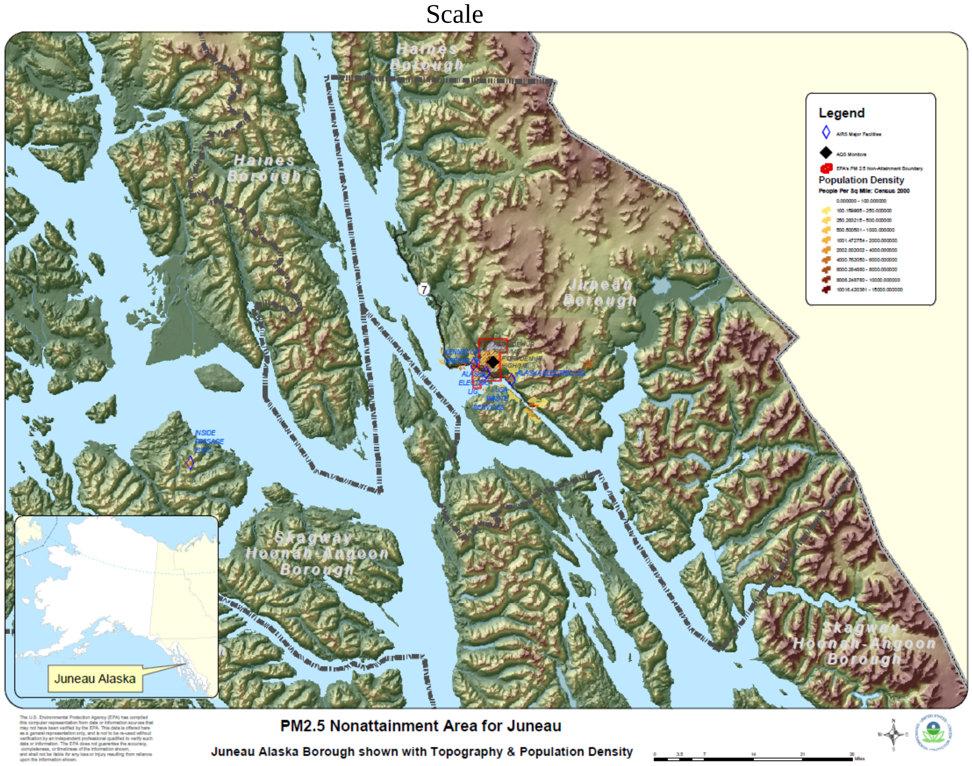


Table 3. Population

Borough	State Recommended Nonattainment?	2005 Population	2005 Population Density (pop/sq mi)
Juneau	Yes	30881	11
Haines	No	2243	1
SHA	No	3137	0

Source: EPA-OAQPS

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each borough who drive to another borough within the Juneau area, the percent of total commuters in each borough who commute to other boroughs within this area, as well as the total Vehicle Miles Traveled (VMT) for each borough in thousands of miles (see Table 4). A borough with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

The listing of boroughs on Table 4 reflects a ranking based on the number of people commuting to other boroughs. The boroughs that are in the nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface

Table 4. Traffic and Commuting Patterns

Borough	State Recommended Non-attainment?	2005 VMT (1000s mi)	Number Commuting to any violating boroughs	Percent Commuting to any violating boroughs	Number Commuting into statistical area	Percent Commuting into statistical area
Juneau	Yes	207	16000	99	16000	99
Haines	No	24	20	2	20	2
SHA	No	34	60	4	60	4

The populated areas of Juneau are located on a narrow coastal plane that is surrounded by water, tall mountains, and glaciers. The result is that Juneau is land-locked—the only access from the outside is by ship or plane. To facilitate access, Juneau is connected to the Alaska Marine Highway System, which means that it has scheduled ferry service. Travel times on the ferry range from roughly one to four hours, although longer trips are available. Practically, this means that Juneau travel activity is not impacted by commutes from outside areas. Further evidence of this conclusion is seen in the counts of vehicles disembarking from the ferries serving Juneau.[11] Using Alaska Marine Highway Statistics, a total of 17,281 vehicles entered and 17,486 vehicles left Juneau in 2005. This translates to fewer than 100 vehicles per day entering and leaving Juneau on average. During the winter months, this value is reduced by more than 50%. Clearly, vehicles commuting into or out of Juneau do not have a significant impact on local air quality.

Within Juneau, the principal commute patterns are between Auke Bay, Mendenhall Valley, Lemon Creek, and downtown along Egan Drive; and between Douglas Island and downtown. Since the Mendenhall Valley is approximately 9 miles from downtown Juneau and it has the largest share of population, the commute along Egan Drive is responsible for a large portion of the travel generated within the community. As noted in the meteorology discussion, emissions produced along Egan Drive, which parallels the Gastineau Channel, are not transported into the Mendenhall Valley prior to or during exceedance conditions.

Summary – As Juneau is isolated from outside communities, the only access is by ship or plane. Vehicle counts show that fewer than 100 vehicles entered and left Juneau on an average day in 2005. During winter months, when $PM_{2.5}$ exceedances are a concern, this number can be reduced by more than 50%. Emissions from external commutes are not contributing to $PM_{2.5}$ violations in Juneau. In contrast, a significant share of travel is produced by commutes between the Mendenhall Valley and downtown Juneau. Emissions from that travel, however, occur

[11] http://www.dot.state.ak.us/amhs/info/general/stats/05tvr/ATVR2005.pdf

primarily outside of the Mendenhall Valley airshed and do not impact concentrations recorded there. All the preceding factors indicate that the surrounding boroughs are not contributors to the $PM_{2.5}$ violations in the Juneau monitor.

The 2005 VMT data used for table 5 and 6 of the 9-factor analysis have been derived using methodology such as that described in "Documentation for the 2005 Mobile National Emissions Inventory, Version 2," December 2008, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: ftp://ftp.epa.gov/EmisInventory/2005_nei/mobile_sector/documentation/2005_mobile_nei_version_2_report.pdf

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled for 1996-2005 for boroughs in Juneau, as well as patterns of population and VMT growth. A borough with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for boroughs that are included in the Juneau Area. Boroughs are listed in descending order based on VMT growth between 1996 and 2005. The data, summarized in Tables 5 and 5.a shows that Juneau experienced slow growth in population and negative growth in VMT.

Table 5. Population and VMT Values and Percent Change.

Location	Population (2005)	Population Density (2005)	Population % change (2000 - 2005)	2005 VMT (1000s mi)	VMT % change (1996 to 2005)
Juneau	30881	11	1	207	(10)
Haines	2243	1	(7)	24	10
SHA	3137	0	(9)	34	(1)

Table 5.a: Juneau Annual Average Daily Traffic Counts 1996–2005

Station #	Station Description	RU/FC[a]	CDS Route	Mile Post	AADT by Year										AADT % change (1996 to 2005)
					2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	
60333000	Egan Drive	U/OPA	296000	2.579	23,341	23,863	23,902	23,637	23,514	23,681	23,785	24,433	23,992	23,947	-2.531
60311000	Glacier Highway	U/MART	296000	14.072	2,028	2,089	2,015	2,019	2,007	2,005	2,333	2,487	2,419	2,454	-17.359
60348000	Douglas Highway	U/MART	296110	1.036	8,528	8,638	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-1.273
60500370	Riverside Drive	U/COL	296500	1.471	4,522	4,613	4,563	4,615	4,617	4,641	4,630	4,727	4,914	5,036	-10.207

[a] U=Urban (in Juneau's case "small"); OPA = Other Principle Arterial – Other; MART = Minor, Arterial; COL = Collector

The following explains the relevance of the stations included within the table:

- **Egan Drive** – Provides the only link between downtown Juneau and populated areas to the northwest (i.e., Mendenhall Valley, Lemon Creek, etc.). Since there is no other route from downtown to these areas, it captures changes in both commute and work trips and should be highly representative of activity within Juneau.

- **Glacier Highway** – Is a continuation of Egan Drive to the west of the Mendenhall Valley into Auke Bay, Eagle Beach, and Lena Cove. Thus, it captures commute and work trips between these communities and downtown.
- **Douglas Highway** – Runs along the northern edge of Douglas Island. It captures both commute and work trips between Douglas Island and downtown Juneau.
- **Riverside Drive** – Runs the entire length of the populated portion of the Mendenhall Valley with a north-south orientation. It captures traffic activity within the largest populated area within Juneau. It also provides insight into vehicle activity impacting concentrations recorded at the Floyd Dryden monitoring site.

To place EPA's estimate of travel growth in perspective, several calculations were performed. First, the 2005 estimate of 207,000 miles was adjusted to represent baseline travel in 1996, which, after correcting for errors[12] and the projected 62% increase, is 127.8 million miles/year (350,076 miles per day). Next, the station-specific % change values presented in Table 7 were weighted in proportion to the miles of roadway represented by each count station. A summary of that calculation is presented in Table 5.b. Combining the weighted average 9.7% reduction in traffic activity with the 1996 estimate of travel produces an annual estimate of 115.4 million miles per year in 2005 (316,254 miles per day).

Table 5.b: Weighted Average Juneau AADT Growth 1996 – 2005 (% change)

Facility Type	Length in Miles[a]	% Share	% Change in AADT
Collector	62.4	19.7	-10.207
Minor Arterial	38.2	12.1	-9.316
Principal Arterial	17.3	5.5	-2.531
Local	198.2	62.7	-10.207[b]
Total	316.1	100.0	-9.677

[a] http://www.dec.state.ak.us/air/anpms/as/doc/JAN06_Draft_Juneau_EI_&_Apps.pdf
[b] Since no values were collected for local roads, they were assumed to be represented by measurements on the nearest road category (i.e., collectors).

The local traffic count data demonstrate that travel activity within Juneau actually declined by almost 10% over the same timeframe. This in turn demonstrates that motor vehicle emissions in Juneau have most likely declined over the past decade because of reductions in VMT and the benefits of a cleaner vehicle fleet (due to the replacement of older dirtier vehicles with newer vehicles meeting more stringent emissions standards).

Another insight into growth in Juneau comes from a review of population changes over the past decade. The stability of Juneau's population is illustrated below in Table 5.c. It shows that between 1996 and 2007, the population had increased by a total of 3.7% (an annualized rate of growth of 0.3%/year). The annual change is quite volatile, with year-to-year changes frequently changing from positive to negative.

[12] The VMT estimate of 207,000 presented in Table 5 of the Juneau analysis in Attachment 1 of EPA's August 18, 2008 letter to Gov. Palin, is an annual estimate of travel. Using this value, the daily estimate of travel in Juneau would be 567 miles per day. Discussions with Region 10 staff confirmed the error and determined that it was off by a factor of 1,000. The adjusted value of 207 million miles was used in calculating the baseline 1996 value. The basis for the 62% growth estimate in unknown but as established to be in error by more verifiable data from state and local agencies.

Table 5.c: Trends in Juneau Population between 1996 and 2007		
Year[a]	Population	Year-to-Year Change Relative to 1996
1996	29,230	-
1997	29,713	1.7%
1998	30,021	1.1%
1999	30,189	0.6%
2000[b]	30,711	1.8%
2001	30,453	-0.9%
2002	30,997	1.9%
2003	30,294	-2.4%
2004	31,122	2.8%
2005	31,225	0.4%
2006	30,811	-1.4%
2007	30,305	-1.7%

[a] Alaska Department of Labor and Workforce Development
[b] U.S. Census Bureau

Summary **–** The traffic counts presented for this factor above show that instead of growing, travel activity in Juneau declined by almost 10% over the past decade. Population data show that growth is slow and stable. almost non-existent and support this finding. Together these data strongly indicate that vehicle related emissions in Juneau have trended down due to a combination of lower traffic and cleaner vehicles in the area.

Factor 6: Meteorology (weather/transport patterns)

For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on "high $PM_{2.5}$ days" for each of two seasons (an October-April "cold" season and a May-September "warm" season). These high days are defined as days where any FRM or FEM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a "pollution rose" to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour $PM_{2.5}$ values by color; days exceeding 35 ug/m^3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

As shown in the pollution rose in Figure 6, on high $PM_{2.5}$ days prevailing surface winds are calm with a slight drift from the east, indicating a slow drainage from the Lemon Creek Valley. The pollution roses show that 24-hour $PM_{2.5}$ concentrations are influenced by emissions from any direction at various times, but these data also suggest that emissions from some directions relative to the violation are more likely to contribute to the violation than emissions from other directions.

In addition, the state submitted detailed meteorological analysis for three events between 2005 and 2007. Analysis of the monitoring data shows that transport of emissions from populated areas within Juneau into the Mendenhall Valley did not occur prior to or during episodes when the ambient $PM_{2.5}$ standard was exceeded. Generally, it was found that prior to each episode winds were predominantly from the east-northeast, a direction that prevented any transport of emissions into the Valley. It was also found that winds within the Mendenhall Valley were either calm or generally flowed toward the Airport from the Mendenhall Valley during high $PM_{2.5}$ days, indicating that pollutant transport from areas outside of the Valley could not have occurred. Furthermore, during one episode, it was found that winds at the Airport remained above 5 knots, while those in the Valley were calm, indicating that air flow in the Gastineau Channel can be completely independent from air flow in the Valley

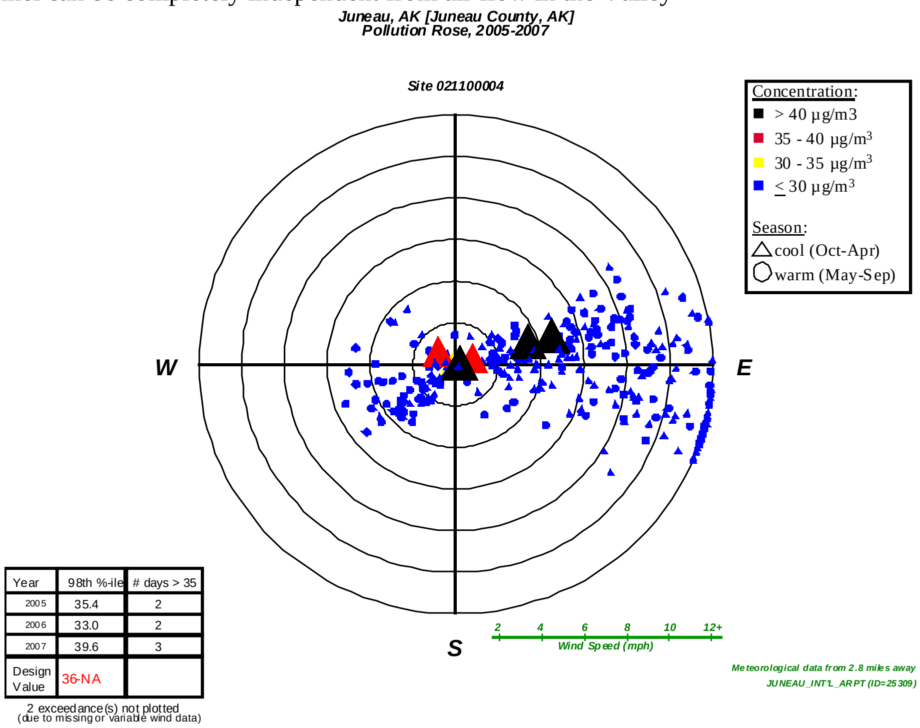


Figure 6: Pollution Rose with meteorological data from the Juneau International Airport

Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis looks at physical features of the land that might have an effect on the air shed and, therefore, on the distribution of $PM_{2.5}$ over Juneau and Mendenhall Valley.

The City of Juneau lies on the Gastineau Channel at sea-level. This area covers populated areas around highway 7 and major point sources around the City of Juneau. Topographically to the north, northeast, and east hills rise to about 3000 and 4000 ft. To the South the city is bounded by the Gastineau Channel and there is a island with a topographical barrier of 3000 ft extending almost to the Stephen passage. To the west of the city also are some smaller topographical features which slope over the Favorite Channel, which is large water body directly connected to the Northern Pacific Ocean.

There are three primary areas of interest in Juneau in terms of impact on the $PM_{2.5}$ monitors. The interplay of local mountains, valleys, and water bodies define these three geographical areas. The Downtown and Douglas areas are distinct from the Lemon Creek Valley, which in turn is distinct from the Mendenhall Valley. Figure 7 shows that Downtown is separated from the Lemon Creek Valley by a mountain range that includes the 3,576 foot Mt. Juneau.

The Downtown and Douglas communities cling to the mountainsides on the tailings of historical mining operations. By contrast, populated areas in the Lemon Creek and Mendenhall Valley exist in valleys carved by glaciers now retreating into the ice field. Figure 8 presents a topographic map that illustrates the terrain surrounding each of those two areas.

The rugged terrain influences local temperatures and the distribution of precipitation and wind, creating considerable variation in weather within relatively short distances. The space between the mainland and Douglas Island mountains is narrow, squeezing rain from moisture-laden clouds from the ocean. Downtown and Douglas receive nearly 93 inches of rain annually. The Juneau Airport, only eight miles away at the mouth of the Mendenhall Valley, has a much wider space between mainland and Douglas Island mountains, and experiences 53 inches annually.

Figure 7: Topography Separating Lemon Creek from Downtown and Douglas

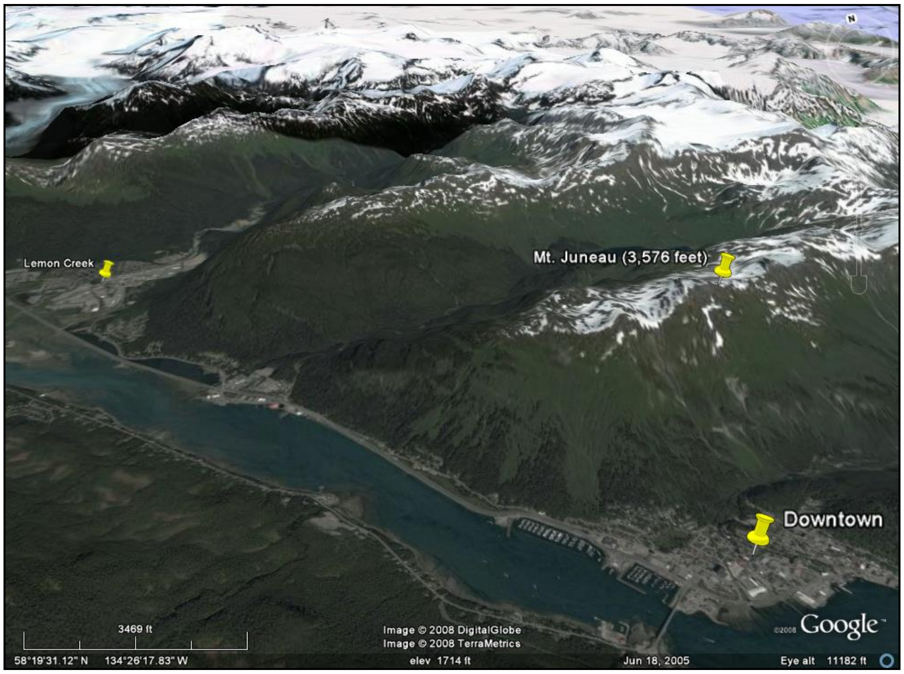
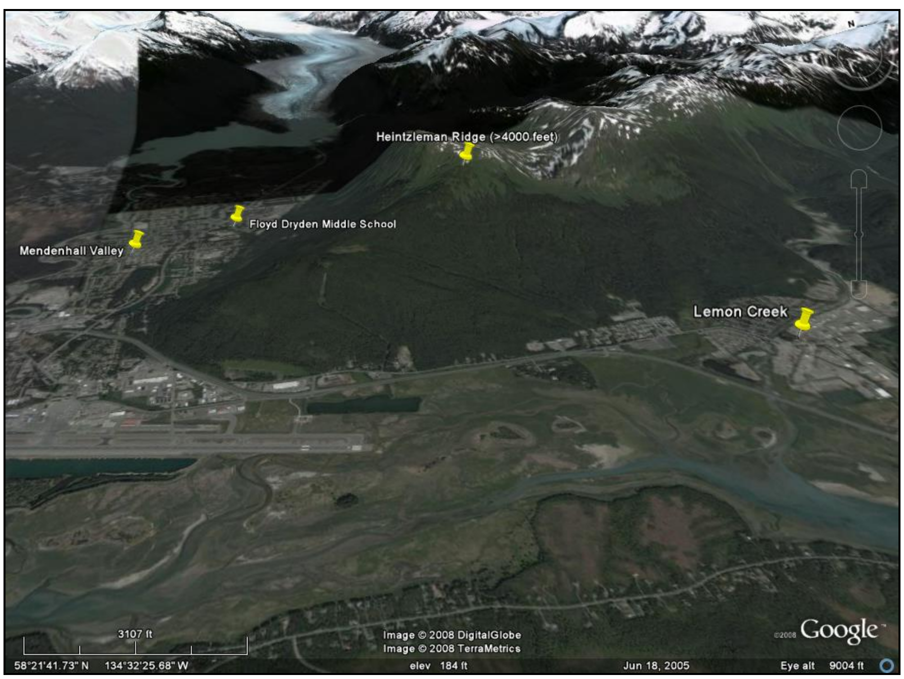


Figure 7: Heintzleman Ridge, which includes Thunder Mountain and tops out at over 4,000 feet, separates Lemon Creek Valley from the Mendenhall Valley.

Figure 8: Topography Separating Lemon Creek from Mendenhall Valley



Periods of severe cold usually start with strong northerly winds, and are often caused by a flow of cold air from northwestern Canada through nearby mountain passes and over the Juneau ice field. These winds are generally brief but strong and gusty and are known locally as Taku Winds. Again, due to the varied topography, these winds are often experienced in downtown Juneau, Douglas, and other local areas, but are generally not felt in the Mendenhall Valley according to the National Climate Data Center.

Summary – The three principal populated areas of Juneau (i.e., Downtown and Douglas, Lemon Creek, and the Mendenhall Valley) are geographically distinct from each other. Significant terrain features such as mountain ranges in excess of 3,000 feet and waterways isolate each area and create barriers to air movement and mixing between these areas, especially during exceedances. The differences in terrain also create large variations in local weather.

Factor 8: Jurisdictional boundaries (e.g., existing PM areas)

In evaluating the jurisdictional boundary factor, consideration should be given to existing boundaries and organizations that may facilitate air quality planning and the implementation of control measures to attain the standard. Areas designated as nonattainment (e.g: for 1997 $PM_{2.5}$ standards) represent important boundaries for state air quality planning.

Part of the Borough of Juneau area is a PM_{10} nonattainment area with boundaries as shown below.

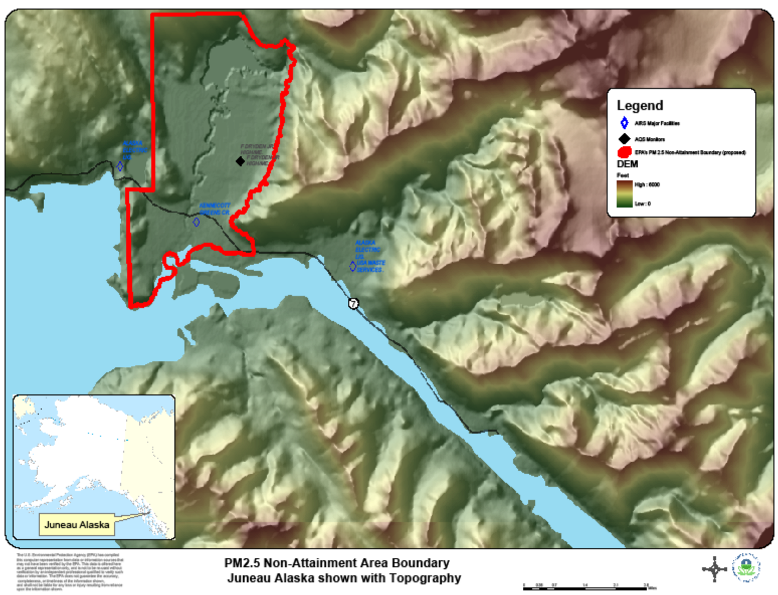


Figure 9. Map of Juneau depicting the previous PM_{10} nonattainment area

Factor 9: Level of control of emission sources

This factor considers emission controls currently implemented for major sources in the Juneau NAA.

The emission estimates on Table 1 (under Factor 1) include any control strategies implemented by the states in the Juneau before 2005 that may influence emissions of any component of $PM_{2.5}$ emissions (i.e., total carbon, SO_2, NOx, and crustal $PM_{2.5}$).

The area is maintaining the 24 hour PM_{10} standard and controls instituted based on the State Implementation Plan are in effect in this area. Juneau recently amended its wood burning ordinance to institute burn bans when concentrations approach the threshold of the 24-hour ambient $PM_{2.5}$ standard instead of the ambient PM_{10} standard. The community has taken the action required to ensure continued attainment of the ambient $PM_{2.5}$ standard. The ordinance is now effective.

Conclusion:

In response to additional emissions and meteorological information submitted by the State of Alaska, EPA is revising the intended designation boundary for the Juneau, AK 24-hour $PM_{2.5}$ nonattainment area to a smaller boundary. EPA is designating part of the Borough of Juneau as nonattainment for the 2006 24-hour $PM_{2.5}$, as described below, and as shown in Figure 10.

Township Range Section Delineated Boundary for the Juneau $PM_{2.5}$ nonattainment area:

> MTRS C040S066E32, MTRS C040S065E36, MTRS C040S065E26, MTRS C041S066E04, MTRS C041S066E05, MTRS C040S065E25, MTRS C040S065E13, MTRS C040S066E17, MTRS C040S065E24, MTRS C040S065E12, MTRS C040S066E05, MTRS C040S066E20, MTRS C040S065E35, MTRS C040S066E08, MTRS C040S065E01, MTRS C040S066E29, MTRS C040S066E04, MTRS C040S066E09, MTRS C040S066E31, MTRS C040S066E30, MTRS C040S066E19, MTRS C040S066E18, MTRS C040S066E06, MTRS C040S066E07.

Assessment of the factors and other relevant information, including additional emissions and meteorological data, provided stronger evidence that, during exceedances of the standard, nearly all of the $PM_{2.5}$ is from residential wood combustion. Also, topography, combined with meteorology for this area, provides further support for this smaller nonattainment area boundary, as the boundary still encompasses the population and population-based activities that contribute to $PM_{2.5}$ mass on days with exceedances of the 24-hour $PM_{2.5}$ NAAQS.

<u>**EPA's designated $PM_{2.5}$ nonattainment area for Juneau, Alaska**</u>

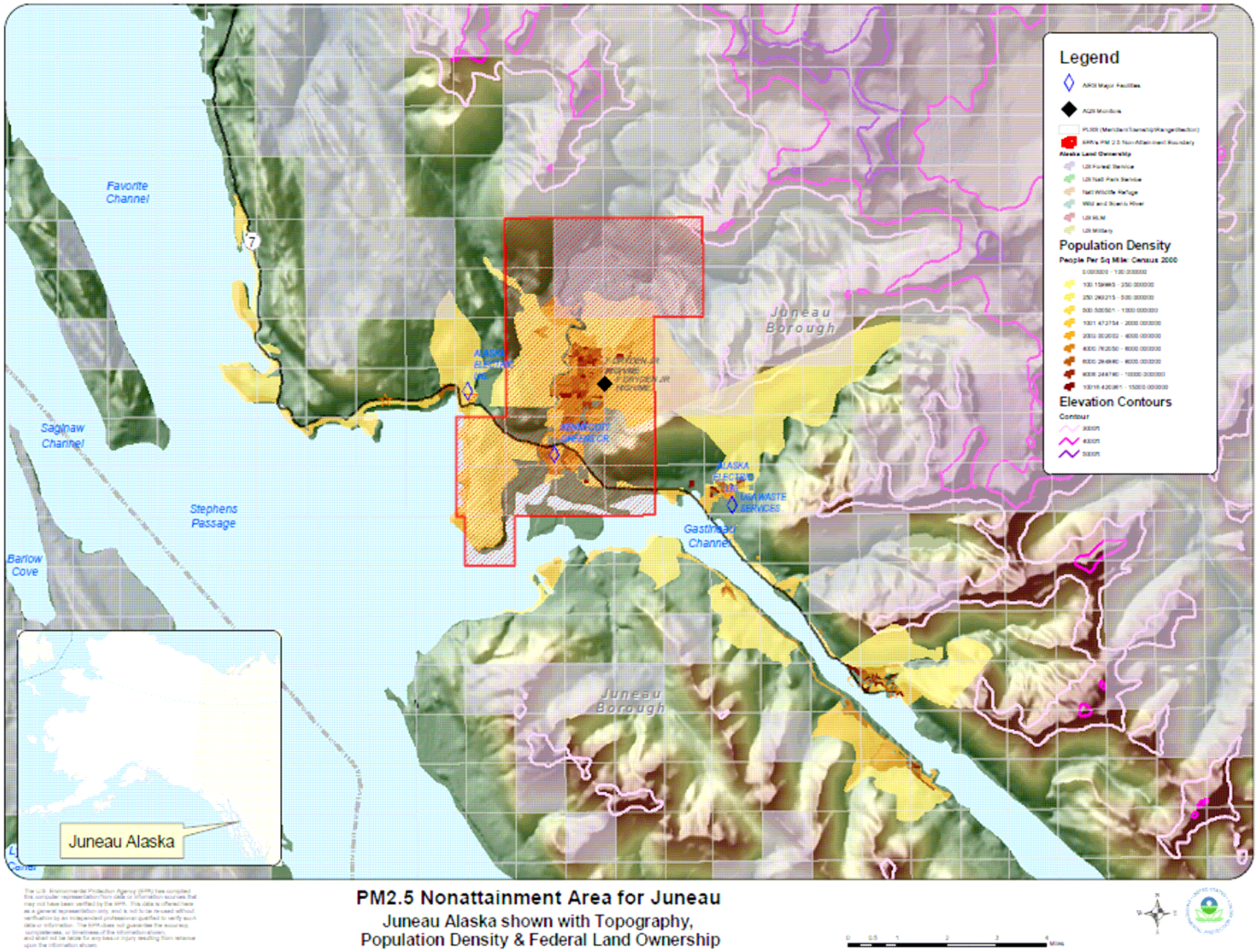


Figure 10

Attachment 3

Description of the Contributing Emissions Score[13]

The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of boroughs in and near an area. Using this methodology, scores were developed for each borough in and around the relevant metro area. The borough with the highest contribution potential was assigned a score of 100, and other borough scores were adjusted in relation to the highest borough. The CES represents the relative maximum influence that emissions in that borough have on a violating borough. The CES, which reflects consideration of multiple factors, should be considered in evaluating the weight of evidence supporting designation decisions for each area.

The CES for each borough was derived by incorporating the following significant information and variables that impact $PM_{2.5}$ transport:

Major $PM_{2.5}$ components: total carbon (organic carbon (OC) and elemental carbon (EC)), SO_2, NO_x, and inorganic particles (crustal).
$PM_{2.5}$ emissions for the highest (generally top 5%) $PM_{2.5}$ emission days (herein called “high days”) for each of two seasons, cold (Oct-Apr) and warm (May-Sept)
Meteorology on high days using the NOAA HYSPLIT model for determining trajectories of air masses for specified days
The “urban increment” of a violating monitor, which is the urban $PM_{2.5}$ concentration that is in addition to a regional background $PM_{2.5}$ concentration, determined for each $PM_{2.5}$ component
Distance from each potentially contributing borough to a violating borough or boroughs

[A more detailed description of the CES can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.]
Attachment 2

[13] A more detailed description of the CES can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C

[i]. Census data supplied by the Alaska Department of Transportation and Public Facilities (ADOT&PF).