Alaska Air Quality Control Plan Volume II. Section III.D.5
Fairbanks North Star Borough (FNSB)
Fine Particulate Matter ($PM_{2.5}$) Moderate Area Attainment Plan

5.1 Executive Summary

5.1.1 Overview

This executive summary is meant to provide the public an overview of the air quality plan or State Implementation Plan (SIP) for the Fairbanks North Star Borough (FNSB) fine particulate matter ($PM_{2.5}$) nonattainment area. The plan has been developed to address federal SIP requirements. The following sections and their associated appendices provide detailed information on the local $PM_{2.5}$ pollution problem area, air monitoring data and network, emission sources and levels, control strategies and contingency measures, technical modeling to project future emission trends, and emergency episode plan. The plan also identifies the statutes, regulations, and ordinances that support the efforts to reduce air pollution in the community. Finally the plan addresses motor vehicle emissions and their link to transportation planning efforts in the community. While many of these sections build and rely upon each other, readers will find that the plan contains some redundancies that are meant to assist in reviewing sections without having to refer back too frequently to other sections.

This plan contains thirteen total sections and associated appendices as follows:

5.1	Executive Summary
5.2	Background and Overview of $PM_{2.5}$ Rule
5.3	Nonattainment Boundary and Design Day Episode Selection
5.4	Ambient Air Quality and Trends
5.5	$PM_{2.5}$ Network and Monitoring Program
5.6	Emission Inventory Data
5.7	Control Strategies
5.8	Modeling
5.9	Attainment Demonstration
5.10	Contingency Plan
5.11	Emergency Episode Plan
5.12	Assurance of Adequacy
5.13	Conformity and Motor Vehicle Emission Budget

5.1.2 Background on $PM_{2.5}$

The Clean Air Act (CAA) requires EPA to set air quality standards (40 CFR Part 50) to protect the health and the welfare of the public and the environment. The law requires EPA to periodically review and update the standards to ensure that health and environmental protection are adequate based on the scientific justifications. EPA has set National Ambient Air Quality Standards (NAAQS) for six principal criteria pollutants and particulate matter (PM) is one of these.

Particulate pollution includes a complex mixture of both solid particles and liquid droplets found in the air. These particles come in different sizes and shapes; particulates less than 10 micrometer (PM_{10}) pose health concerns because they can be inhaled and cause respiratory problems and particles less than 2.5 micrometer ($PM_{2.5}$) in size, also known as “fine particles” can lodge deeply into lungs and enter the bloodstream causing numerous health problems.

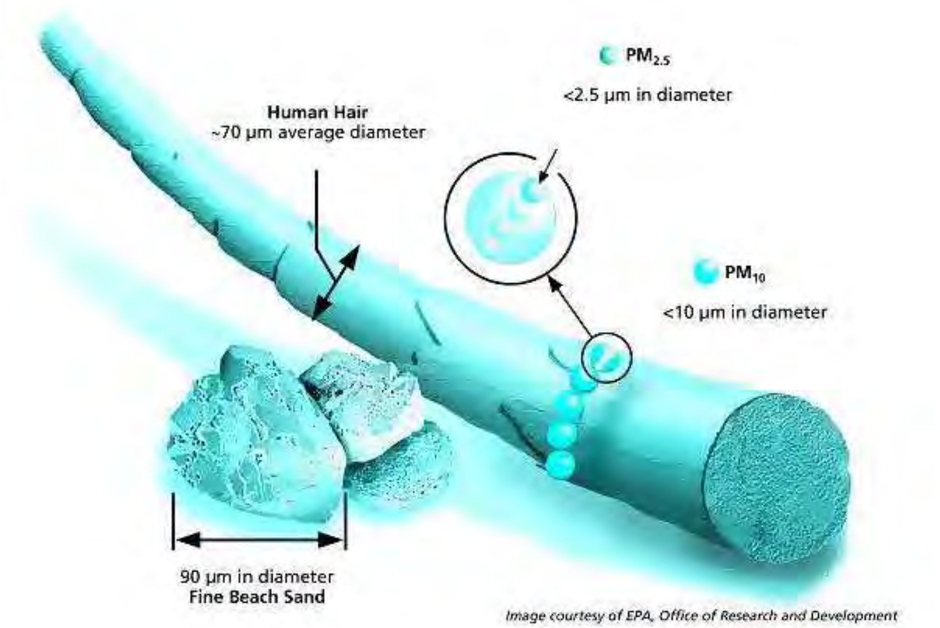

Figure 5.1-1. Particle Size Comparison

Health studies have shown a significant association between exposure to fine particles and premature mortality. Other important effects include aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions, emergency room visits, absences from school or work, and restricted activity days), lung disease, decreased lung function, asthma attacks, and certain cardiovascular problems such as heart attacks and cardiac arrhythmia. Individuals particularly sensitive to fine particle exposure include older adults, people with heart and lung disease, and children.

Sources of fine particles include all types of combustion activities (motor vehicles, power plants, wood burning, etc.) and certain industrial processes. Particles with diameters between 2.5 and 10 micrometers are referred to as "coarse." Sources of coarse particles include crushing or grinding operations, and dust from paved or unpaved roads.

5.1.3 Designating the FNSB $PM_{2.5}$ Nonattainment Area

In 1997, EPA established the first annual and 24-hour NAAQS for $PM_{2.5}$. In 2006, EPA strengthened the 24-hour ambient $PM_{2.5}$ standard from 65 micrograms per cubic meter (µg/m^3) to 35 µg/m^3. States were required to examine monitoring data collected within their communities and make designation recommendations based on the new standard by December 2007. Compliance with ambient air quality standards is based on the calculation of a "design value" for individual monitors consistent with the calculation of the applicable standard. For the 24-hour ambient $PM_{2.5}$ standard, the design value is calculated from the 3-year average of annual 98th percentile values.

In 2009, EPA designated Fairbanks as nonattainment for the 24-hour $PM_{2.5}$ standard using measurements collected at the State Office Building over the previous 3-year period, 2006 – 2008. The 98th percentile value for each of those years was 42.2 µg/m^3, 33.1 µg/m^3 and 46.7 µg/m^3; collectively they produced a $PM_{2.5}$ design value of 41 µg/m^3 for the 3-year period ending in 2008. Design values are updated each year, based on the previous 3-years of data. Figure 5.1-2 shows the 98th percentile values and design values for the State Office Building monitor from 2000-2013. The EPA designated boundary of the Fairbanks North Star Borough (FNSB) $PM_{2.5}$ nonattainment area is depicted in Figure 5.1-3.

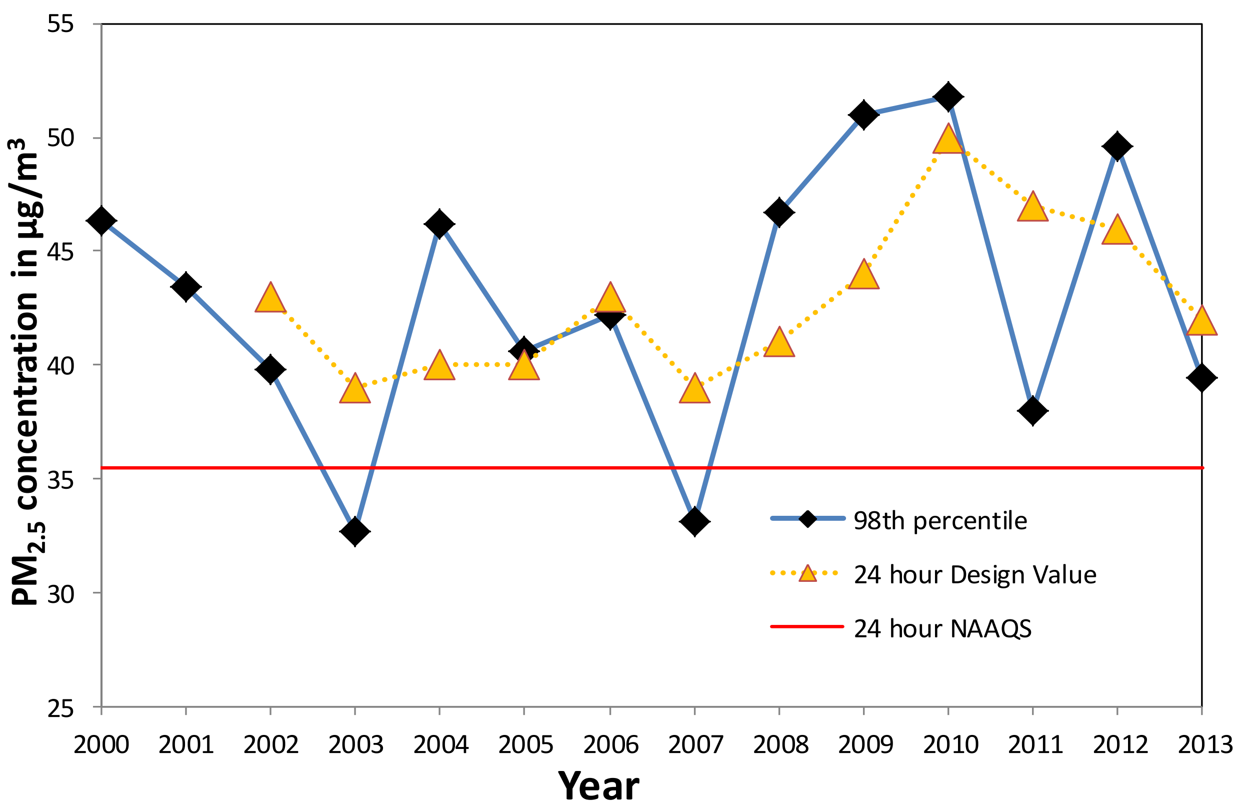

Figure 5.1-2 Fairbanks State Office Building Design Value Concentrations

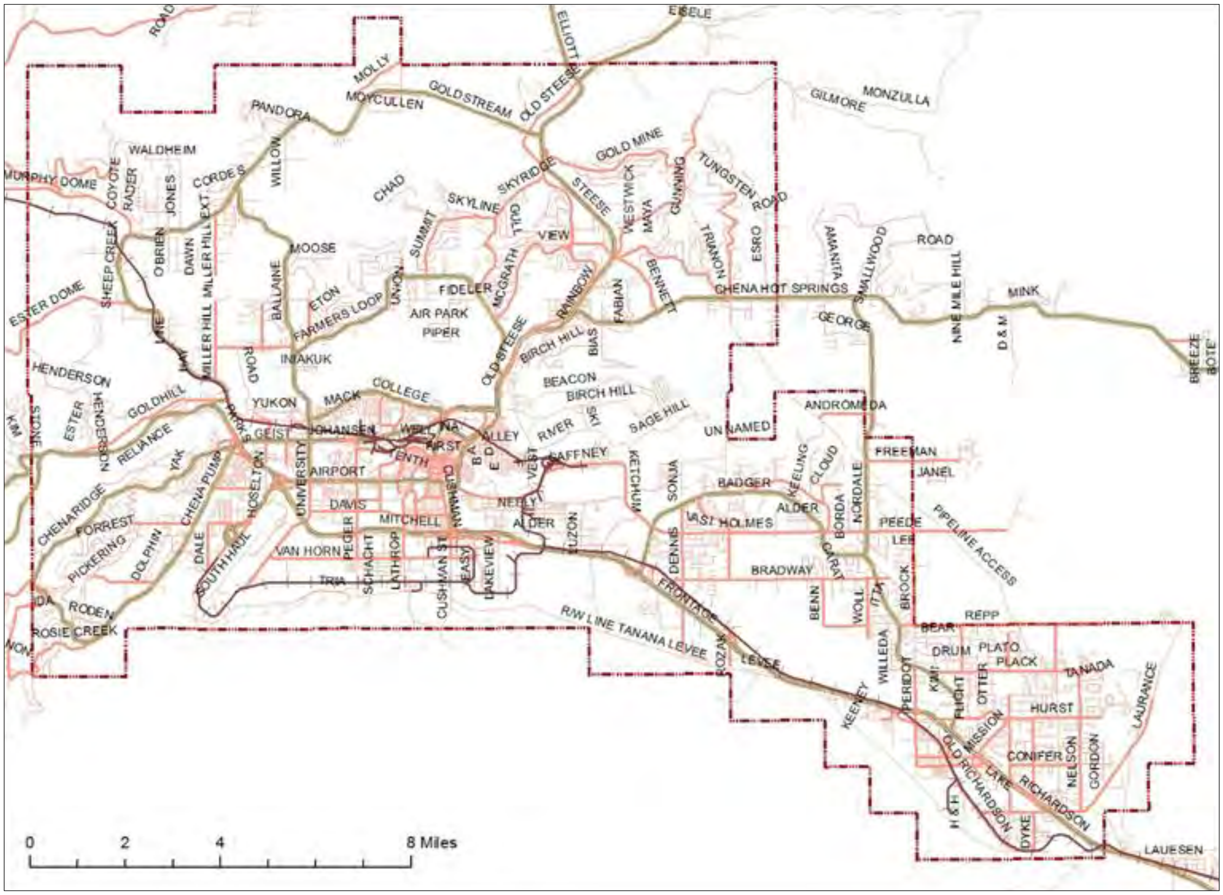

Figure 5.1-3. Fairbanks $PM_{2.5}$ Nonattainment Boundary

5.1.4 Developing an Air Quality Attainment Plan

The CAA generally requires states to submit an air quality attainment plan or State Implementation Plan (SIP) within three years following a designation of non-attainment. In April 2007 EPA promulgated a detailed implementation rule for $PM_{2.5}$ non-attainment areas and in March 2012 issued additional guidance. Alaska's effective date of designation as a non-attainment area was December 14, 2009. Alaska's original due date for the SIP under Subpart 1 was December 14, 2012. On January 4, 2013 the DC Circuit Court ruled that the Clean Air Act requires implementation of the $PM_{2.5}$ NAAQS under Clean Air Act Part D, Subpart 4 (Sections 188-190) rather than implementation under Subpart 1. On June 2, 2014, EPA published a new rule that identified those States in nonattainment for $PM_{2.5}$ as 'Moderate' areas and proposed a new due date for submittal of moderate nonattainment area Subpart 4 SIPs to EPA. Under the new subpart 4 'Moderate' area designation, the SIP must demonstrate using air quality modeling that attainment is possible or impracticable by December 31, 2015.

States are required to develop and implement SIPs in accordance with the CAA, which is enforced through the EPA. The SIP contains narrative overviews, background information, control strategies, technical data, data analyses and implementation plans for complying with

CAA requirements. Alaska's State Air Quality Control Plan contains all the required SIPs for Alaska and is incorporated by reference into state regulations at 18 AAC 50.030.

For Fairbanks, the FNSB is delegated air quality planning authority for $PM_{2.5}$. The Borough develops and submits their local air quality plans to the DEC for adoption and inclusion in the SIP. This $PM_{2.5}$ plan describes how the State of Alaska and FNSB in collaboration with other agencies will meet the federal requirements to control and reduce $PM_{2.5}$ pollution in the FNSB non-attainment area. It also describes how the State of Alaska and FNSB will identify and implement air pollution control measures to achieve lower emissions of fine particulate matter ($PM_{2.5}$) as well as nitrogen oxides (NOx), sulfur oxides (SOx), and ammonia which also can contribute to the $PM_{2.5}$ pollution. The plan also describes how the State and FNSB will work to educate the community on using cleaner burning and more efficient home heating units.

Developing an air quality plan to address fine particulate matter is a multi-step process. The goal is to develop a plan that addresses the problem, reflects the local situation, and has controls that are reasonable and cost effective. Planning steps include:

- Characterizing the air pollution problem using technical tools and analyzing data. This step includes:
  - Monitoring Studies
  - Assessing Emissions
  - Modeling Impacts
- Evaluating options to reduce air pollution and develop the plan. The Clean Air Act requires emission reductions that are permanent and enforceable.
  - Identify and evaluate programs that can reduce pollutant emissions.
  - Develop regulations and ordinances to ensure permanent reductions.
  - Consider voluntary measures that can assist in mitigating pollution.
  - Draft the local air quality plan and have it reviewed by the public and Borough Assembly.
- Adopting the local plan into state regulations and transmitting it to EPA for approval.
  - The state incorporates the local plan into the SIP through regulation providing additional opportunities for public notice, comment, and hearing.
  - Once the state regulatory process is complete, DEC transmits the plan to EPA for approval
- EPA taking action on the plan to make it federally enforceable.
  - EPA reviews the plan to insure it is complete and meets all requirements of the Clean Air Act.
  - EPA issues a federal register notice of their action, takes public comment, and finalizes their decision.

DEC, FNSB, and EPA Region 10 engaged cooperatively in discussions throughout the development of this SIP for the nonattainment area. The objective of this early and ongoing dialogue was to help ensure the SIP meets federal requirements and can be processed efficiently by EPA.

5.1.5 Analysis Framework for the Plan

Extensive effort was devoted to the development of a technical analysis framework for the SIP. This included selection of representative conditions causing elevated $PM_{2.5}$ concentrations, the definition of a modeling domain that accounts for the meteorological and emission contributions impacting monitors located within the nonattainment area, the collection of activity data and emission factors that support the development of a representative emission inventory. Key components of the analysis framework include:

- Two multi-day episodes in 2008 were selected to represent days leading up to high concentrations, design day conditions, and days that exceed design day conditions. These episodes (January 23 – February 10 and November 2 -17) provide a reasonable baseline for analyzing controls to see what impact they have on reducing emissions to levels below the standard.

- Estimates of hourly meteorological conditions and emissions were developed for 201 x 201, 1.33 km grid cells that encompassed a modeling domain substantially larger than the nonattainment area for each of the multi-day episodes. The meteorological estimates were held constant for each analysis year. Emission estimates for individual source categories were developed to account for changes in activity (e.g., miles traveled, fuel mix and use, distribution of combustion devices, etc.) in 2008, 2015, 2017 and 2019. Emission estimates in 2008, 2015, 2017 and 2019 were prepared for baseline conditions (which accounts for the effects of natural turnover in vehicles, fuel burning devices, etc., growth and the effects of controls in place). Emission estimates were also prepared to account for the effects of controls implemented after 2008. The primary future year analyzed in this plan is 2015. The 2017 and 2019 analysis years are included to help demonstrate future progress toward compliance with the ambient air quality standard.

- The EPA approved Community Multiscale Air Quality (CMAQ) Modeling System was used to assess the impact of changes in baseline and controlled emissions on progress towards attainment.

- Emission estimates for each of the analysis years were based on controls that were fully implemented by the beginning of that year. For example, emission estimates for 2015 are based on the control measures and activity changes that were in place at the end of 2014. This is a conservative approach that only counts the benefits achieved by the start of the analysis year; it provides no benefit for control measures implemented or extended in the analysis year (2015).

5.1.6 Reducing $PM_{2.5}$ Air Pollution

The FNSB $PM_{2.5}$ nonattainment area plan relies on several primary control strategies coupled with additional voluntary measures to mitigate $PM_{2.5}$ air pollution. During the period 2008-2013, a number of programs were implemented at the local and state levels to encourage changes in behavior that produce emission reductions. The plan discusses these efforts and their emission reduction benefits by 2015 as well as additional emission reduction measures that are planned for or continuing during the period from 2015 to 2019. Measures included are:

- Solid fuel-fired heating device upgrades through change out and retrofit incentive programs
- Solid fuel-fired heating device emission standards to ensure new heaters are clean burning
- Improving solid fuel-fired heating device operations through public education, fuel and visible emission requirements
- Encouraging reduced use of solid fuel-fired heaters during air pollution episodes through public education and a voluntary cessation program
- Alaska Housing Finance Corporation energy efficiency and weatherization programs to reduce space heating demands
- Expanded availability and use of natural gas for space heating after 2016
- Expanded availability of motor vehicle plug-in infrastructure to reduce vehicle cold-start emissions
- Mass transit to reduce the emissions from the use of single occupant vehicles
- Diesel anti-idling and emission reductions for heavy vehicles and equipment
- Federal vehicle emission controls that provide for cleaner burning cars over time
- Winter season prohibition on outdoor open burning to avoid additional smoke emissions in the nonattainment area
- Stationary source air permitting to control power plants and industrial facilities

These programs are discussed in greater detail in Sections 5.7 and 5.10. Section 5.7 discusses all the control measures identified, implemented, planned, and underway within the non-attainment area. Section 5.10 is focused on the contingency measures that are planned for the period between 2015 and 2019 that show additional progress to reach attainment by 2019.

5.1.7 Findings and Demonstrating Attainment

The analysis framework described in Section 5.1.5 was used to quantify the impact of changing trends in activity and controls on emissions and concentrations in future years. The key findings of that analysis were that it was not possible to demonstrate attainment by the December 31, 2015 federal attainment deadline, but that it is possible to demonstrate attainment by 2019.

The plan makes an “impracticability” demonstration because the combined benefits of the Borough’s wood stove change out program projected through 2015, the Alaska Resource Agency project to retrofit outdoor wood boilers with catalytic converters, the natural turnover of both vehicles and wood burning heaters, and other voluntary measures are insufficient to reduce emissions to levels needed to demonstrate attainment by the December 31, 2015 deadline. The combined benefit of the non-voluntary measures produced a predicted 2015 concentration of 40.1 $\mu g/m^3$, which was adjusted to 39.6 $\mu g/m^3$ to reflect a 0.5 $\mu g/m^3$ benefit of the voluntary control measures. While this value represents a substantial reduction from the 44.7 $\mu g/m^3$ design value, it falls far short of the 35.0 $\mu g/m^3$ standard.

The plan further details an analysis of the benefits of implementing additional control measures that are planned for, and measures that will continue, after 2015. These measures include the new state emission standards for wood burning appliances, a dry wood program and natural gas expansion. Together with the continuing measures already underway, these measures produced a predicted 2019 concentration of 34.0 $\mu g/m^3$, which was adjusted to 33.5 $\mu g/m^3$ to account for the 0.5 $\mu g/m^3$ benefit of voluntary measures. The plan further discusses the potential benefits of adding a program that uses compressed wood "energy logs" to further reduce emissions and the predicted 2019 design value. Thus, this plan shows that it is possible to demonstrate attainment by 2019.

5.1.8. The Public Review Process

Addressing air pollution problems can be challenging for communities. For any air quality plan to be successful, it must be accepted and implemented by the community as a whole. For this reason, it is critically important that the Borough, State, and EPA receive feedback and input from the public on this air quality plan. Additional information on open houses, oral hearings, and ways to provide comments are available through the Alaska Department of Environmental Conservation's Division of Air Quality website at: http://dec.alaska.gov/air/index.htm.

5.2. Background and Overview of PM2.5 Rule

5.2.1 What is Particulate Matter?

Particulate pollution, also called particulate matter or PM, is a complex mixture of solid and liquid particles that are suspended in air. The components of particulate matter are a mixture of inorganic and organic chemicals, including carbon, sulfates, nitrates, metals, acids and volatile compounds. Man-made and natural sources emit particulate matter directly or indirectly by emitting other pollutants that react in the atmosphere to form PM. There are different sizes and shapes of particulate matter. Coarse particulate matter (PM_{10}) is less than 10 micrometers in diameter. It primarily comes from road dust, agriculture dust, river beds, construction sites, mining operations and other similar activities. Fine particulate matter ($PM_{2.5}$) is less than 2.5 micrometers in diameter. $PM_{2.5}$ is a product of combustion, primarily caused by burning fuels. Examples of sources include power plants, vehicles, wood burning stoves and wildland fires. The Environmental Protection Agency (EPA) regulates both coarse and fine particulate matter which can be inhaled thereby posing a risk to public health. Particulate pollution also affects the visibility in many national parks and wilderness areas, impacts the natural environment and the aesthetic values of our surroundings.

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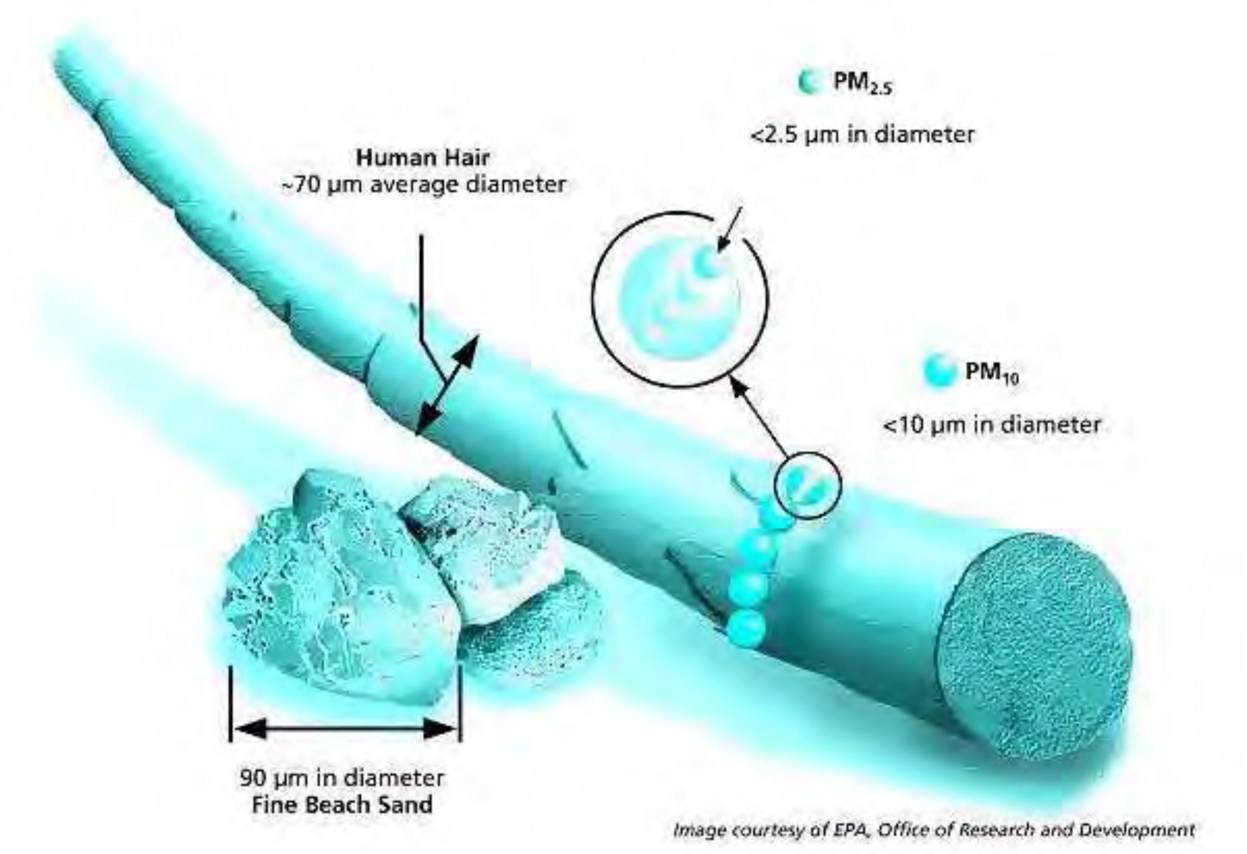


Figure 5.2.-1. Particle Size Comparison

5.2.2 Health Effects:

Scientific and health research has reported associations between the levels of particulate matter in the air and adverse respiratory and cardiovascular effects in people. The size of the particles inhaled is directly linked to their potential in causing health problems. Both coarse and fine particles cause health problems when people are exposed to harmful concentrations. These particles are small enough to pass from our lungs to our bloodstream. PM can alter the body's defense systems against foreign materials, damage lung tissues, aggravate existing respiratory and cardiovascular disease, and can lead to cancer. In some cases, PM exposure can even lead to premature death. Adverse health effects have been associated with exposures to PM over both short periods (such as a day) and longer periods (a year or more).

The people who are most at risk from PM exposure are those with asthma, influenza, lung, heart, or cardiovascular disease, the elderly, and children. Symptoms of exposure may include sore throat, persistent cough, burning eyes, wheezing, shortness of breath and chest pain, irregular heart beat and development of chronic bronchitis.[1]

5.2.3 Environmental Effects:

The main components of fine particulate matter ($PM_{2.5}$) are soil-related particles, sulfur dioxide, nitrogen oxides and volatile organic compounds. These components can combine in a variety of ways that noticeably affect urban, agricultural and natural systems. The effects of fine particulate matter can be seen in physical and chemical degradation of our surroundings from acid deposition and changes in visibility resulting in haze.

In the instance of acid deposition, the impacts are seen both on aesthetic appeal and physical damages to the surface of the structures, both of which may have serious economic consequences. Acid rain accelerates the decay of building materials and paints causing damages to the buildings, statues and sculptures resulting in excessive cost for the upkeep of these structures. Acid deposition affects aquatic and terrestrial ecosystems by changing the pH and can make a water body or soil either too acidic or basic for the survival of different organisms and plant life.[2]

Particulate matter absorbs and scatters the light thus affecting the visibility and causing haze. Light scattering efficiency differs considerably for fine and coarse particles. Larger light scattering efficiencies for fine particles have been observed when significant numbers of particles are in the 0.5 to 1.0 micrometer size range. The great majority of light scattering is caused by elemental carbon, a product of smoke and fuel burning. Particulate matter pollution such as particulate sulfate found in the atmosphere by the conversion of SO_2 is responsible for 40-65% of the haze in parts of the United States.[3] Some haze causing particles are directly

[1] http://www.epa.gov/airquality/particlepollution/health.html
[2] http://www.epa.gov/acidrain/effects/index.html
[3] http://www.epa.gov/air/visibility/pdfs/introvis.pdf

emitted to the air. Others are formed when gases emitted to the air combine into particles as they are carried many miles from the source of the pollutants.

5.2.4 Annual and 24 hour National Ambient Air Quality Standards (NAAQS):

The Clean Air Act (CAA) requires EPA to set air quality standards (40 CFR Part 50) to protect the health and the welfare of the public and the environment. The law requires EPA to periodically review and update the standards to ensure that health and environmental protection are adequate based on the scientific justifications. EPA has set National Ambient Air Quality Standards (NAAQS) for six principal criteria pollutants and particulate matter is one of these. Particulate pollution includes a complex mixture of both solid particles and liquid droplets found in the air. These particles come in different sizes and shapes; particulates less than 10 micrometer pose health concerns because it can be inhaled and cause respiratory problems and particles less than 2.5 micrometer in size, also known as "fine particles" can lodge deeply into lungs and enter the bloodstream causing numerous health problems.

EPA first issued particulate matter standards in 1971 and revised the standards in 1987. In 1997, EPA established $PM_{2.5}$ annual and 24-hour standards for the first time, which were 15 micrograms per cubic meter (µg/m^3) and 65µg/m^3 respectively.[4] In September of 2006, the agency revised the 1997 $PM_{2.5}$ standards which tightened the 24-hour standard from 65µg/m^3 to 35µg/m^3.[5] In December 2012, EPA further strengthened the annual $PM_{2.5}$ standard to 12µg/m^3.[6] During this time, EPA retained the existing 24-hour PM_{10} standard of 150µg/m^3 and revoked the annual PM_{10} standard.

Table 5.2.-1

EPA Fine Particulate Matter NAAQS Revisions

	Averaging Period	
Year	24-Hour, µg/m^3	Annual, µg/m^3
1997	65	15
2006	35	15
2012	35	12

EPA continues to review all NAAQS pollutants every five years to determine if the existing levels should be retained or revised. EPA's review is based on extensive research of thousands of peer-reviewed scientific studies about the effects of each criteria pollutant on public health and welfare.[7]

[4] Federal Register, Volume 62, No.138, Friday, July 18, 1997, pages 38652-38760
[5] Federal Register, Volume 71, No.200, Tuesday, October 17, 2006, pages 61144-61233
[6] Federal Register, Volume 78, No.10, Tuesday, January 15, 2013, pages 3086-3287
[7] See EPA web site at: http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html

5.2.5 Non-Attainment Designation

5.2.5.1 Clean Air Act and Alaska Air Quality

The CAA was promulgated on December 31, 1970 and by 1972, Alaska submitted their first air quality control State Implementation Plan (SIP). Carbon monoxide, sulfur dioxide and particulate matter were addressed in the SIP from the beginning. Coarse particulate matter was of concern because of the existence of point sources, unpaved roads and wood smoke which were prevalent in many communities all around Alaska. Historically Eagle River and Juneau have violated the Clean Air Act air quality requirements for coarse particulate matter PM_{10}, though both of the areas are now attaining the PM_{10} NAAQS and in maintenance status.

Alaska had been in compliance with the $PM_{2.5}$ standard since 1997 until the EPA revised its standard in 2006. The more stringent 2006 standard showed areas of the Fairbanks North Star Borough (FNSB), exceeding the $PM_{2.5}$ standard and the Mendenhall Valley in Juneau coming very close to violating the standard. A monitoring site in the Fairbanks North Star Borough was consistently exceeding the level of the 24-hour $PM_{2.5}$ NAAQS and therefore determined to be in violation. This triggered the requirement for the state to identify and designate an appropriate area surrounding Fairbanks Alaska to be in non-attainment status. A non-attainment area is any area that does not meet the NAAQS for any of the Clean Air Act criteria pollutants; particulate matter in this instance.

Once formally designated, the State and the Fairbanks North Star Borough (FNSB) began studies and additional monitoring to identify the causes of the $PM_{2.5}$ pollution so that this air quality plan could be developed to control and reduce particulate matter emissions.

5.2.6 Fairbanks $PM_{2.5}$ Non-Attainment Designation

In developing non-attainment area recommendations for the 2006 $PM_{2.5}$ NAAQS, the Alaska Department of Environment Conservation (DEC) evaluated three years of air quality data for four areas of Alaska: Anchorage, Fairbanks, the Mendenhall Valley in Juneau, and the Butte area in the Matanuska-Susitna Borough. Only one of the communities showed that it was consistently exceeding the health-based 24-hour standard of $35\mu g/m^3$. The three year calculated average for Fairbanks was $43\mu g/m^3$ and the Mendenhall Valley in Juneau was exactly at $35\mu g/m^3$. Fairbanks exceeds the standard during winter months. All of the communities showed attainment for the annual exposure limit of $15\mu g/m^3$. DEC in consultation with local governments followed the nine factor analysis approach set out in EPA guidance and developed a proposed boundary for the $PM_{2.5}$ non-attainment area in Juneau and Fairbanks.

On December 14, 2007, DEC submitted a letter to EPA recommending that the City of Fairbanks and areas surrounding it within the Fairbanks North Star Borough, be designated as non-attainment for the 2006, 24-hour $PM_{2.5}$ NAAQS. The letter was an initial designation recommendation by the State of Alaska in accordance with the requirements of Section 107(d)(A) of Clean Air Act.

The non-attainment boundary proposed by DEC was meant to encompass the portion of the Fairbanks North Star Borough air shed likely to be violating the fine particulate matter health standard. No monitoring data for the outlying areas and City of North Pole existed at that time, therefore, these areas were excluded from the initial non-attainment boundary recommendation. DEC noted that if new monitoring data for these areas exceeded the $PM_{2.5}$ standard, then a revision to the proposed boundary would be warranted.

In August of 2008, EPA notified the State of Alaska of its intent to designate Fairbanks and the Mendenhall Valley in Juneau as non-attainment and the remaining boroughs in the state as attainment/unclassified. In proposing non-attainment area boundaries, EPA expanded upon the areas recommended by the state to include a much larger area and allowed the state until October 20, 2008 to submit additional information to be considered towards the non-attainment area designation process.

After reviewing EPA's proposed designation of the non-attainment boundaries for Fairbanks and Juneau, the State of Alaska submitted a revised non-attainment boundary for Fairbanks. The state proposed to include an area larger than the initial proposal, but smaller than the area proposed by EPA, for the Fairbanks non-attainment area. Regarding Juneau, the state asked EPA to revisit certain assumptions underlying EPA's technical analysis and to include Juneau's 2008 monitoring data before making final decisions on the non-attainment designation boundary

In a letter dated October 20, 2008, DEC provided extensive supporting documents from the local communities and military bases, demonstrating to EPA that smaller non-attainment area boundaries were appropriate in both Fairbanks and Juneau. This letter and its attachments may be found at: http://dec.alaska.gov/air/PM2-5_AK.htm.

On November 13, 2009 portions of the Fairbanks North Star Borough were officially designated as being in "non-attainment" for $PM_{2.5}$ by the EPA. The federal register publication (74 FR 58690) dated November 13, 2009, however, excluded the Mendenhall Valley in Juneau from classification as a non-attainment area.

EPA reviewed and revised the $PM_{2.5}$ NAAQS again in 2012, strengthening the annual standard from 15 to 12 $\mu g/m^3$. Subsequently in 2013, DEC evaluated the most recent air monitoring data within the state to determine compliance with the revised annual $PM_{2.5}$ NAAQS and recommended to EPA that all areas of the state be designated as in attainment. As of March 2014, EPA had not yet responded to the State's designation recommendation.

5.2.7 State Implementation Plan (SIP) Requirements and Compliance with Clean Air Act

The SIP is developed and implemented by states in accordance with the CAA, which is enforced through the EPA. The SIP contains narrative overviews, background information, control strategies, technical data, data analyses and implementation plans for complying with CAA requirements. Alaska's Air Quality Control Plan consists of required SIPs for Alaska which is incorporated by reference into state regulations at 18 AAC 50.030.

For Fairbanks, the Fairbanks North Star Borough (FNSB) is delegated air quality planning authority. The Borough develops and submits their local air quality plans to the DEC for adoption and inclusion in the SIP. This $PM_{2.5}$ plan describes how the State of Alaska in collaboration with other agencies will meet the federal requirements to control and reduce $PM_{2.5}$ pollution in the FNSB non-attainment area. This plan contains the selected control strategies executed or planned by the state and the FNSB. The $PM_{2.5}$ plan describes how the State of Alaska will identify and implement air pollution control measures to achieve lower emissions of fine particulate matter ($PM_{2.5}$) as well as nitrogen oxides (NOx), sulfur oxides (SOx), and ammonia which also can contribute to the $PM_{2.5}$ pollution. The plan also describes how the State and FNSB will work to educate the community on using safer and more efficient home heating units.

5.2.8 State Implementation Plan (SIP) Due Date

The CAA generally requires states to submit a SIP within three years following a designation of non-attainment. In April 2007 EPA promulgated a detailed implementation rule for $PM_{2.5}$ non-attainment areas and in March 2012 issued additional guidance. Both the 2007 rule and 2012 guidance identified the Clean Air Act Section 110(a)(1) and Part D, Subpart 1 (Sections 171-179) as the relevant sections to follow in developing a $PM_{2.5}$ SIP. Alaska's effective date of designation as a non-attainment area was December 14, 2009. Alaska's original due date for the SIP under Subpart 1 was December 14, 2012.

Alaska did not meet this date and was finalizing a number of SIP technical documents when on January 4, 2013 the DC Circuit Court ruled that the Clean Air Act requires implementation of the $PM_{2.5}$ NAAQS under Clean Air Act Part D, Subpart 4 (Sections 188-190) rather than implementation under Subpart 1. Shortly after being notified of the court decision, Alaska began adjusting and reworking its development of the $PM_{2.5}$ SIP to meet the additional and differing requirements of Subpart 4.

On June 2, 2014, EPA published in the Federal Register (Vol. 79, No. 105, p. 31566-31782) a new rule that identified those States in nonattainment for $PM_{2.5}$ as 'Moderate' areas and proposed a new due date for submittal of moderate nonattainment area Subpart 4 SIPs to EPA. Under the 2014 rule, the $PM_{2.5}$ SIP for the moderate nonattainment area in the Fairbanks North Star Borough is due to the EPA by December 31, 2014. Under the new subpart 4 'Moderate' area designation, the SIP must demonstrate using air quality modeling that attainment is possible or impracticable by December 31st, 2015.

5.2.9 Attainment Dates

The January 4, 2013 litigation described above has impacted the date on which the SIP must be submitted, and the date the State is required to demonstrate attainment. A significant requirement of the SIP is an attainment demonstration using controls that will be adopted and their effectiveness through modeling analyses. Originally under the Subpart 1 requirements the attainment date was determined to be no later than five years from the date the area was designated nonattainment. Five years from the December 14, 2009 nonattainment designation, under Subpart 1, established an original attainment date of December 14, 2014.

Under Subpart 4 provisions of the Clean Air Act, an attainment date shall be no later than six years from the date an area was designated nonattainment. Therefore, the attainment date for the FNSB $PM_{2.5}$ nonattainment area is December 14, 2015.

If the area does not attain the NAAQS by 2015, the area's nonattainment classification will change from 'Moderate' to 'Serious' by operation of law.[8] For serious areas, under Subpart 4 provisions, an attainment date shall be no later than 10 years from the original designation date. A new 'Serious' SIP must be developed to demonstrate attainment by December 14, 2019. [9]

5.10 Consultation and Planning Process for SIP

There are several requirements for coordination and consultation in the development of a SIP or SIP amendment. Provisions of sections 110(a)(M) and 174 of the CAAA (42 U.S.C. 7410(a)(2)(m) and 42 U.S.C 7504) require the consultation and participation by local political subdivisions and local elected officials affected by the plan. Under section 174 (42 U.S.C 7504), a plan submitted to EPA as a formal SIP or SIP amendment must be prepared by "an organization certified by the State, in consultation with elected officials of local governments." Such an organization is required to include local elected officials and representatives of the following organizations:

- the state air quality planning agency (i.e., DEC);
- the state transportation planning agency (i.e., Alaska Department of Transportation & Public Facilities (ADOT/PF)); and
- the metropolitan planning organization (MPO) responsible for Continuing, Cooperative and Comprehensive (3C) transportation planning process for the affected area (FMATS).

40 CFR 93.105(a)(1) of the conformity rule requires consultation with state and local air agencies, State and federal DOTs (ADOT/PF and the Federal Highway Administration (FHWA)/Federal Transit Administration (FTA) within the Department of Transportation(DOT)), Environmental Protection Agency (EPA), and MPOs in developing applicable implementation plans.

5.11 Fairbanks Metropolitan Area Transportation Systems and Authority

In April of 2003, the Fairbanks Metropolitan Area Transportation Systems (FMATS) Policy Committee was designated as the Metropolitan Planning Organization (MPO) and cooperative decision making body for the urbanized area of Fairbanks and North Pole. The FMATS is an ongoing cooperative and comprehensive planning effort between the ADEC, FNSB, Cities of Fairbanks and North Pole and ADOT/PF. It is responsible for developing three primary planning or programming activities which include the FMATS Metropolitan Transportation Plan, Transportation Improvement Program and FMATS Unified Planning work Program. The FMATS structure consists of two-tiered committee system that reviews all transportation planning efforts within the area. FMATS also develops air quality conformity determinations for transportation plans and participates in interagency consultation for the mobile source emission budgets included in this SIP.

[8] Clean Air Act Section 188(b)(2)
[9] Clean Air Act Section 188(c)

The FMATS Policy Committee provides guidance and control over studies and recommendations developed by support staff. Voting members of the policy committee are listed below.

- FNSB Mayor;
- City of Fairbanks Mayor;
- City of North Pole Mayor;
- ADOT/PF Northern Region Director;
- FNSB Assembly representative;
- City of Fairbanks Council representative;
- DEC Director of Air Quality.

The FMATS Technical Committee and member support staff analyze transportation and land use issues and develop draft recommendations for the policy committee. Voting members include the following.

- City of Fairbanks Engineer;
- City of Fairbanks Public Works Director;
- City of North Pole Public Works Director;
- FNSB Planning Director;
- FNSB Transit Director;
- FNSB Planning Commission;
- ADOT/PF Planning Manager;
- DEC Air Quality;
- Fort Wainwright;
- University of Alaska Fairbanks;
- Fairbanks International Airport;
- Freight Carriers;
- Alaska Railroad;
- Tanana Chiefs Conference.

Successful planning and implementation regarding some components of this plan requires coordination between air quality and transportation planning agencies in the community and outside the community. This coordination was ensured through consultation with the FMATS Technical and Policy Committees, as well as monthly status meetings with FHWA and EPA, during plan development. Future planning and implementation will continue with coordination between air quality and transportation planning agencies.

Fairbanks North Star Borough Organization and Authority

The FNSB has been designated by the State as the local air quality planning agency and takes the lead in developing air quality plans for the local area. FNSB is the planning agency that coordinates transportation related air quality planning with the MPO and FHWA, and development of the air quality plan with the DEC and EPA.

The FNSB has operated a local air pollution control program since 1972, first through its Environmental Services Division/Department and now through the Department of Transportation. Much of the FNSB's early efforts were concerned with establishing an ambient air monitoring network and enforcing its regulations concerning open burning, visible emissions, and dust control. FNSB past air quality efforts were centered on air quality planning and finding ways to reduce ambient carbon monoxide (CO) concentrations. The Borough has historically relied on DEC to control large stationary emission sources within the FNSB. In January 2010, the FNSB and DEC signed an updated Memorandum of Understanding that allowed the Borough to take the lead for developing a SIP to address $PM_{2.5}$ air pollution, which has resulted in the development of this attainment plan.

The FNSB has an Air Pollution Control Commission that provides recommendations to the assembly regarding air quality issues. This Commission was established by Borough ordinance under Chapter 2.48 to develop comprehensive plans for the prevention, abatement, and control of air pollution in the borough. The commission consists of seven voting members and is up for reauthorization every six years, by ordinance. This commission was reauthorized in 2012.

The legal authority for establishing local air pollution control programs is found in Alaska Statutes 46.14.400, Local Air Pollution Control Programs (see Appendix to Section II). The FNSB air pollution control regulations are contained in Chapter 8 of the Code of Ordinances. A copy of these regulations may be found in Appendix III.D.5.12.

5.12 Plan Development Process

Overview

Developing an air quality plan to address fine particulate matter is a multi-step process. The goal is to develop a plan that addresses the problem, reflects the local situation, and has controls that are reasonable and cost effective. Planning steps include:

- Characterizing the air pollution problem using technical tools and analyzing data. This step includes:
    - Monitoring Studies
    - Assessing Emissions
    - Modeling Impacts
- Evaluating options to reduce air pollution and develop the plan. The Clean Air Act requires emission reductions that are permanent and enforceable.
    - Identify and evaluate programs that can reduce pollutant emissions.
    - Develop regulations and ordinances to ensure permanent reductions.
    - Consider voluntary measures that can assist in mitigating pollution.
    - Draft the local air quality plan and have it reviewed by the public and Borough Assembly.
- Adopting the local plan into state regulations and transmitting it to EPA for approval.
    - The state incorporates the local plan into the SIP through regulation providing additional opportunities for public notice, comment, and hearing.

  - Once the state regulatory process is complete, DEC transmits the plan to EPA for approval
- EPA taking action on the plan to make it federally enforceable.
  - EPA reviews the plan to insure it is complete and meets all requirements of the Clean Air Act.
  - EPA issues a federal register notice of their action, takes public comment, and finalizes their decision.

DEC, FNSB, and EPA Region 10 engaged cooperatively in discussions throughout the development of the SIP for the nonattainment area. The objective of this early and ongoing dialogue was to help ensure the development of a SIP that meets federal requirements and can be processed efficiently by EPA. Early consultation and coordination assists in identifying and addressing issues that could result in delays or deficiencies later in the SIP development and EPA approval process.

5.13 Air Quality Goals and Objectives

Important to any air quality planning effort are overarching goals and objectives. The goals and objectives provide not only the basis on which the plan is developed, but also direction for future policy decisions that may affect local air quality. The goals and objectives must reflect the intent of the CAA, but should also reflect the values, views, and desires of Fairbanks' citizens and elected officials. The goals and objectives need to integrate land use, air quality, energy and transportation planning concerns to provide meaningful future air quality benefits for Fairbanks' citizens. Initially the air quality goals and objectives were borrowed from the carbon monoxide air quality plan for consistency and then, where applicable, adjusted specifically for $PM_{2.5}$.

<u>Primary Goals and Objectives</u>

Primary goals and objectives are defined as those related to the attainment and maintenance of NAAQS throughout the Borough. Primary goals include the following:

- Attaining the $PM_{2.5}$ NAAQS within the entire Fairbanks North Star Borough.
- Prevention of any significant deterioration of air quality within the portions of the Fairbanks North Star Borough that are designated as attainment.

Primary objectives are as follows:

- Development and implementation of long-term control measures that will lead to continued attainment of the NAAQS for $PM_{2.5}$ in Fairbanks.

<u>Community Goals and Objectives</u>

In addition to the primary goals, there are community goals that must be considered and striven for during development and implementation of the air quality plan. These goals include the following:

- Protecting the health of all FNSB citizens from the harmful effects of elevated ambient concentrations of $PM_{2.5}$.
- Establishing an effective public information and comment program to ensure that FNSB citizens have the opportunity to take an active role in the development of the plan.
- Minimizing the negative regulatory and economic impact of air pollution control measures on FNSB citizens and businesses.
- Achieving both healthy winter air and affordable heating for local homes and businesses.
- Supporting the maintenance of an efficient local transportation system that accommodates public needs, has a variety of transportation modes, and aids in the achievement of the goals and objectives of the air quality plan.

In order to address the community goals listed above, the following efforts were undertaken to support the development of the air quality plan:

- Technical studies and assessments to characterize the extent of the $PM_{2.5}$ pollution and the sources contributing to degraded air quality.
- An assessment of benefits that would result from each control measure considered.
- An assessment of how each control measure would integrate with other potential control measures.
- An active outreach program to ensure that local citizens are provided with information on the air pollution problem, how the plan was developed, what control measures are contained in the plan, and how the measures will affect them. The outreach program also ensured that citizens had the opportunity to provide comments on the plan prior to its submittal to the Borough Assembly for approval.

5.14 Public Participation Process

Section 110(a) of the CAA requires that a state provide reasonable notice and public hearings of SIP revisions prior to their adoption and transmittal to EPA. To ensure that the public had adequate opportunity to comment on the revisions to the Fairbanks air quality attainment plan, a multi-phase process for ensuring public involvement was used.

Briefings were held with FMATS members during the Policy and Technical Committees' regularly scheduled meetings, and input was solicited regarding the suggested content of the plan, particularly with respect to transportation related measures and the motor vehicle emission budget. All FMATS meetings are public meetings and advertised in the local daily newspaper. Local citizens are invited to attend and participate in discussions during the meetings. Staff thus attempted to involve local residents well in advance of actual plan development, to ensure that public input was incorporated into the air quality planning process in a timely manner.

Regular briefings were held with the FNSB Air Pollution Control Commission during the plan development. The Commission's meetings are open to the public and advertised to the community. Regular briefings were also held at FNSB Assembly Committee of the Whole work sessions to brief the Assembly members on the development of the plan and discuss control options. There is an opportunity for public participation in the air quality planning process at the FNSB Assembly level, during public testimony on air quality regulatory changes (i.e., revisions to the solid fuel change-out program). By allowing public testimony prior to Assembly debate, this process ensures that citizens have a chance to comment directly to locally elected officials prior to their consideration of regulatory changes. A similar process was available to the public to comment on changes incorporated into this plan. All FNSB Assembly briefings were posted on the DEC website for easy reference and were available during the SIP development and public review process.

The final opportunity for public involvement occurs at the state administrative level. Prior to regulatory adoption of these SIP revisions, DEC held a public comment period on the revisions from <INSERT DATE> through <INSERT DATE> including a public hearing in Fairbanks on <INSERT DATE>. This provided another forum for the public to comment on the air quality plan prior to its adoption at the state level and submission to EPA.

5.3. NONATTAINMENT AREA BOUNDARY AND DESIGN DAY EPISODE SELECTION

After EPA lowered the 24-hour ambient $PM_{2.5}$ standard from 65 meter ($\mu g/m^3$) to 35 $\mu g/m^3$ in December 2006, States were required to examine monitoring data collected within their communities and make designation recommendations based on the new standard by December 2007. After an examination of monitoring data collected at the State office building in downtown Fairbanks from 1999–2006, DEC recommended that Fairbanks be designated nonattainment for the revised $PM_{2.5}$ standard. Based on this recommendation, EPA initiated a process to define the size of the $PM_{2.5}$ nonattainment area within Fairbanks. Since monitoring data were collected at only one location, this process did not have much insight into how concentrations varied throughout the Borough. This resulted in EPA initially suggesting that a large portion of the Borough be designated nonattainment (to be conservative). In response, the State and Borough assembled an extensive set of data describing population density; terrain; meteorology; available air quality data, including limited measurements from Fort Wainwright and Eielson Air Force bases; available emission inventory estimates, etc. This information ultimately led to the selection of a much smaller final $PM_{2.5}$ nonattainment boundary for Fairbanks. The $PM_{2.5}$ boundary is different than the previously defined carbon monoxide (CO) boundary specified for Fairbanks. The boundary is important because it defines the area that is subject to regulatory controls needed to produce reductions in ambient concentrations needed to attain the standard.

Figure 5.3-1 shows a map of the nonattainment area boundary. The EPA rulemaking establishing the $PM_{2.5}$ nonattainment area[1] included the following townships and ranges within the Fairbanks North Star Borough:

- 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; and
- MTRS F002S003E—Sections 5–8, 18.

[1] Federal Register, Vol. 74, No. 218, Friday, November 13, 2009, pages 58688-58781.

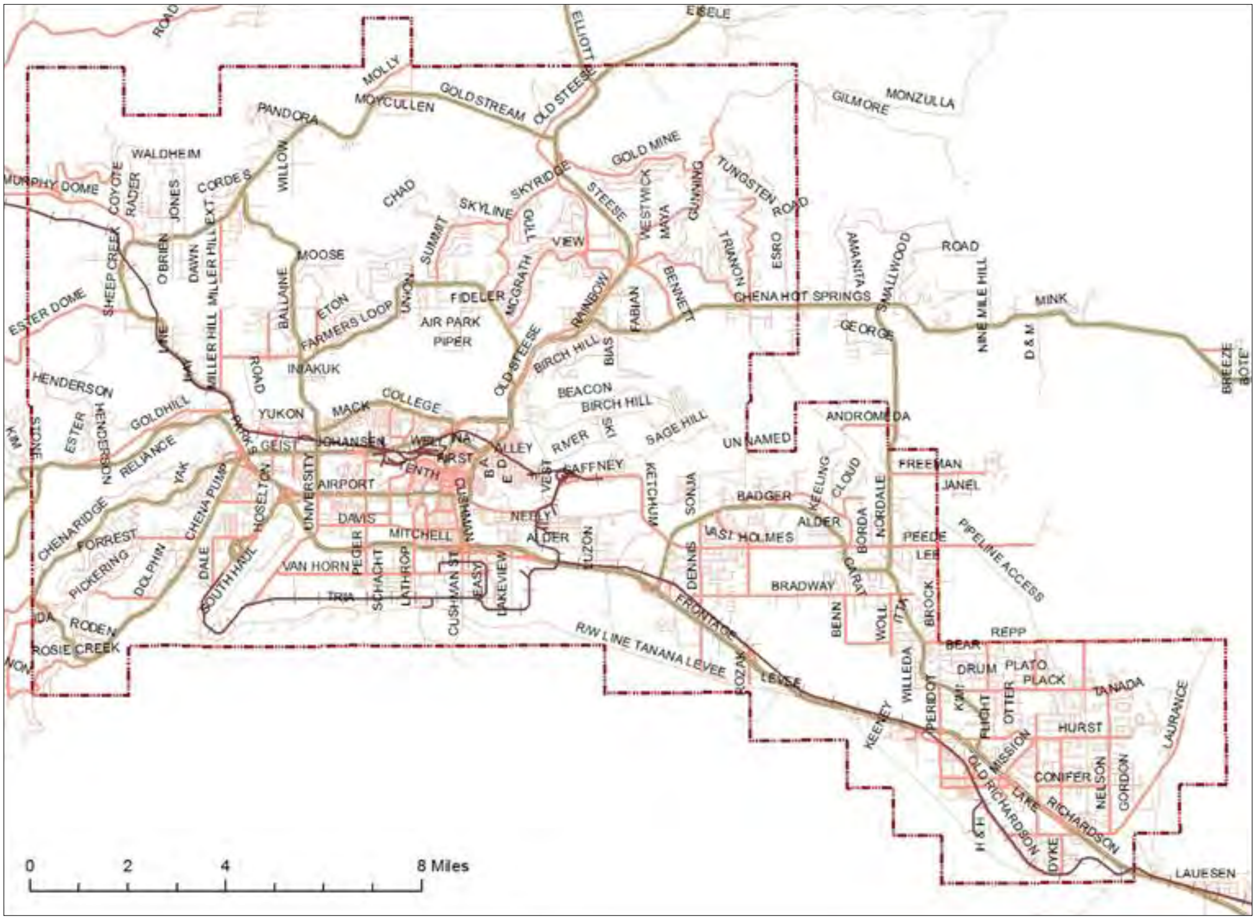


Figure 5.3-1. Fairbanks $PM_{2.5}$ Nonattainment Boundary

Eielson was excluded from the nonattainment area because monitoring data from the base showed that $PM_{2.5}$ concentrations were dramatically lower than those collected in downtown Fairbanks and meteorological data showed that upper air wind flows, which move the plume from the Central Heat and Power Plant, were rarely in the direction of the nonattainment area when concentrations were above the standard. Conversely, no measurements were available to document concentrations within the Ester and Goldstream Valleys. Since these areas are growing and have similar meteorology to the downtown area, where elevated concentrations have been recorded, they were included within the nonattainment boundary. Because preliminary measurements collected by the Borough at the Transportation Center on Peger Rd. and in North Pole indicated that these areas experienced elevated $PM_{2.5}$ concentrations, they were also included within the nonattainment boundary.

A detailed rationale of the Nonattainment Boundary selection can be found in Appendix III.D.5.3.

5.3.1. Summary of Design Day/Episode Selection for the Fairbanks $PM_{2.5}$ NonAttainment Area

Sections 108 and 109 of the Clean Air Act (CAA) require EPA to regularly review and update the NAAQS. As previously discussed, in 2006 EPA strengthened the 24-hour fine particle standard from the 1997 level of 65 µg/m^3 to 35 µg/m^3, and retained the annual fine particle standard at 15 µg/m^3. In 2012, EPA retained the 24-hour $PM_{2.5}$ standard, but strengthened the annual standard to12 µg/m^3. Elements of the NAAQS include the indicator, averaging period, level, and form of the standard. The indicator specifies the pollutant and whether it is primary or secondary; the averaging period specifies whether it is 24-hour, annual, etc.; the level specifies the concentration that provides protection for public health; and the form specifies the metrics used to assess compliance with the level of the standard (e.g., average annual, 98th percentile, etc.).

The 24-hour $PM_{2.5}$ standard is calculated using a three-year average of annual 98th percentile values. The "design value" is calculated from the three-year period of data ending in the base year EPA defines as the reference for assessing progress towards attainment. EPA specified 2008 as the base year for areas designated as nonattainment for the 2006 24-hour $PM_{2.5}$ standard. The design value for the base year was calculated from 98th percentile values for 2006, 2007, and 2008. A description of that calculation is presented in Appendix III.D.5.8. The base year design value calculated for Fairbanks is 40.7 µg/m^3. The design value is updated with each new year of monitoring data (i.e., it changes year to year).

In order to assess the impact of air quality controls, it is necessary to first model the baseline conditions that lead to concentrations that are representative of the Fairbanks design day. Since 2008 was selected as the base year for planning, the Borough, ADEC, and EPA evaluated the monitoring and meteorological data from that year to find episodes that could be used to represent typical conditions in Fairbanks when concentrations exceed the standard at "design day" levels. The agencies reviewed the monitored concentrations, meteorological conditions, and the results of a principal component analysis of their relationship to find episodes that met the criteria listed below.

- Days with 24-hour concentrations near 41 µg/m^3 (as monitored by the FRM and/or BAM method).
- Days with speciation measurements available to provide insight into the chemical composition of recorded mass and an assessment of model performance.
- Meteorological conditions that represent typical inversion scenarios for days exceeding the standard—these are steady-state conditions where high concentrations ebb and flow and there is no appreciable change in meteorology.
- Meteorological conditions that represent a period when an approaching high-pressure system causes a rapid increase in concentrations.

- Episodes having multiple days above the standard and in the vicinity of the design day to provide better statistical confidence from modeling analyses.

- A sufficient "lead-in" period of 3-4 days prior to a higher concentration event to allow an air quality model to come to equilibrium and then follow natural fluctuations in pollutants.

Ultimately the agencies selected the two periods described below for use in the planning process.

1. *January 23 – February 10, 2008*. This episode would provide insight into conditions for near design day concentrations (a value of 42) as well as more severe conditions producing substantially higher concentrations (i.e., those associated with an advancing high-pressure system). This is a period with colder temperatures. A summary of the concentrations and temperatures recorded for each day as well as the availability of speciation data is presented in Table 5.3-1.

2. *November 2 -17, 2008*. This episode reflects the stable conditions with the ebb and flow in concentrations; it has a corrected BAM value of 41.1 and an FRM value on the preceding day of 40.4. It occurs under relatively warmer temperatures, with lower space heating emissions and lower ventilation rates. A summary of the concentrations and temperatures recorded for each day, as well as the availability of speciation data, is presented in Table 5.3-2.

These multi-day episodes meet the above criteria and allow for analysis of days leading up to high concentrations, design day conditions, and days that exceed design day conditions. These episodes provide a reasonable baseline for analyzing controls to see what impact they have on reducing emissions to levels below the standard, while also allowing the Borough to assess how those controls may impact days with concentrations that exceed the 41 $\mu g/m^3$ design value.

Table 5.3-1
Summary of Fairbanks $PM_{2.5}$ Concentrations* and Daily Temperatures During January/February 2008 Design Episode

	24-hour Concentrations (µg/m^3)			Daily Temperatures (ºF)		
Date	FRM	BAM	Speciation Data Available	Max	Min	Average
01/23/08		5.9		23	-11	6
01/24/08		27.2		-4	-30	-17
01/25/08	17.5	22.2	Yes	0	-31	-15
01/26/08		46.8		-25	-44	-34
01/27/08		35.8		-12	-43	-27
01/28/08	19.6	22.2	Yes	-6	-24	-15
01/29/08		42.0		-20	-31	-25
01/30/08		55.1		-15	-28	-21
01/31/08	No Data	19.9	Yes	-6	-15	-10
02/01/08		24.0		-5	-14	-9
02/02/08		13.2		-8	-30	-19
02/03/08	23.5	24.8	Yes	-19	-40	-29
02/04/08		51.7		-29	-44	-36
02/05/08		68.2		-29	-46	-37
02/06/08	No Data	71.0	Yes	-30	-47	-38
02/07/08		61.1		-29	-47	-38
02/08/08		73.4		-24	-46	-35
02/09/08	40.5	45.7	Yes	-15	-44	-29
02/10/08		32.7		-12	-48	-30

* FRMs are operated once every three days; BAMs collect hourly values, which are used to calculate 24-hour averages.

Table 5.3-2
Summary of Fairbanks $PM_{2.5}$ Concentrations* and Daily Temperatures
During November 2008 Design Episode

Date	24-hour Concentrations (μg/m^3)			Daily Temperatures (ºF)		
	FRM	BAM	Speciation Data Available	Max	Min	Average
11/02/08	15.5	15.6		8	-6	1
11/03/08		6.6		12	2	7
11/04/08		9.7		14	-2	6
11/05/08	40.4	38.8		7	-10	-1
11/06/08		41.1		8	-11	-1
11/07/08		26.8		1	-17	-8
11/08/08	37.0	35.6	Yes	2	-12	-5
11/09/08		41.1		1	-15	-7
11/10/08		23.4		16	-5	6
11/11/08	27.4	23.7	Yes	17	-1	8
11/12/08		11.9		14	3	9
11/13/08		20.4		15	-9	3
11/14/08	50.7	51.1	Yes	3	-11	-4
11/15/08		29.4		14	-2	6
11/16/08		48.4		8	-13	-2
11/17/08	20.0	18.9		16	3	10

* FRMs are operated once every three days; BAMs collect hourly values, which are used to calculate 24-hour averages.

5.4 Ambient Air Quality Data and Trends

At 65º latitude, Fairbanks, has a subarctic continental climate, which strongly exacerbates wintertime air pollution and contributes to exceedances of the 24-hour average NAAQS for $PM_{2.5}$. Due largely to the short period of daylight, low sun angle, and relatively dry continental air, average monthly temperatures in Fairbanks are below freezing from October through April,[1] and the average January temperature is -10ºF. As a result of these climatological influences, Fairbanks is frequently subjected to ground-based temperature inversions that are among the strongest surface-based inversions found anywhere in the United States.[2] A temperature inversion is the results of a stable air mass. A stable air mass can form as result of changing weather conditions, for example where a warm less dense air mass moves over a dense cold air mass. Temperature inversions, caused by a stable air mass, limit the rate and extent of vertical mixing of surface-based emissions and, together with the low wind speeds, low mixing depths,[3] and extremely low temperatures that commonly accompany them in Fairbanks,[4] create atmospheric conditions that are conducive to the buildup of $PM_{2.5}$ concentrations from low release height emission sources.

Temperature inversions are a semi-permanent feature of the winter atmosphere in Fairbanks, occurring about 80% of the time in December and January[3]. During this period of minimal solar radiation, the midday temperature rarely changes more than a few degrees, and nocturnal radiation inversion conditions persist 24-hours per day.[5] However, similar inversions can occur anytime during the cold months and can last for days, often accompanied by clear skies, low temperatures, and very poor air pollution dispersion. Because of such inversions, the concentration levels of ground level pollutants in the atmosphere in Fairbanks can approach that of much larger metropolitan areas in the contiguous United States.[6] Such conditions in Fairbanks frequently result in elevated $PM_{2.5}$ concentrations and exceedances of the 24-hour average NAAQS. While the annual averaged $PM_{2.5}$ concentrations measured in Fairbanks are approaching the standard, they do not exceed the annual $PM_{2.5}$ NAAQS. This is mainly due to the low summertime $PM_{2.5}$ levels which offset the elevated winter time values.

5.4.1 Overview of $PM_{2.5}$ Monitoring Network

[1] Climatology of the United States No. 84, "Daily Normals of Temperature, Precipitation and Heating and Cooling Degree Degrees, 1961-1990," Alaska, Fairbanks, WSPO AP, National Oceanic and Atmospheric Administration.
[2] Wendler, Gerd, et al, "Low Level Temperature Inversions in Fairbanks, Central Alaska," *Monthly Weather Review*, January 1975.
[3] Brader, Jim et al, "Meteorology of Winter Air Pollution in Fairbanks," accessible here: ftp://ftp.co.fairbanks.ak.us/AQ-Symposium/Symposium_Presentations_ftp/James_Brader_Weather.pdf
[4] Hartmann, Brian et al, "Climatology of the Winter Surface Temperature Inversion in Fairbanks, Alaska," Geophysical Institute, University of Alaska, Fairbanks, accessible here: https://ams.confex.com/ams/pdfpapers/84504.pdf
[5] Bowling, Sue Ann, 1985, "Climatology of High-Latitude Air Pollution as Illustrated by Fairbanks and Anchorage, Alaska," *Journal of Climate and Applied Meteorology*, **25**, 22-34.
[6] *Ibid*, Low Level Temperature Inversions.

The FNSB Air Program operates and manages five[7] permanent monitoring stations for $PM_{2.5}$:

- One State and Local Air Monitoring Site (SLAMS);
- One Speciation Trend Network (STN) site; and
- Three Special Purpose Monitoring (SPM) sites for $PM_{2.5}$.

The FNSB SLAMS, STN, and SPM sites for $PM_{2.5}$ are identified below in Table 5.4-1; their locations are presented in Figure 5.4-1. Siting criteria and other details about each site are documented elsewhere.[8] The site at the downtown State Office Building began monitoring $PM_{2.5}$ in 1998. Federal Reference Method (FRM) from these monitoring locations have been used for regulatory purposes to characterize neighborhood scale sites in the nonattainment area. The nonattainment designation and the modeling episode days are from the base year 2008. The State Office Building Monitor FRM data from 2005-2012 is in Appendix III.D.5.4. Most of these sites also house continuous $PM_{2.5}$ monitors (Beta Attenuation Monitors – BAM) which are used to issue air quality advisories. These continuous analyzers do not meet $PM_{2.5}$ Federal Equivalent Method (FEM) criteria and are not used to measure compliance with the NAAQS.

Table 5.4-1
SLAMS and SPM Sites for $PM_{2.5}$ in FNSB

Site Name	Location	AQS-ID	Designation	Install Date	Scale
State Office Building	Fairbanks	02-090-0010	SLAMS/STN	Oct 1998	neighborhood
North Pole Elementary	North Pole	02-090-0033	SPM	Nov 2008	neighborhood
NCore	Fairbanks	02-090-0034	SPM	Oct 2009	neighborhood
North Pole Fire Station	North Pole	02-090-0035	SPM	Mar 2012	neighborhood

In addition to the fixed location monitors displayed below in Figure 5.4-1, the Borough operates two other types of routine sampling for $PM_{2.5}$; a Relocatable Air Monitoring System (RAMS trailer), and a mobile sampling platform ("sniffer vehicle"). Measurements from these monitors are used to help identify and document $PM_{2.5}$ concentration hotspots in order to better understand the regional and local sources of elevated $PM_{2.5}$ concentrations, and to help ensure the representativeness of FRM monitoring locations. More information about operation of both fixed and mobile monitors is presented in Section III.D.5.5.

[7] The site at North Pole Elementary School was terminated in 2013.
[8] "Alaska 2013 Air Monitoring Network Plan, Chapter 3, Fairbanks North Star Borough," Air Quality Division, Alaska Department of Environmental Conservation, available here: http://dec.alaska.gov/air/am/AK%20Monitoring%20plans-docs/2013%20Network%20Review/2013%20Monitoring%20Plan%20Ch%203%20Fairbanks%20Final.pdf

Figure 5.4-1. Location of Fixed Site $PM_{2.5}$ Monitors

5.4.2 Trends in Monitored $PM_{2.5}$ Concentrations

The 24-hour $PM_{2.5}$ standard is designed to provide health protection against short-term fine particle exposures, particularly in areas with high peak $PM_{2.5}$ concentrations; the standard is set at 35µg/m^3. A community attains the 24-hour standard when the 98th percentile of 24-hour $PM_{2.5}$ concentrations for each year, averaged over three years, is less than or equal to 35 µg/m^3. Since "the form of the standard" (the basis for attainment) is specified using 98th percentile values, the values calculated for each monitor for each year presented in Table 5.4-2 are 98th percentile values.

Table 5.4-2 shows that with the exception of the 2011 values reported for North Pole Elementary (which had a limited number of measurements) and the NCore site, all values from 2008 to 2013 exceeded 35µg/m^3. Fluctuations in concentrations recorded across the years reflect differences in both meteorology and human activity in areas impacting the monitors. In general, there is a rough correlation (with the exception of the North Pole Elementary value in 2009) among the State Office Building, North Pole Elementary and NCore monitoring sites. In contrast, the concentrations recorded at the North Pole Fire Station are 2-3 times the values recorded at the other monitors in 2012 and 2013. The Borough and ADEC are still investigating if this site is representative of the North Pole area or indicates an area with unusually high concentrations (commonly referred to as a "hot spot").

While Table 4-2 displays 98th percentile values, another measure of public exposure to elevated $PM_{2.5}$ concentrations is the number of days the 24-hour standard is exceeded each year; this information is presented in Table 5.4-3. It shows that since 2009 there has been a decline in the number of days the standard is exceeded at the State Office Building site. A similar but noisier trend is also evident at the NCore site, which is located less than half a mile to the northwest of the State Office Building monitor. The North Pole sites, located 12-13 miles southeast of the State Office Building monitor, show a different trend—one of stability. The number of days the standard is exceeded at North Pole Elementary has been constant since 2010. Although it is not possible to discern a trend from 2 years of data, the values for the North Pole Fire Station show an increase from 2012 to 2013. When viewing Table 5.4-3 it is important to remember that FRM data in Fairbanks is only collected once every 3 days. Thus, the values displayed are not representative of the days the public is exposed to higher concentrations. If the conditions on the unmonitored days are the same as those on the monitored days, which they are not, the values in Table 5.4-3 could be up 3 times higher.

Table D.5.4-2
Trend in 98th Percentile $PM_{2.5}$ Concentrations Recorded
at Fairbanks Monitoring Sites (FRM)
2008 – 2013

Site Name	Location	98th Percentile (µg/m³)					
		2008	2009	2010	2011	2012	2013
State Office Building	Fairbanks	47	51	51	38	49	42
NCore	Fairbanks	NA	44[a]	51	33	50	45
North Pole Elementary	North Pole	NA[b]	114	53	21[c]	68	47
North Pole Fire Station	North Pole	NA	NA	NA	NA	158	122

Notes:
a. NCore only had 17 measurements in 2009
b. NPe only had 1 measurement in 2008
c. NPe only had 40 measurements in 2011

Table 5.4-3
Trend in Days Exceeding the 24-hour $PM_{2.5}$ Standard
at Fairbanks Monitoring Sites (FRM)
2008 – 2013

Site Name	Location	Days Exceeding 35 µg/m³ Standard					
		2008	2009	2010	2011	2012	2013
State Office Building	Fairbanks	7	13	11	4	7	3
NCore	Fairbanks	NA	5[b]	9	1	4	3
North Pole Elementary	North Pole	NA[a]	5	8	0[c]	9	8
North Pole Fire Station	North Pole	NA	NA	NA	NA	9	13

Notes:
a. NCore only had 17 measurements in 2009
b. NPe only had 1 measurement in 2008
c. NPe only had 40 measurements in 2011

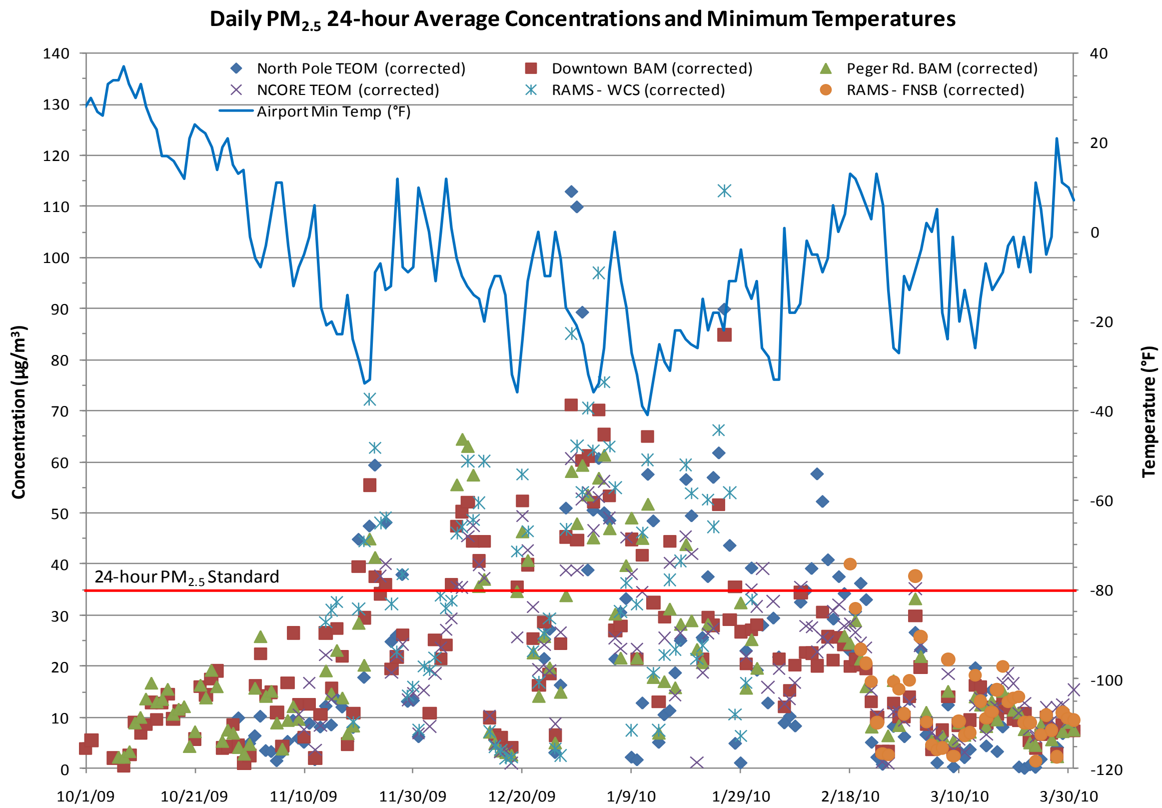
A different view of public exposure to $PM_{2.5}$ concentrations can be seen in the daily concentrations recorded during the course of the winter (October – March). Since multiple graphics would be required to present this information across the years presented in the tables above, as an example data is only displayed for the 2009-2010 winter in Figure 5.4-2. Data are presented for each day for 6 separate monitors: North Pole Elementary (North Pole); NCore; State Office Building (Downtown Fairbanks); a temporary site located at the Borough Transportation Department on Peger Road (Peger Rd.); and mobile monitoring data (Relocatable Air Monitoring System -RAMS) trailer measurements at Watershed Charter School (RAMS - WCS) and downtown Fairbanks (RAMS - FNSB).

Continuous monitors were operated at each of these sites, and measurements of concentrations were recorded on days when the FRMs are not operated. The continuous monitors collect hourly measurements which can be averaged into daily, 24-hour averages. Because of sampling differences and the fact that the continuous monitors are not federally approved as equivalent to the FRM monitors, the daily concentrations from the continuous monitors were compared to the FRM data and then adjusted, or corrected, using a derived correlation factor.[9] The corrected values are displayed in Figure 5.4-2.

Table 5.4-3 shows the total number of days on which the federal daily $PM_{2.5}$ standard threshold (35 $\mu g/m^3$) was exceeded at each site. The average number of exceedances was 30, excluding the second RAMS trailer location. The fact that the number of exceedances was the same, or nearly the same at the Downtown, NCORE, and North Pole sites verifies that the $PM_{2.5}$ problem in the Fairbanks area is truly regional, even though the exceedances often did not occur on the same days. The Peger Road location is a more industrial area where fewer residential sources of $PM_{2.5}$ impact the monitor; therefore, the slightly lower number of exceedances at that site is not unreasonable. As for the RAMS – WCS site, the higher number of exceedances is likely due to impacts from sources in the neighborhood, since the trailer was located in a residential area.

[9] Memo from Craig Anderson, Sierra to Cindy Heil, ADEC entitled “Summary and Analysis of Fairbanks $PM_{2.5}$ Data for Winter 2009 – 2010,” August 2010.

Figure 5.4-2
Daily $PM_{2.5}$ 24-hour Average Concentrations and Minimum Temperatures



The concentration data shown in Figure 5.4-2 also reveal that nearly all of the exceedances occurred between mid-November and mid-February, roughly a 90-day time span, resulting in exceedances of the daily standard threshold on about one-third of the days. The maximum 24-hour concentration observed at each site was as follows:

- Downtown: 84.9 µg/m^3 on 1/26/2010
- NCORE: 60.6 µg/m^3 on 12/29/2009
- Peger Rd.: 64.5 µg/m^3 on 12/9/2009
- North Pole: 112.8 µg/m^3 on 12/29/2009
- RAMS – WCS: 113.1 µg/m3 on 1/26/2010
- RAMS – FNSB: 39.9 µg/m^3 on 2/18/2010

It should be noted that each site has several days with missing data due to equipment or monitoring site infrastructure problems, such as trailer heater failures, or maintenance. For instance, both the NCORE and Peger Road sites were not operating on January 26, 2010, the day on which the highest concentrations of the season were observed at the other two Fairbanks locations.

Also displayed in Figure 5.4-2 is the minimum temperature (°F) recorded at Fairbanks International Airport each day. The general trend was that when temperatures decreased,

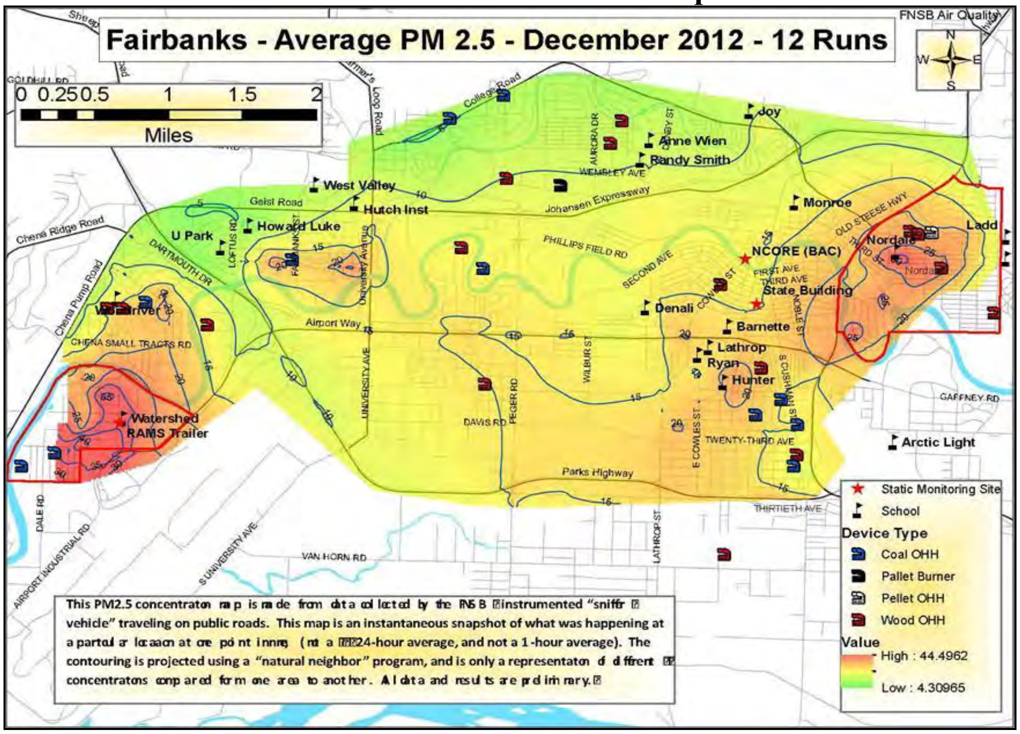
$PM_{2.5}$ concentrations increased, which was similar to patterns observed in previous winters. The minimum temperature on the majority of days on which the daily $PM_{2.5}$ standard threshold was exceeded was below -15 °F. However, it is also clear that exceedances occurred during a wide array of daily minimum temperatures, ranging from +13 °F down to -41 °F.

Overall, the data displayed in Figure 5.4-2 show that daily average concentrations are not uniform across time and display considerable variation across sites on any given day, with less variance on the warmer shoulder months of the winter and more variance as temperatures get colder. Since it is cost prohibitive to place monitors at a wide range of locations throughout the nonattainment area, the Borough has operated a "sniffer vehicle" to collect $PM_{2.5}$ concentration data on regular routes that traverse a larger portion of the nonattainment area. While these measurements are instantaneous, and are therefore not directly comparable to 24-hour average values, data has been collected multiple times per day many days per winter since the 2007-2008 winter. Analysis of that data has confirmed that certain areas within Fairbanks and North Pole regularly have higher concentrations.

FNSB staff use ARC-GIS software with scripted programming to analyze vehicle sampling data. The results are routinely made publicly available in near real time at the Borough's web site.[10] A sample of such data and analysis from recent drives in the cities of Fairbanks and North Pole is shown in Figure 5.4-3. Sampling data like these, collected over multiple years, have provided a detailed picture of both communities and have allowed Borough staff to identify and focus data collection, public information, and SIP mitigation strategies on those areas having the highest $PM_{2.5}$ concentrations. The locations with the highest concentrations identified in Figure 5.4-3 are consistent with those observed in numerous vehicle runs conducted in previous years.

[10] ftp://ftp.co.fairbanks.ak.us/Air%20Quality/SnifferData/schoolssniffermapsDecJan2013.htm.

Watershed/Nordale $PM_{2.5}$ Hotspots



North Pole / Badger Rd $PM_{2.5}$ Hotspots

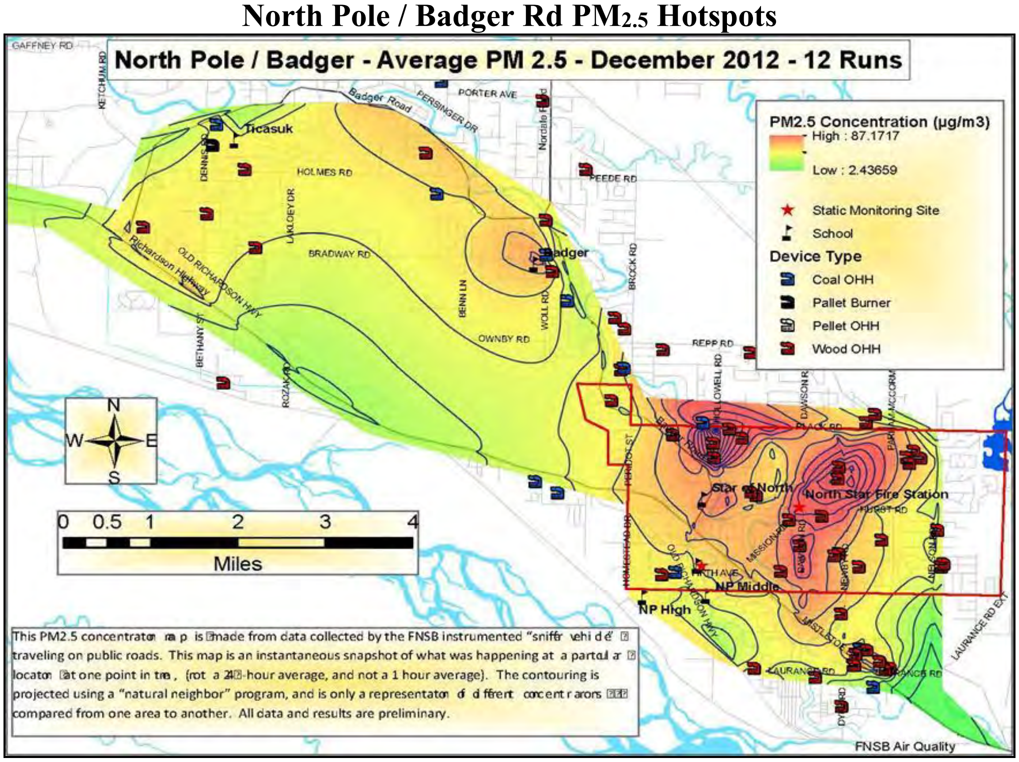
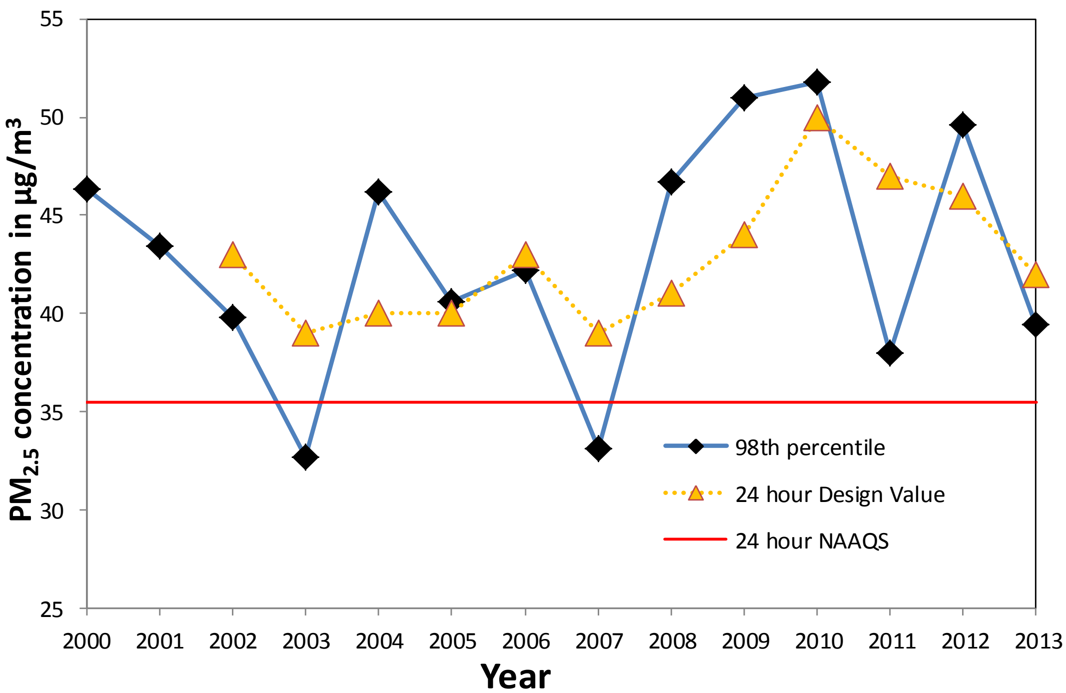


Figure 5.4-3 Multiple $PM_{2.5}$ Hotspots Identified within Nonattainment Area

5.4.3 Calculation of Design Values

Compliance with ambient air quality standards is based on the calculation of a "design value" for individual monitors consistent with the form of the standard. For the 24-hour ambient $PM_{2.5}$ standard, the design value is calculated from the 3-year average of annual 98th percentile values. In 2009, EPA designated Fairbanks as nonattainment for that standard using measurements collected at the State Office Building over the previous 3-year period, 2006 – 2008.[11,12] The 98th percentile value for each of those years was 42.2 $\mu g/m^3$, 33.1 $\mu g/m^3$ and 46.7 $\mu g/m^3$; collectively they produced a $PM_{2.5}$ design value of 41 $\mu g/m^3$ for the 3-year period ending in 2008. Design values are updated each year, based on the previous 3-years of data.

Figure 5.4-4 displays both the 98th percentile $PM_{2.5}$ concentrations and the design value calculated for the previous 3-year period at the State Office Building between 2001 and 2013. The recurring pattern of peaks and valleys in the 98th percentile concentrations reflecting the recurring severity and benevolence of meteorology.



[11] At that time, the State Office Building was the only FRM monitoring site with 3-years of $PM_{2.5}$ measurements.

[12] 74 FR 58690 dated November 13, 2009

Figure 5.4-4 State Office Building Historical Design Value and 98th% Percentile 24-hr $PM_{2.5}$ Concentrations

While the design values described above are used to assess compliance with the ambient 24-hour $PM_{2.5}$ standard, a different design value is calculated to provide guidance on the emission reductions needed for attainment planning. That value is calculated as a rolling 3-year average of concentrations recorded over the 5-year period between 2006 and 2010, as recommended by EPA modeling guidance. This approach uses a longer averaging period so that more recent measurements are used to calculate reduction targets; it produces a baseline design value[12] of 44.7 $\mu g/m^3$. The difference between that value and the standard, 9.7 $\mu g/m^3$, establishes the reductions in projected (i.e., modeled) concentrations the attainment plan needs to achieve. Since EPA established the base year for attainment planning to be 2008, it means that forecasts of ambient concentrations need to decline 9.7 $\mu g/m^3$ or 21.7% relative to the concentration modeled for the 2008 base year. Since 98th percentile concentrations are rounded to the nearest integer (i.e., 35.4 rounds to 35), the reduction target is therefore 9.3 $\mu g/m^3$ (44.7 – 34.4).[13] That value is divided by the number of years between designation of nonattainment (2009) and the Moderate Area attainment date (2015), to establish one year's worth of progress for assessing Reasonable Further Progress and compliance with Contingency Measure requirements (1.6 $\mu g/m^3$)[14].

5.4.4. Representativeness of Meteorological Conditions Used in Design Value Calculations

ADEC commissioned a statistical assessment of the relationship between $PM_{2.5}$ concentrations and meteorology in Fairbanks to determine which variables are associated with elevated concentrations.[14] The analysis relied upon $PM_{2.5}$ measurements recorded by the BAM located at the State Office Building in downtown Fairbanks, calibrated to the filter-based FRM measurements from the same site. The study also used a range of variables describing the state of the atmosphere near the surface. Besides $PM_{2.5}$ concentrations, the analysis used surface-based meteorological measurements and observations, upper air soundings, and a variety of computed variables (e.g., temperature profile at fixed heights aloft, height of the mixed layer, etc.). With 16 variables included in the dataset (daily average $PM_{2.5}$ concentrations and 15 meteorological variables), the analysis determined the relationships between the meteorological variables and $PM_{2.5}$

[12] See Appendix 5.8 SANDWICH Method.
[13] http://www.epa.gov/ttn/oarpg/t1/memoranda/pmfinal.pdf
[14] *http://www.epa.gov/airquality/particulatematter/2014/20140428fr.pdf*

[14] Crawford, Robert et al, "Statistical Assessment of $PM_{2.5}$ and Meteorology in Fairbanks, Alaska" (draft), prepared for the Alaska Department of Environmental Conservation by Rincon Ranch Consulting and Sierra Research, March 2013. The draft study has undergone peer review and has been submitted for EPA review.

concentrations. Six factors (listed below) were identified as the key determinants[15] of $PM_{2.5}$ concentrations:

- Degree of atmospheric stability created by radiative cooling of the surface under clear and dry Arctic skies;
- Surface air temperature;
- Average wind speed through the mixed layer;
- Presence of snow;
- Presence of ice fog; and
- A measure of pollutant trapping aloft.

These variables were incorporated into a simple statistical model that was used to test whether the meteorological conditions recorded during the 2006-2010 design period are representative of the long-term meteorology of Fairbanks (as represented by twenty winters from 1989-90 through 2010-11). The results indicated that the 2006-2010 design period had somewhat more severe meteorology with respect to $PM_{2.5}$ concentrations than would be expected from the 20-year period addressed in the analysis. Several factors influenced this finding, including:

- Somewhat colder surface temperatures during 2006-2010 throughout the full range of winter conditions

- Stronger surface temperature inversions during 2006-2010

- Consistently lower wind speeds through the mixed layer during 2006-2010, through the range of winter conditions

- Fewer instances where the presence of a warm-air layer aloft increased the trapping of pollutants in the local airshed. This is the only major meteorological factor tending to reduce $PM_{2.5}$ concentrations in the design period compared to the 20-winter period analyzed.

To summarize, the 2006-2010 design period's apparent severity for $PM_{2.5}$ concentrations is driven by a combination of colder-than-average surface temperatures coupled with consistently stronger surface inversions and lower average wind speeds in the mixed layer, offset to some extent by fewer instances in which warm air aloft increased trapping. On the coldest days, the severity of $PM_{2.5}$ concentrations are from low wind speed and strong inversions. Overall, there is no indication that the 2006-2010 design period understates the meteorological challenges to reaching $PM_{2.5}$ attainment, and it may be conservative with respect to the severity of meteorology.

5.4.5 Exceptional Events

[15] These first six vectors accounted for 93% of the total variance explained, and Vector 1 alone accounted for 53% of the total variance, i.e., most of the variance in the data.

As noted above, attainment of the 24-hour standard is based on the 3-year average of the 98th percentile values calculated for each monitor using measurements collected over the course of the year. Fairbanks experiences high $PM_{2.5}$ concentrations during the winter that are the result of stable boundary layers, low wind speeds and anthropogenic activity. Fairbanks also experiences high concentrations during the summer that are the result of wild fires (located both near and far from the nonattainment area) and meteorology (wind speed, wind direction, etc). Since most wild fires are caused by non-anthropogenic events (e.g., lightning strikes, etc.), EPA has established a process for not including days with elevated concentrations in regulatory calculations (e.g., the calculation of design values). The process requires states to identify the high concentration days (known as "exceptional events"), their non-anthropological causes (e.g., wild fires, volcanic activity, etc.), and evidence that the causes could not be controlled.

The CAA section 319(b) references the exceptional event exception and the process governing the request to exclude exceptional events from regulatory calculations was established by EPA in 2007 (72 *Fed. Reg.* 13,560 (3/22/07)). The Exceptional Events Rule establishes criteria and procedures for determining if an exceptional event has influenced ambient air quality monitoring data. The Exceptional Events Rule (EER) clarified the CAA in that public health should be protected where and when possible without holding State and Local Agencies accountable for unique events beyond their control such as high winds, wildfires and volcanic activities. The EPA defines an exceptional event as an ambient air quality event that "is not reasonably controllable or preventable, a natural event, and is determined by the Administrator in accordance with 50.14©(3)(iii)to be an exceptional event" (40 CFR 50.1 (j)). The EER gives ADEC the option of presenting the EPA Region 10 with compelling and clear causal evidence of an event with exceptionally high concentration(s) affecting the area of interest in a regulatory manner that cannot be reasonably controlled. ADEC must provide supporting documentation for the following elements in their Exceptional Event Waiver Request (EEWR) package submitted to EPA Region 10:

(A) The event satisfies the criteria set forth in 40 CFR 50.1(j);

(B) There is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected the air quality in the area;

(C) The event is associated with a measured concentration in excess of normal historical fluctuations, including background; and

(D) There would have been no exceedance or violation but for the event.

(iv) With the submission of the demonstration, the State must document that the public comment process was followed

Once Region 10 concurs with the ADEC's EEWR that the event related exceedances are excluded from regulatory calculations, ADEC can delete them from the calculations used to determine the design value, which is used for nonattainment designations, re-designations or reclassifying an extant nonattainment area to higher classification.

In Alaska's case, the State has prepared exceptional events waiver requests (EEWR) for any measured concentrations with regulatory significance: exceedances or not, that could possibly cause areas not previously in danger of a nonattainment designation to be designated nonattainment, whether or not they affect current regulatory designations. ADEC cannot predict future year ambient air quality monitoring results. However, because a number of EPA's regulations include three year averages for design values, it behooves the ADEC to prepare for the worst case scenario ahead of time.

Once exceptional events concentrations are identified, the state and local agencies follow the exceptional events implementation guidance posted on EPA's website May 13, 2013.[16] Once an exceedance is noted by air quality staff, the Air Monitoring and Quality Assurance (AMQA) program manager immediately notifies EPA Region 10. If the exceedance(s) is/are due to an Exceptional Event and the event has regulatory significance, then State staff begin to collect evidence and prepare modeling for preparation of an EEWR demonstration package. All monitor data related to the event(s) are flagged in EPA's national Air Quality System (AQS) database with an exceptional event waiver request (EEWR) before July 1 of the year following the year in which the flagged measurements occurred. Days measuring exceedances and values that may affect the annual design value are qualified with an exceptional events flag consistent with the requirements of 40 CFR 50.14 (for example the AQS flag RT refers to Request Exclusion Wildfire U.S.). These data records are associated with an event description in AQS. ADEC flags other days with concentrations that have been affected by the event(s) but that will not have regulatory significance with informational flags in AQS (for example the AQS flag IT refers to Informational Wildfire U.S.). For the events with regulatory significance, the ADEC prepares an exceptional event waiver request (per the list above).

On September 20, 2012, ADEC submitted an EEWR for Fairbanks, Alaska for nine days in July and early August 2009.[17] On December 19, 2012, EPA Region 10 concurred with 6 of the days that were exceedances, and declined to act on the three dates that were not exceedances because they did not have regulatory significance.

Table 5.4-4
Fairbanks $PM_{2.5}$ Exceptional Event Requests Submitted to EPA for 2009

Date	$PM_{2.5}$ concentration
07/06/2009	**44.1**
07/09/2009	19.3
07/15/2009	**75.3**

[16] ibid
[17] http://dec.alaska.gov/air/am/exceptional_events.htm

07/24/2009	17.7
07/27/2009	25.6
07/30/2009	**159.5***
08/02/2009	**89.7**
08/05/2009	**127.7****
08/08/2009	**61.0**

Notes: Exceedances indicated in **bold** font. * and ** denote sampling times of 16.75 hours and 19 hours respectively. Sampling stopped because filters were clogged by excessive particulate loading and the instrument shut down. The daily concentrations were calculated using the sampling time only.

On September 26, 2013, ADEC submitted an EEWR for Fairbanks, Alaska for four days in May, June and July 2010.[18] On March 11, 2014, EPA concurred with the exceedance EEWR request for July 13, 2010 but declined to act on the three dates that were not exceedances because they did not have regulatory significance.

Table 5.4-5
Fairbanks $PM_{2.5}$ Exceptional Event Requests Submitted to EPA for 2010

Date	$PM_{2.5}$ Concentration	
	State Office Building	North Pole Elementary School
05/29/2010	21.8	13.4
06/01/2010	23.4	23.9
07/13/2010	**44.5**	22.7
07/16/2010	21.3	2.6

Notes: Exceedances indicated in **bold** font.

ADEC did not submit any EEWR for 2006-2008, 2011 and 2012. ADEC is currently preparing an EEWR for Fairbanks, Alaska, for six days in 2013.

[18] ibid

5.5. PM2.5 NETWORK AND MONITORING PROGRAM

Air quality monitoring data are used to determine compliance with the NAAQS. It is important to monitor and compare ambient air quality concentrations to modeled emission projections to determine if the projections are reasonable and credible. Section 110(a)(2)(B) of the CAAA (42 U.S.C. 7410(a)(2)(b)) requires that each implementation plan submitted to EPA provide for the establishment and operation of "appropriate devices, methods, systems, and procedures necessary to monitor, compile, and analyze data on ambient are quality." Details of the ADEC PM 2.5 Network and Monitoring Program and be found in the Appendix III.D.5.5.

The Fairbanks North Star Borough (FNSB) Air Program operates and manages five monitoring stations located within the Northern Alaska Air Quality Control Region: one State and Local Air Monitoring Site (SLAMS) for carbon monoxide (CO), one SLAMS site for $PM_{2.5}$, one Speciation Trend Network (STN) site, one multi pollutant Ncore site and one Special Purpose Monitoring (SPM) sites for $PM_{2.5}$. Both, the SLAMS and STN sites are located at the Fairbanks State Office Building. Figure 5.5-1 is a map showing the entire Fairbanks and North Pole area. The red dots indicate the locations of the monitoring sites. The locations of the monitoring network are described in the table below.

Table 5.5-1 SLAMS and SPM sites in the Fairbanks North Star Borough

$PM_{2.5}$					
Site Name	**Location**	**AQS ID**	**Designation**	**Install Date**	**Scale**
State Office Building	Fairbanks	02-090-0010	SLAMS	Oct, 1998	neighborhood
			STN	Mar, 2005	neighborhood
NCore	Fairbanks	02-090-0034	NCore	Oct, 2009	neighborhood
North Pole Fire	North Pole	not available	SPM	Mar, 2012	neighborhood
CO					
Site Name	**Location**	**AQS ID**	**Designation**	**Install Date**	**Scale**
Old Post Office	Fairbanks	02-090-0002	SLAMS	Jan, 1972	micro

The Old Post Office site is located at 250 Cushman Street, in the middle of central business district and at one of the busiest intersections in downtown Fairbanks. This site is equipped with a CO

(SLAMS) monitor and the dominant source of CO for this site is automobile exhaust. There are some small family dwellings in the area, but land use is predominantly business. The Alaska Railroad industrial area and Aurora Energy coal fired power plants are both located within one mile of the site. Coal fired power plants operated by the University of Alaska, Fairbanks and Fort Wainwright Army Post are located within five miles of this site. CO is also measured at the NCore site. If a viable correlation can be established between both CO sites, the Old Post office site might be shut down, as CO levels are generally low.

The State Office Building site at 675 Seventh Ave is located in the middle of the central business district. Fine particulate matter sources for this site change season to season. During the winter months, the primary sources are home heating, vehicle exhaust and wood smoke, while during the summer, the main source is from wildland fire smoke. This site is equipped with a Federal Reference Monitor (FRM) for $PM_{2.5}$ (SLAMS), and the $PM_{2.5}$ speciation monitors (STN). Both filter based samplers are set to the national 1 in 3 day sampling schedule.

The NCORE site is located at 809 Pioneer Road. The site is located approximately 35 meters north of the Chena River near the Fairbanks North Star Borough building and within one mile of numerous road systems. ADEC chose this site for multi pollutant monitoring since Fairbanks is dealing with the most significant air quality impacts in the state. This is a neighborhood-scale population orientated site. The site is equipped with FRM PM_{10} and $PM_{2.5}$ (SLAMS), continuous PM_{10} and $PM_{2.5}$, $PM_{10-2.5}$ (SPM), speciated $PM_{2.5}$ (SPM) monitors, hourly CO (SLAMS quality), SO_2 (SLAMS quality), total reactive nitrogen (NO_y), and ozone (O_3) (SLAMS),surface meteorology for wind speed/direction, ambient temperature, relative humidity (RH) and barometric pressure. While the site houses continuous $PM_{2.5}$ analyzers that should be capable of measuring "FRM-like" data, the samplers do not meet EPA performance requirements as Class III Federal Equivalence method (FEM) and are not used for regulatory purposes. The data therefore are only used for trend analyses, supporting documentation and air quality advisories.

North Pole Fire Station site is located on the west side of North Pole Fire Station #3 at 3288 Hurst Road in the middle of a residential area. This site houses a FRM $PM_{2.5}$ sampler operating on the national 1 in 3 day sampling schedule. As with the NCore site, a continuous $PM_{2.5}$ analyzer (non

FEM) is also located at the site, which is used for air quality advisories. The dominant source of $PM_{2.5}$ for this site changes from season to season. The source contribution to winter time $PM_{2.5}$ is still being studied. Wood smoke from home heating is currently considered one of the major sources. During the summer months, the main source is wildland fire smoke.

The monitoring network is operated 24 hours each day. Two types of $PM_{2.5}$ monitors are installed in Fairbanks area, Met-One Beta Attenuation Monitors (BAM 1020) provides information in real time for evaluating the air quality index and Thermo Electron Inc. Partisol 2000 samplers follow the national 1-in-3 day sampling schedule. The filters from the Partisol 2000 samplers are sent to the ADEC laboratory for gravimetric analysis and the data are reduced to produce the 24-hour average particulate concentrations. The continuous data from BAM 1020 monitors are uploaded to a central computer every day of the week. $PM_{2.5}$ monitoring is conducted following requirements established in federal regulations, EPA guidance and instrument manufacturer recommendations.

Pole Elementary

Figure 5.5-1 Map of the Fairbanks and North Pole Area. Red dots indicate the locations of the monitoring sites.

5.6. EMISSION INVENTORY DATA

5.6.1. INTRODUCTION

5.6.1.1. Purpose of the Emission Inventory

Title I of the Clean Air Act Amendments of 1990 (CAA) contains provisions requiring development of emission inventories for designated areas that fail to meet the National Ambient Air Quality Standards (NAAQS). A portion of the Fairbanks North Star Borough (FNSB) that includes the cities of Fairbanks and North Pole as well as surrounding areas has been designated as a NAAQS $PM_{2.5}$ Moderate non-attainment area for violation of the 24-hour average standard enacted in 2006. In compliance with published EPA requirements, the inventories are provided as a part of the Alaska's State Implementation Plan (SIP) to formulate a strategy to attain the $PM_{2.5}$ NAAQS in Fairbanks.

As further described in Section III.D.5.9, a Moderate Area SIP must either demonstrate[1] that:

i. The plan will provide for attainment by the applicable attainment date (December 31, 2015 in this case); or

ii. Demonstrate that attainment by such date is impracticable.

Related to a demonstration of "impracticability," CAA Part D, subpart 4 Section 189(a)(1)(C) also requires that Moderate Area plans include provisions to assume reasonably available control measures no later than four years after the moderate area designation was made, which is addressed in Section III.D.5.7.

This section of the SIP is intended to fulfill EPA requirements for preparing the 2008 Base Year and 2015 Attainment Year emission inventories, as specified in the provisions of the CAA and EPA guidance documents. The intent of this section is to describe how emissions were first estimated for the 2008 base year and then projected forward to 2015 with technically and economically feasible controls implemented within that time to determine whether the area will reach attainment by 2015. This attainment analysis is based on atmospheric modeling that simulates the formation of ambient $PM_{2.5}$ given input emissions and meteorology and is described in detail in Section III.D.5.8 of the SIP.

The Fairbanks Moderate Area SIP emission inventory is considered a Level II inventory, as classified under the Emission Inventory Improvement Program (EIIP).[2] It is a Level II inventory

[1] CAA Part D, subpart 4, Section 189(a)(1)(B).
[2] "Introduction to the Emission Inventory Improvement Program, Volume 1," prepared for Emission Inventory Improvement Program Steering Committee, prepared by Eastern Research Group, Inc., July 1997.

because it will provide supportive data for strategic decision making under the context of the SIP and is based on a combination of locally and regionally collected data.

5.6.1.2. Description of Inventories and Geographic Area

There are two classes of inventories based on their intended use, as summarized below:

1. *Planning Inventories* – These inventories are developed to fulfill regulatory planning and reporting requirements and are pollutant- and area designation-specific. Under EPA terminology, they include *base year* inventories ("foundational" emission source and activity inventories upon which all others are based), *three-year cycle* inventories (submitted to EPA under periodic reporting requirements and published under the agency's National Emissions Inventory, or NEI) and *reasonable further progress (RFP)* inventories (developed and submitted to EPA to demonstrate sufficient progress toward NAAQS attainment or regional haze regulatory requirements). Planning inventories contain annual and, in some cases, seasonal emission estimates.

2. *Modeling Inventories* – Modeling inventories are more spatially and temporally resolved in order to account for geographic- and day-specific variations in emissions that affect monitored ambient concentrations. For the Fairbanks SIP, modeling inventories were developed over a gridded modeling domain called "Grid 3," which encompasses an area of 201 × 201 grid cells, each 1.33 km square. Figure 5.6-1 shows the size and location of the Grid 3 modeling domain within the state. As shown, the domain encompasses portions of four counties/boroughs: Fairbanks North Star, Denali, Southeast Fairbanks, and Yukon-Koyukuk. The Fairbanks $PM_{2.5}$ non-attainment area is also shown in Figure 5.6-1 and covers a small portion of the borough (county).

In conformance to 40 CFR[3] §51.1002(c), the applicable inventories include emissions estimates for the following pollutants: $PM_{2.5}$, PM_{10}, SO_2 (SOx), NOx, VOC, and NH_3. Emissions shown for $PM_{2.5}$ and PM_{10} refer to direct emissions of both filterable and condensable particulate matter.

For this Moderate Area $PM_{2.5}$ SIP, a specific set of planning and modeling inventories were prepared to satisfy CAA and EPA regulatory requirements. Table 5.6-1 summarizes the inventories developed and submitted to satisfy these moderate area SIP requirements.

[3] Code of Federal Regulations.

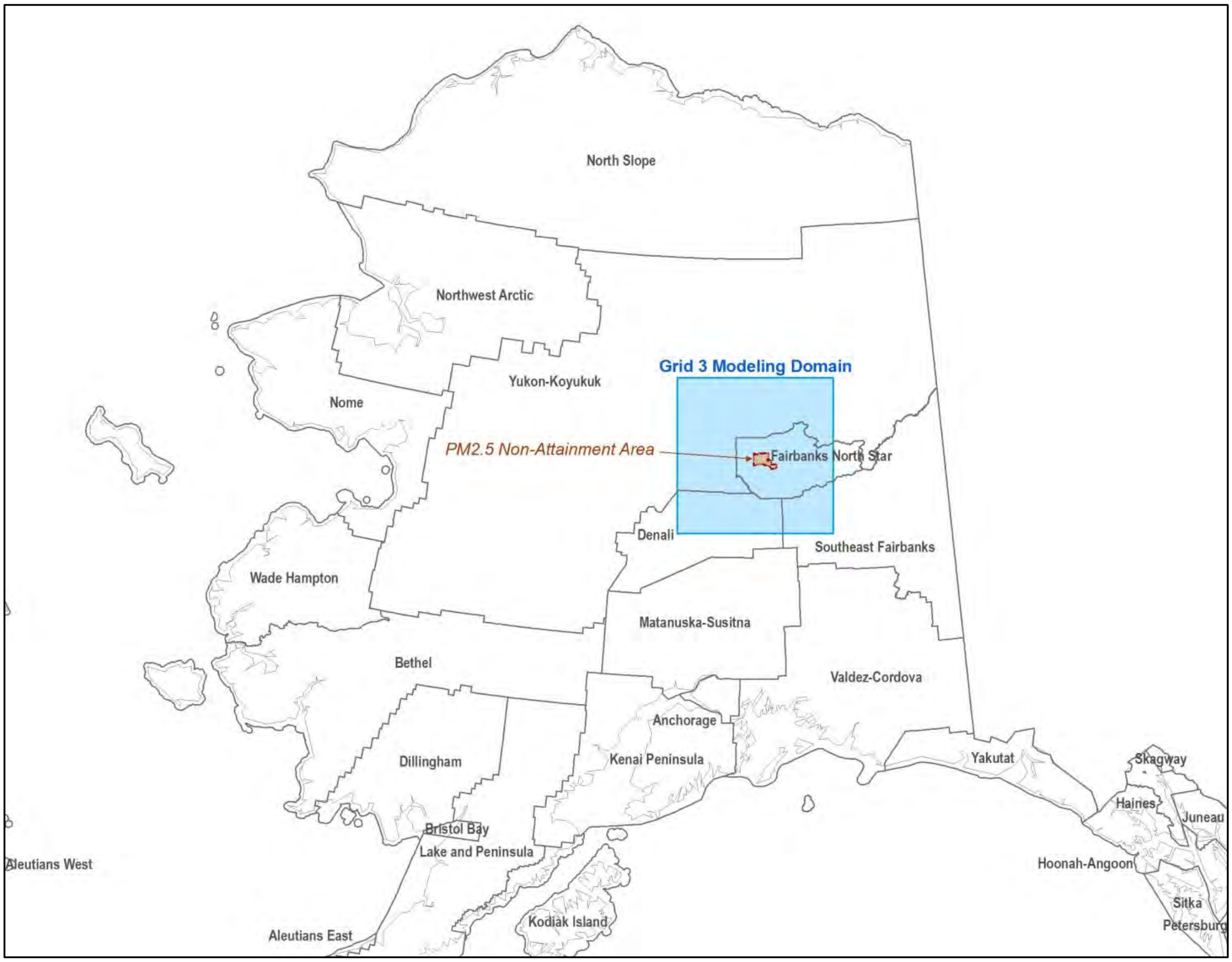


Figure 5.6-1. Fairbanks Modeling Inventory Domain and $PM_{2.5}$ Non-Attainment Area

Table 5.6-1 Summary of Applicable Inventories for Moderate Area $PM_{2.5}$ SIP

Class	Type	Geographic Area	Calendar Year	Regulatory Requirements
Planning	Base Year	Statewide	2008	EPA Regulations*
	Base Year	Non-Attainment Area	2008	CAA 172(c)(3)
	Projected, with controls	Non-Attainment Area	2015	CAA 172(c)(3)
Modeling	Baseline	Modeling Domain	2008	CAA 189(a)(1), CAA 189(b)(1)
	Projected, with controls	Modeling Domain	2015	CAA 189(a)(1), CAA 189(b)(1)

* As specified in EPA's "Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations," November 2005.

As further described in Section III.D.5.9, it was found that attainment of the 24-hour $PM_{2.5}$ NAAQS by 2015 is impracticable. Thus, in addition to the required inventories listed in Table 5.6-1, a broader set of inventories was developed out to calendar year 2019. These additional 2019 inventories serve two goals:

1. To support the primary finding of this plan—that attainment by 2015 is impracticable—and buttress this finding of impracticability by showing the progress toward attainment both by and beyond 2015 based on implementation and penetration schedules for control measures that are technologically and economically feasible.

2. To demonstrate a path toward attainment by 2019. Although this latter goal is not a requirement for this Moderate Area plan, the State of Alaska and FNSB have devoted considerable thought and resources toward identifying and funding control programs that are currently forecasted to provide sufficient emission reductions to bring Fairbanks into attainment of the 24-hour $PM_{2.5}$ NAAQS, albeit not by 2015.

Table 5.6-2 lists the complete set of emission inventories prepared for this SIP which as described above, support both a finding of impracticable attainment by 2015, but projected attainment by 2019 based on currently available data and forecasted control measures.

Table 5.6-2
Inventories Developed for Fairbanks Moderate Area $PM_{2.5}$ SIP

Class	Inventory Type	Geographic Area	Calendar Year(s)	Point Sources	Resolution		Includes Controls?	Reporting Level
					Spatial	Temporal		
Planning	Base Year	Statewide	2008	Actual	State	Annual		Emission Inventory Sector (EIS) or Tier 1
	Base Year	Non-Attainment Area	2008	Allowable	NA Area	Annual, Winter Season		
	Control	Non-Attainment Area	2015	Allowable	NA Area		Yes	
	RFP	Non-Attainment Area	2017	Actual	NA Area	Winter Season	Yes	
	MVEB	Non-Attainment Area	2017	n/a	NA Area	Winter Season		
Modeling	Baseline	Modeling Domain	2008	Actual	1.3 km Grid Cell	Episodic (day and hour)		SCC
	Projected Baseline	Modeling Domain	2015, 2019	Allowable, Actual				SCC
	Control	Modeling Domain	2015, 2019	Allowable, Actual			Yes	SCC

n/a – Not applicable.
SCC – Source Classification Code (a detailed emission source classification scheme developed by EPA)

In addition to identifying those inventories supporting either planning or modeling requirements as described earlier, Table 5.6-2 identifies the other key attributes of each inventory including type, geographic area, calendar year, point source emission type, spatial and temporal resolution, and source reporting level, each of which is further explained below.

- *Inventory Type* – Indicates the type of inventory. Base Year refers to the primary inventory that was developed based on actual source activity levels for a specified year and emission factors representative of that year. For this SIP, calendar year 2008 has been designated as the base year, which coincides with the baseline year for which historical $PM_{2.5}$ episodes are evaluated in the attainment modeling. Thus the modeling inventory developed for calendar year 2008 is called the Baseline inventory and is used to validate the performance of the atmospheric simulation model in predicting ambient $PM_{2.5}$ concentrations compared to actual ambient measurements collected during the 2008 modeling episodes. There are two basic types of inventories for calendar years beyond the 2008 base year: (1) Projected Baseline, which accounts for source activity changes from forecasted population and economic growth and device turnover relative to the base year; and (2) Control, which accounts for emission reductions associated with adopted or forecasted state and local control measures (in addition to population/economic growth). The planning inventories in Table 5.6-2 listed as RFP and MVEB (for Motor Vehicle Emissions Budget) are special inventories that must be developed within the SIP to satisfy Reasonable Further Progress (RFP) requirements. The RFP inventory encompasses all source categories and as explained later in Section 5.6.5 was developed to ensure linear progress toward attainment. The MVEB includes only on-road motor vehicle emissions (not all source categories). It is used to establish vehicle emission budgets for use in subsequent federal regional transportation conformity determinations as explained in Section 5.6.6. (The MVEB inventory is described in further detail in Section III.D.5.13.)

- *Geographic Area* – The geographic area or extent of the sources included within each inventory is also listed in Table 5.6-2. Three different areas, shown earlier in Figure 5.6-1, are represented: Statewide, Non-Attainment Area, and Modeling Domain.

- *Calendar Year(s)* – The calendar years associated with each inventory are listed in this column. In addition to the 2008 base/baseline year, inventories were developed for 2015, the "attainment finding" year for this Moderate Area SIP as well as for 2019. These were developed both to strengthen the case for impracticable attainment by 2015 and to project the effects of forecasted controls toward attainment by 2019. The MVEB is required for 2017 to satisfy RFP quantitative milestone requirements specified in the particulate matter section of the 1992 general preamble section to the CAA.[4] EPA has interpreted that the three-year RFP milestone requirement counts from the due date for the SIP (December 2014 in this case). Therefore, per EPA guidance, the applicable calendar year for the MVEB was 2017.

- *Point (Industrial) Sources* – There are two different emission levels associated with stationary point source facilities that must be considered in developing SIP inventories that meet CAA requirements and satisfy EPA guidance: (1) Allowable, which refers to permitted or Potential to Emit (PTE) emission limits associated with the facility operating permit; and (2) Actual, which are estimates of actual annual or episodic emissions based on historically recorded facility operating throughput or continuous emissions monitoring systems. Actual emissions are generally lower than Allowable emissions (unless a facility is found to be in violation of its operating permit, which was not the case for point source facilities inventoried within the Fairbanks $PM_{2.5}$ SIP).

- *Spatial & Temporal Resolution* – These columns refer to the levels of spatial and temporal resolution of each inventory. As listed in Table 5.6-2, the inventories reflect three different levels of spatial resolution: (1) State, for statewide emissions; (2) NA Area, for total emissions within the Fairbanks $PM_{2.5}$ non-attainment area; and (3) 1.3 km Grid Cell, representing individual 1.3 km grid cell-level emissions within the modeling domain of 201 × 201 grid cells. The levels of temporal resolution reflected in the inventories as listed in Table 5.6-2 are (1) Annual, which reflects total emissions over the entire calendar year; (2) Winter Season, reflecting average emissions over the winter non-attainment season (defined as October through March); and (3) Episodic, for which emissions are resolved by individual day and hour to support the episodic attainment modeling. To simplify the SIP inventory development effort, average emissions over all modeling episode days were calculated and assumed to represent winter-season average emissions. (Given the strong dependence of wintertime emissions in Fairbanks on ambient temperature, this assumption is likely to result in estimates that are higher than those averaged over the entire winter season. Since these winter-season estimates serve planning purposes, this approach to representing winter-season estimates was conservative and assumed to be sufficient.)

[4] Federal Register, Vol. 57, No. 74, April 16, 1992, pg. 13539.

- *Includes Controls* – This column simply identifies whether the inventory includes emission reductions resulting from state or local control measures.

- *Reporting Level* – As noted in Table 5.6-2, the level for which individual source emissions were reported differed between the planning and modeling inventories. Emissions for all planning inventories were developed and reported at the major source sector (stationary point, stationary non-point, on-road, and non-road) or EPA "Tier 1" sector level. Emissions for all modeling inventories were compiled and reported at the individual Source Classification Code (SCC) level.

Most of the effort and rigor in the SIP inventory development focused on the modeling inventories that were used to support the "impracticable attainment by 2015" and "likely attainment by 2019" findings. As described later in Section 5.6.2, the planning inventories were estimated more simply, in some cases by scaling estimates from corresponding modeling inventories to represent annual or winter season (October through March) emissions.

5.6.1.3. Sources Not Inventoried

All potential sources of $PM_{2.5}$ or significant precursor pollutants were evaluated for inclusion within the emission inventory. Generally speaking, sources were excluded from the inventory only under one of the following conditions:

- Data were unavailable; or

- Sources outside the non-attainment area were not believed significant or were well removed from the non-attainment area.

Sources for which data were not available were generally restricted to estimates of ammonia (NH_3) emissions for some source categories, most notably actual episodic emissions for point sources. Sources estimated to be not significant or well outside the non-attainment area included several specific point source facilities and stationary non-point (area) sources. As described in Technical Appendix III.D.5.6, area source emissions were developed only for the Fairbanks North Star Borough portion of the modeling domain. Given the sparse population density of the other three counties within the modeling domain (Denali, Southeast Fairbanks, and Yukon-Koyukuk), area source emissions for these counties were assumed to be not significant and were excluded from the inventory.

5.6.1.4. Inventory Preparation Personnel and Responsibilities

Listed below are the agencies/organizations and key personnel involved in the preparation of the emission inventory and their respective roles.

<u>Alaska Department of Environmental Conservation (DEC)</u>

- Alice Edwards – Managed overall SIP inventory development.

- Cindy Heil – Managed State-funded local data collection (including episodic point source data) and survey studies and coordinated evaluation of potential State control measures.

- Deanna Huff – Assisted in validation of episodic point source facility data, including review of stack parameter/release height data in conjunction with CALPUFF point source modeling supplementing the grid model-based attainment modeling.

- Joan Hardesty – assembled episodic point source data and facility operating permit data and assisted in review and validation of facility source coordinates.

Fairbanks North Star Borough (FNSB)

- Jim Conner and Ron Lovell – Managed Borough-funded local data collection and testing studies and coordinated review/investigation of existing and potential Borough control programs.

- Todd Thompson, Paul Simpson, and Christina DeHaven – Provided detailed transaction and geospatial data on activity within the Borough Wood Stove Change Out program.

Sierra Research (consultant to DEC and FNSB)

- Bob Dulla – Managed Sierra Research's overall inventory support efforts, including coordination of State and local data collection, validation, and implementation within the emissions inventory; also performed source-level inventory quality assurance and control measure reduction review.

- Tom Carlson – Principal technical lead for the emissions inventory preparation and control measure benefits analysis; development of stationary point source, stationary non-point source, and non-road mobile source emissions; and quality assurance review of on-road mobile source emissions.

- Mark Hixson – Responsible for development of on-road mobile source emissions and generation of attainment model-ready gridded and speciated emission inputs.

- Frank Di Genova – Performed review and analysis of State and Borough-funded space heating device emission testing studies and assimilation of validated results into emissions inventory framework and provided overall inventory quality assurance review.

- Dan Welch – Reviewed as-received episodic facility point source activity and fuel use data, flagged issues or calculation errors, and resolved/corrected these issues/errors through DEC-directed follow-up with affected facility operators.

5.6.1.5. Organization of the SIP Inventory Documentation

Beyond this introductory section, Section III.D.5.6.2 summarizes the data source and methodologies used to developed the 2008 base year and baseline inventories for the SIP. An overview of the approach used to calculate emissions for each sector is presented followed by summaries of the 2008 Base Year and 2008 Baseline inventories.

Section III.D.5.6.3 describes the sources of population and economic growth projections and the approach used to generate projected baseline emission estimates in 2015 and 2019 (before application of control measure reductions). It also provides emission summaries by source sector for each projected baseline inventory.

Control inventories in 2015 (the attainment demonstration year) and 2019 are discussed in Section III.D.5.6.4. Each of the adopted or planned state and local control programs is described separately, including assumptions regarding compliance and penetration effectiveness and the sources upon which they were based. Emission summaries are also presented for the 2015 and 2019 control inventories.

Section III.D.5.6.6 explains how the 2017 Reasonable Further Progress inventory was calculated and how it meets RFP-based “linear progress toward attainment” requirements.

Section III.D.5.6.6 outlines the approach used to develop the 2017 Motor Vehicle Emission Budgets to satisfy RFP milestone requirements and establish budgets for use in subsequent regional transportation conformity determinations.

Finally, Section III.D.5.6.7 summarizes the data validation and quality assurance procedures utilized in preparing the complete set of SIP emission inventories.

In addition to the methodology summaries and tabulated emissions presented within this section of the SIP, Technical Appendix III.D.5.6 provide a series of in-depth descriptions of the individual data sources and detailed methodologies used to calculate emissions for the baseline, projected baseline, and control modeling inventories.

5.6.2. 2008 Baseline and Base Year Inventories

This sub-section presents and summarizes the sources and methods used to develop the 2008 Baseline modeling inventory and the 2008 Base Year planning inventories. As noted earlier in Section III.D.5.6.1, emission estimates in planning and modeling inventories are compiled at different levels. The former contains estimates on an area-wide and annual or seasonal basis; the latter is more highly resolved in space and time, representing emissions by individual 1.3 km square grid cell, day, and hour for each of the 35 winter days encompassing the two 2008 historical modeling episodes in the attainment modeling analysis listed below.

- Episode 1 – January 23 through February 10, 2008 (19 days)
- Episode 2 – November 2 through November 17, 2008 (16 days)

A detailed discussion of the 2008 Baseline modeling inventory is presented first because portions of the planning inventories were developed based on the more detailed modeling inventory. This is followed by a discussion of the Base Year planning inventories.

5.6.2.1. 2008 Baseline Modeling Inventory

Overview – Considerable effort was invested in developing the modeling inventories, starting with the foundational 2008 Baseline inventory. Because of strong variations in monthly, daily, and diurnal source activity and emission factors (largely driven by significant swings in ambient conditions between very cold winters and warm summers within the Alaskan interior), it was critically important to account for these effects in developing the 2008 Baseline modeling inventory for each of the 35 winter episode days.

For all inventory sectors, episodic modeling inventory emissions were calculated using a "bottom-up" approach that relied heavily on an exhaustive set of locally measured data used to support the emission estimates. For source types judged to be less significant[5] or for which local data were not available, estimates relied on EPA-developed NEI county-level activity data and emission factors from EPA's *Compilation of Air Pollutant Emission Factors*,[6] AP-42 database.

Table 5.6-3 briefly summarizes the data sources and methods used to develop episodic modeling inventory emissions by source type. It also highlights those elements based on locally collected data. As shown by the shaded regions in Table 5.6-3, the majority of both episodic wintertime activity and emission factor data supporting the 2008 Baseline modeling inventory was developed based on local data and test measurements.

As evidenced by source classification structure used to highlight utilization of key local data sources, development of detailed episodic emission estimates to support the attainment modeling focused on three key source types:

1. *Stationary Point Sources* – industrial facility emissions for "major" stationary sources as defined later in this sub-section developed from wintertime activity and fuel usage;

2. *Space Heating Area (Nonpoint) Sources* – residential and commercial heating of buildings with devices/fuels used under wintertime episodic ambient conditions; and

3. *On-Road Mobile Sources* – on-road vehicle emissions based on local activity and fleet characteristics with EPA-accepted adjustments to account for effects of wintertime vehicle/engine block heater "plug-in" use in Fairbanks using MOVES2010a (the latest version of MOVES at the time the SIP inventory work began).

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[5] Assessments of source significance or relative share were not made "in isolation" but were evaluated and corroborated by other source apportionment techniques discussed in Section III.D.5.8 of the SIP, including Positive Matrix Factorization (PMF) and EPA-approved Chemical Mass Balance (CMB) statistical analysis.

[6] "Compilation of Air Pollutant Emission Factors," Fifth Edition and Supplements, AP-42, U.S. EPA, Research Triangle Park, NC. January 1995.

As seen in emission summaries presented later in this sub-section, these three source types were the major contributors to both direct $PM_{2.5}$ emissions as well as emissions of potential precursor pollutants SO_2, NOx, VOC, and NH_3 within both the non-attainment area as well as the broader Grid 3 modeling domain.

Table 5.6-3
Summary of Data/Methods Used in 2008 Baseline Modeling Inventory

Source Type/Category	Source Activity	Emission Factors
Point Sources	Episodic facility and stack-level fuel use and process throughput	Continuous emissions monitoring or facility/fuel-specific factors
Area (Nonpoint) Sources, Space Heating	Detailed wintertime Fairbanks non-attainment area residential heating device activity measurements and surveys	- Test measurements of common Fairbanks wood and oil heating devices using local fuels - AP-42 factors for local devices or fuels not tested (natural gas, coal)
Area Sources, All Others	- Seasonal, source category-specific activity from a combination of State/Borough sources - NEI-based activity for commercial cooking	AP-42 emission factors
On-Road Mobile Sources	Local and state-based estimates of annual and seasonal vehicle miles traveled	- MOVES2010a emission factors based on local fleet/fuel characteristics - Augmented with Fairbanks wintertime vehicle warmup and plug-in emission testing data
Non-Road Mobile Sources	- Local activity estimates for key categories such as snowmobiles, aircraft and rail - NONROAD2008a model-based activity for Fairbanks for other categories	- NONROAD2008a model factors for non-road equipment - EDMS model factors for aircraft - EPA factors for locomotives

Following this overview, expanded summaries are presented that describe the approaches used to generate episodic emission estimates for each of the source types/categories listed in Table 5.6-3 for the 2008 Baseline modeling inventory. In addition to these methodology summaries, an exhaustive Inventory Technical Appendix (Appendix III.D.5.6) provides detailed descriptions of the data sources, issues considered, and step-by-step methods and workflow used to generate modeling inventory emissions at the Source Classification Code (SCC) level.

Following these summaries, a series of detail tabulations and plots of the 2008 Baseline modeling inventory are presented.

Stationary Point Sources – For the 2008 Baseline modeling inventory, DEC queried facilities from its permits database to identify major and minor point source facilities within the modeling domain. DEC uses the definition of a major source under Title V of the Clean Air Act (as specified in 40 CFR §51.20) to define the “major source” thresholds for reporting annual emissions. These thresholds are the potential to emit (PTE) annual emissions of 100 tons for all relevant criteria air pollutants. Natural minor and synthetic minor facilities (between 5 and 99 TPY) reporting emissions under either New Source Review (NSR) or Prevention of Significant Deterioration (PSD) requirements were also initially included in the query to ensure that facilities within the non-attainment area just below the 100 TPY threshold were also identified to determine whether their emission levels might warrant treatment as individual stationary point sources within the SIP model inventory.

A total of 14 facilities were identified. Of these, DEC noted that three of the facilities—the Golden Valley Electric Association (GVEA) Healy Power Plant and the heating/power plants at Fort Greely (near Delta Junction) and Clear Air Force Base (near Anderson)—were excluded from development of episodic emissions. These facilities were excluded because of their remoteness relative to Fairbanks (all are between 55 and 78 miles away)[7] or the fact that they were located generally downwind of the non-attainment area under episodic air flow patterns (Healy Power Plant and Clear AFB). Three others were identified as minor/synthetic minor sources: (1) Fort Knox Mine (26 miles northeast of Fairbanks), (2) Usibelli Coal Preparation Plant (in Healy), and (3) CMI Asphalt Plant (in Fairbanks); these were excluded from treatment as individual episodic point sources because they either were located outside the non-attainment area (Fort Knox and Usibelli) or exhibited insignificant wintertime activity (CMI Asphalt Plant).

(These excluded facilities were treated as stationary non-point or area sources within the inventory.)

The names and primary equipment and fuels of the eight remaining facilities for which episodic data were collected and developed are summarized in Table 5.6-4. One facility, Eielson Air Force Base, is located just outside the non-attainment area boundary on the southeast edge. All other facilities listed in Table 5.6-4 are located within the non-attainment area.

DEC then requested additional actual day- and hour-specific activity and emissions data from each facility (as available) covering the two 2008 historical modeling episodes. Information was requested for both combustion and fugitive sources. Requested data elements included emission units, stack parameters (height, diameter, exit temperature and velocity/flowrate), release points (location coordinates), control devices (as applicable), seasonal and diurnal fuel properties, and throughput.

DEC's contractor, Sierra Research, Inc. (Sierra) then assembled and reviewed the submitted data for completeness, consistency, and validity prior to integrating the episodic data into the SIP inventories. Given the differences in structure and content of the submitted episodic data, the data were individually reviewed for each facility before being assembled into a consistent inventory structure.

[7] Individual point source plume modeling conducted by DEC in support of the SIP using the CALPUFF model found that under the episodic meteorological conditions, emissions from facilities located outside the Fairbanks $PM_{2.5}$ non-attainment area exhibited negligible contributions to ambient $PM_{2.5}$ concentrations in the area.

Table 5.6-4
Summary of SIP Modeling Inventory Point Source Facilities

Facility ID	Facility Name	Primary Equipment/Fuels
71	Flint Hills North Pole Refinery	11 crude & process heaters burning process gas/LPG (9 operated during episodes), plus 2 natural gas fired steam generators, gas flare
109	GVEA Zehnder (Illinois St) Power Plant	Two gas turbines burning HAGO[a], two diesel generators burning Jet A
110	GVEA North Pole Power Plant	Three gas turbines, two burning HAGO, one burning naphtha (plus an emergency generator and building heaters not used during episodes)
236	Fort Wainwright	Backup diesel boilers & generators (3 each) - none operated during episodes
264	Eielson Air Force Base	Over 70 combustion units - six coal-fired main boilers only operated during episodes
315	Aurora Energy Chena Power Plant	Four coal-fired boilers (1 large, 3 small), all exhausted through common stack
316	UAF Campus Power Plant	Two coal-fired, two oil-fired boilers (plus backup generators & incinerator not operated during episodes)
1121	Doyon Utilities (private Fort Wainwright units)	Six coal-fired boilers

[a] Heavy Atmospheric Gas Oil. HAGO is a crude distillate at the heavy end of typical refinery "cuts" with typical boiling points ranging from 610-800°F. Due to geographic proximity, GVEA seasonally uses HAGO, a by-product from Flint Hills Refinery.

Generally, most facilities provided hourly $PM_{2.5}$ and SO_2 emission rates by individual emission unit. As explained in greater detail below, Sierra then developed estimates of NOx and VOC emission rates from AP-42[8] based emission factors (where fuel use data were explicitly provided) or from fuel-specific emission factor ratios.

Figure 5.6-2 through Figure 5.6-5 provides comparisons of $PM_{2.5}$, SO_2, NOx, and VOC emissions, respectively, for each source facility for which episodic data were collected. (Episodic NH_3 data were not available.) Within each figure, four sets of daily average emissions (in tons/day) are plotted for each facility, as described below.

1. *2008 E1 Avg* – Episode 1 (Jan. 23 - Feb 10, 2008) average daily actual emissions
2. *2008 E2 Avg* – Episode 2 (Nov.2 – Nov. 17, 2008) average daily actual emissions
3. *2008 Actual* – 2008 actual annual average daily emissions (from DEC database)
4. *PTE* – Allowable or permitted annual Potential to Emit (PTE) levels, expressed on an average daily basis (from DEC database)

[8] "AP-42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources," Environmental Protection Agency, January 1995.

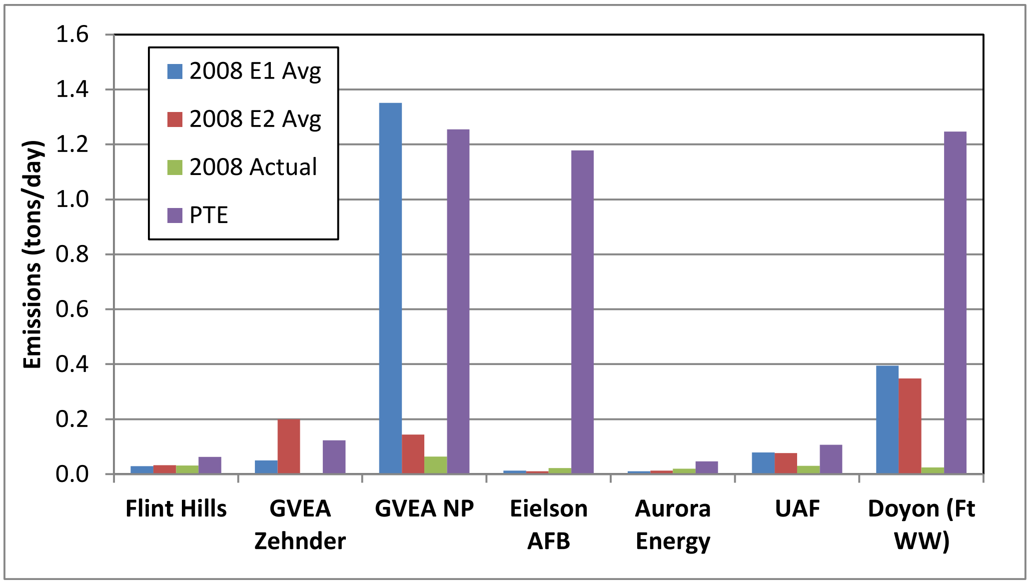

Figure 5.6-2. 2008 $PM_{2.5}$ Episodic, Actual Annual, and PTE Point Source Emissions (tons/day)

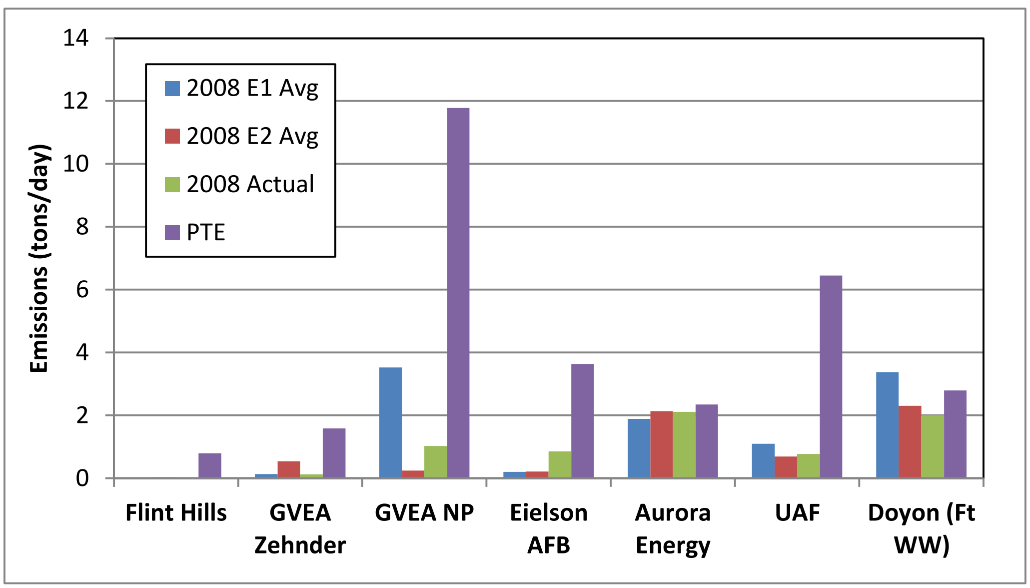

Figure 5.6-3. 2008 SO_2 Episodic, Actual Annual and PTE Point Source Emissions (tons/day)

In comparing allowable (PTE) limits to the actual emissions in this set of figures, one should compare only actual annual emissions (green bars) to the PTE limits (purple bars) since all the data are plotted on an average daily basis. In other words, the fact that GVEP NP Episode 1 average daily emissions in Figure 5.6-2 (blue bar) are higher than the PTE level (purple bar) does not indicate the PTE limit was exceeded since it is an annual, rather than daily, average limit.

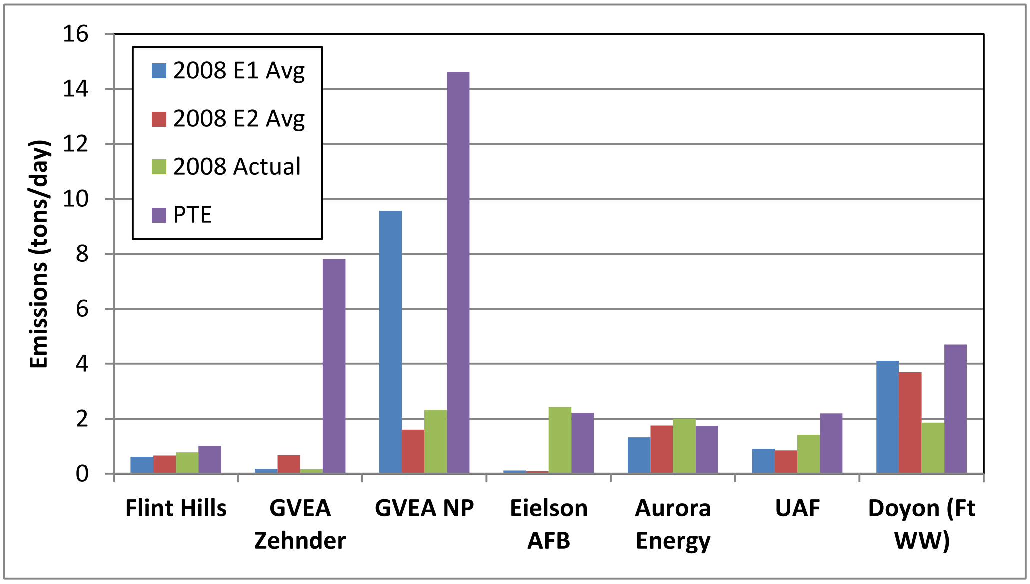

Figure 5.6-4. 2008 NOx Episodic, Actual Annual and PTE Point Source Emissions (tons/day)

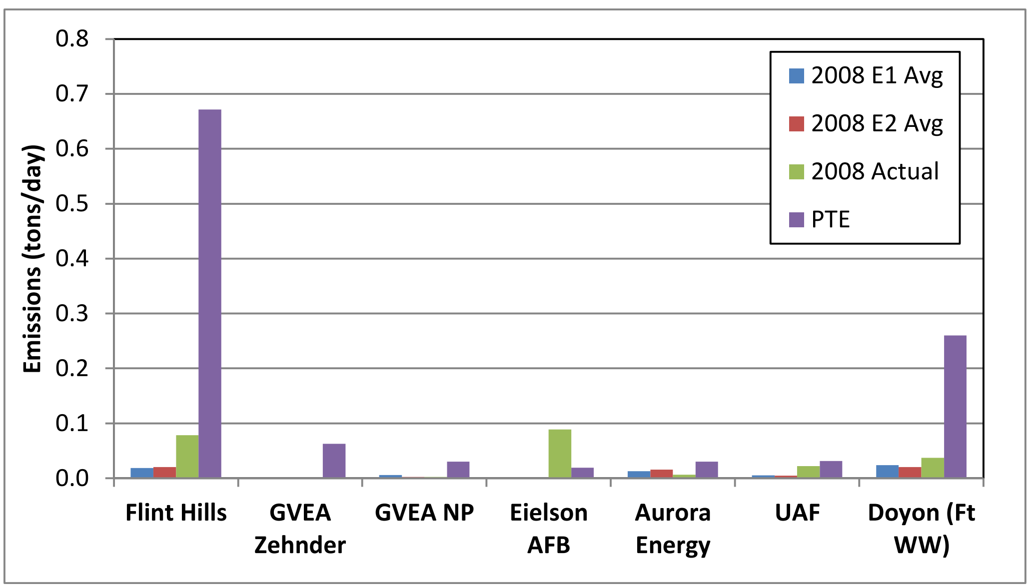

Figure 5.6-5. 2008 VOC Episodic, Actual Annual and PTE Point Source Emissions (tons/day)

As seen in Figure 5.6-2, significant differences exist for certain facilities between actual daily average $PM_{2.5}$ emissions during the winter modeling episodes and permitted (i.e., PTE) average daily emission levels. Moreover, the difference in average actual daily emissions also varied significantly between modeling episodes (and compared to actual annual average emissions) for specific facilities, notably the GVEA North Pole (NP) power plant.

Figure 5.6-3 through Figure 5.6-5 show similar comparisons for the precursor pollutants.

In comparing the facility-specific daily emission averages across this series of plots, it is noted that the PTE emissions represent allowable limits based on operating permits in place in the 2008 baseline year that continue through 2014 with exceptions at UAF[9] and Flint Hills[10] that were assumed to not affect allowable emissions in the projected 2015 inventories.

In addition, the episodic actual emissions for these point sources in the modeling inventory are represented on a day- and hour-specific basis. The E1 and E2 emission levels shown in the plots are averages compiled from the day- and hour-specific emissions across each modeling episode.

Space Heating Area Sources – Inventory assessments and source apportionment analysis performed to support initial development of the SIP identified space heating as the single largest source category of directly emitted $PM_{2.5}$. Thus, the 2008 Baseline modeling inventory incorporated an exhaustive set of locally collected data in Fairbanks that were used to estimate episodic wintertime space heating emissions by heating device type and fuel type. These local wintertime data and their use in generating space heating emissions are summarized below.

- *Fairbanks Winter Home Heating Energy Model* – A multivariate predictive model of household space heating energy use was developed based on highly resolved (down to five-minute intervals) actual instrumented measurements of heating device use in a sample of Fairbanks homes during winter 2011 collected by the Cold Climate Housing Research Center (CCHRC) in Fairbanks. The energy model was calibrated based on the CCHRC measurements and predicted energy use by day and hour as a function of household size (sq ft), heating devices present (fireplaces, wood stoves, outdoor hydronic heaters, and oil heating devices) and day type (weekday/weekend).

- *Multiple Residential Heating Surveys* – Representations of area (ZIP code) specific wintertime heating device uses and practices were developed from a series of annual telephone-based surveys of residential households within the non-attainment area, ranging in size from 300-700 households per survey. The results of these surveys were used to develop estimates of the types and number of heating devices used during winter by ZIP code within the non-attainment area. The survey data were also used to cross-

[9] UAF received a construction permit (under Title I of the CAA) in April 2014 for replacement of its two existing coil-fired boilers with new dual fuel-fired circulating fluidized bed (CFB) boilers that will result in modest changes in facility PTE levels. As of the date of this SIP submittal, it was unknown if these boiler replacements would actually occur in 2015. Thus, pre-April 2014 PTE levels were assumed for UAF in 2015.

[10] In the first half of 2014, the Flint Hills Refinery was shut down. Production of both gasoline and other fuel products ended in early summer. The facility's actual and PTE emissions were still applied in the 2015 inventory given uncertainty about the closing/decommissioning schedule for the refinery at the time the inventory was finalized.

check the energy model-based fuel use predictions as well as to identify and apportion wood use within key subgroups (certified vs. non-certified devices and purchased vs. user-cut wood, the latter of which reflects differences in moisture content that affects emissions).

- *Fairbanks Wood Species Energy Content and Moisture Measurements* – CCHRC performed an additional study that measured wood drying practices and moisture content of commonly used wood species for space heating in Fairbanks. These measurements were combined with published wood species-specific energy content data and additional residential survey data (2013 Wood Tag Survey) under which respondents identified the types of wood they used to heat their homes. Birch, Spruce, and "Aspen" (i.e., Poplar) were identified as the three primary locally used wood species.

- *Laboratory-Measured Emission Factors for Fairbanks Heating Devices* – An accredited testing laboratory, OMNI-Test Laboratory (OMNI), was contracted to perform a series of heating device emission tests using a sample of wood-burning and oil heating devices commonly used in Fairbanks in conjunction with samples of locally collected wood and heating oil. The primary purpose of this testing was to evaluate and, if necessary, update AP-42-based emission factors that were generally based on heating device technology circa 1990. The OMNI study provided the first and most comprehensive systematic attempt to quantify Fairbanks-specific, current technology-based emission factors from space heating appliances and fuels. The laboratory-based emission testing study consisted of 35 tests of nine space heating appliances, using six typical Fairbanks fuels. Both direct PM and gaseous precursors (SO_2, NOx, NH_3) were measured, along with PM elemental profiles. All emission tests were conducted at OMNI's laboratory in Portland, Oregon. Supporting solid fuel, liquid fuel, and bottom ash analyses were performed by Twin Ports Testing, Southwest Research Institute (SwRI), and Columbia Analytical Services, respectively. PM profiles of deposits on Teflon filters from dilution tunnel sampling were analyzed by Research Triangle Institute using XRF, ion chromatography, and thermal/optical analysis.

Space heating emissions were estimated using OMNI-based results where available for specific devices and AP-42-based estimates for devices for which OMNI tests were not conducted. Table 5.6-5 shows the device and fuel types resolved in estimating space heating emissions for the modeling inventory, their assigned SCC codes, and the source of the emission factors (OMNI testing or AP-42-based) used in calculating emissions for each device.

Table 5.6-5
Fairbanks Space Heating Devices and Fuel Types and Source of Emission Factors

Device Type	SCC Code	Emission Factor
Wood-Burning Devices		
Fireplace, No Insert	2104008100	AP-42
Fireplace, With Insert - Non-EPA Certified	2104008210	AP-42
Fireplace, With Insert - EPA Certified Non-Catalytic	2104008220	AP-42
Fireplace, With Insert - EPA Certified Catalytic	2104008230	AP-42
Woodstove - Non-EPA Certified	2104008310	OMNI
Woodstove - EPA Certified Non-Catalytic	2104008320	OMNI
Woodstove - EPA Certified Catalytic	2104008330	OMNI
Pellet Stove (Exempt)	2104008410	OMNI
Pellet Stove (EPA Certified)	2104008420	OMNI
OWB (Hydronic Heater) - Unqualified	2104008610	OMNI
OWB (Hydronic Heater) - Phase 2	2104008640	OMNI
Other Heating Devices		
Central Oil (Weighted # 1 & #2), Residential	2104004000	OMNI
Central Oil (Weighted # 1 & #2), Commercial	2103004001	OMNI
Portable Heater: 43% Kerosene & 57% Fuel Oil	2104004000	AP-42
Direct Vent Oil Heater	2104007000	AP-42
Natural Gas - Residential	2104006010	AP-42
Natural Gas - Commercial, small uncontrolled	2103006000	AP-42
Coal Boiler (bituminous/subbituminous, hand-fed)	2104002000	OMNI
Waste Oil Burning	2102012000	OMNI

Episodic day- and hour-specific emissions from space heating fuel combustion were calculated by combining heating energy use estimates from the Fairbanks Energy Model with ZIP code-specific device distributions from the local survey data (along with wood species mix and moisture content data) and block-level GIS shapefile counts of housing units from the 2010 U.S. Census, along with emission factors for the devices listed in Table 5.6-5. These calculations are discussed in detail in Appendix III.D.5.6.

Finally, as described in further detail in Section III.D.5.8, the space heating emissions were passed to the SMOKE inventory pre-processing model on an episodic daily and hourly basis. Earlier versions of the SMOKE model accepted only nonpoint or area source emissions that were temporally resolved using independent monthly, day of week, and diurnal profiles. As described in Section III.D.5.8, Sierra developed a modified version of SMOKE to also accept area source emissions in a similar fashion to which day- and hour-specific episodic point source emissions can be supplied to the model. This was critically important in preserving the actual historical temporal resolution reflected in the space heating portion of the modeling inventory when applied in the downstream attainment modeling.

<u>All Other Area Sources</u> – Modeling inventory emissions for all other stationary area sources other than those related to space heating were calculated more simply, although still using local

data where available. The primary data source used to estimate "Other" area source emissions was an earlier 2009 Alaska criteria pollutant inventory study[11] sponsored by DEC.

This DEC study, referred to as the "Big 3" inventories, consisted of the development of pollutant emission estimates for the three most populous counties in the state: the Municipality of Anchorage, the Fairbanks North Star Borough, and the Juneau Borough. The Big 3 inventories were developed for calendar years 2002, 2005, and 2018 using a combination of 2002 base year data and growth/control forecasts for 2005 and 2018. The inventories encompassed all source sectors (point, area, on-road, non-road) and the following criteria pollutants: VOC, NOx, CO, SOx, NH_3, PM_{10}, and $PM_{2.5}$. For each calendar year, annual emissions as well as winter and summer seasonal emissions were developed. The seasonal estimates reflected six-month winter (October through March) and summer (April through September) daily averages based on seasonal activity profiles developed using local data where available.

For use in this $PM_{2.5}$ SIP inventory, SCC-level summer and winter season emission estimates were extracted from National Emission Inventory (NEI) Input Format (NIF) spreadsheet structures developed under the Big 3 study to allow DEC to submit data to support the NEI. Only area source SCC records were extracted for the Fairbanks Borough in calendar year 2005, the nearest year to the SIP inventory 2008 base year.

The SCC-level winter 2005 emissions from the earlier inventory were projected to 2008 using historical year-to-year county-wide population estimates compiled by the Alaska Department of Labor and Workforce Development (ADLWD) for use in the 2008 Baseline modeling inventory for this SIP. The three-year (2005-2008) population growth factor for Fairbanks from the historical ADLWD data was 1.026, reflecting the 2.6% increase applied to the 2005 Big 3 emissions for Fairbanks in projecting emissions for other area sources to the 2008 Baseline.

In compiling these other area source emission estimates, a series of SCC-level source category comparisons were made between the Big 3 inventory and EPA's 2008 NEI inventory for Fairbanks nonpoint sources. In performing these comparisons, a gap was found in that commercial cooking emissions (e.g., from restaurant char broilers) had not been included in the Big 3 inventory. As a result, commercial cooking emissions within the Other Area Source sector of the 2008 Baseline modeling inventory were developed based on data from the 2008 NEI (Version 3).

It is also noted that a number of source categories within the Other Area Source sector were estimated to have no emissions during episodic wintertime conditions. These "zeroed" wintertime source categories are listed below (with SCC codes in parentheses).

- Fugitive Dust, Paved Roads (2294000000)
- Fugitive Dust, Unpaved Roads (2296000000)
- Industrial Processes, Petroleum Refining, Asphalt Paving Materials (2306010000)

[11] L. Williams, et al., "Criteria Pollutant Inventory for Anchorage, Fairbanks, and Juneau in 2002, 2005 and 2018," prepared for Alaska Department of Environmental Conservation, Sierra Research Report No. SR2009-02-01, February 2009.

- Solvent Utilization, Surface Coating, Architectural Coatings (2401001000)
- Solvent Utilization, Miscellaneous Commercial, Asphalt Application (2461020000)
- Miscellaneous Area Sources, Other Combustion, Forest Wildfires (2810001000)
- Miscellaneous Area Sources, Other Combustion, Firefighting Training (2810035000)

Some of these source categories, notably those for fugitive dust and forest wildfires, have significant summer season (and annual average) emissions; however, emissions from these categories do not occur during winter conditions in Fairbanks when road and land surfaces are covered by snow and ice.

<u>On-Road Mobile Sources</u> – Emissions from on-road motor vehicles were developed within the 2008 Baseline modeling inventory using locally developed vehicle travel activity estimates and fleet characteristics as inputs to EPA's MOVES2010a vehicle emissions model.[12] To support the gridded inventory structure and episodic (daily/hourly) emission estimates of the modeling inventory, MOVES2010a was used to generate detailed fleet emission rates and was combined with EPA's SMOKE-MOVES integration tool to pass the highly resolved and emission process-specific emission rates into input structures required by the SMOKE inventory pre-processing model.

For the 2008 Baseline inventory, MOVES inputs were based primarily on data gathered as part of the conformity analysis for the Fairbanks Metropolitan Area Transportation System (FMATS) 2012-2015 Transportation Improvement Program (TIP).[13] FMATS is the Metropolitan Planning Organization (MPO) for Fairbanks. The timing of the FMATS TIP was such that it was one of the first regional conformity analyses conducted using MOVES. Inputs for that conformity analysis were derived from local transportation modeling efforts, vehicle registration data, and other local data. The transportation and other vehicle activity data are discussed below. The remaining fleet characteristics and other MOVES inputs are discussed in Appendix III.D.5.6.

Regional Travel Model Vehicle Activity – Vehicle activity on the FMATS transportation network was based on the TransCAD travel demand modeling performed for the 2012-2015 TIP. The TransCAD modeling network covers the entire Fairbanks $PM_{2.5}$ non-attainment area and its major links extend beyond the non-attainment area boundary, as illustrated in Figure 5.6-6.

[12] Although EPA has released subsequent versions, MOVES2010b (initially released in May 2012 and updated in October 2012 and MOVES2014 (released on July 31, 2014), the vehicle emissions portion of the SIP inventory was initiated before these newer version release dates. Moreover, for the primary criteria pollutants contained in the modeling inventory, the differences between MOVES2010a and MOVES2010b are not significant. MOVES2014 was not considered for use in the SIP since it was released in the latter stages of the SIP's development.
[13] T. Carlson, R. Dulla, "Draft Conformity Analysis for Federally Approved 2012-2015 FMATS Transportation Improvement Program (TIP), prepared for Fairbanks Metropolitan Area Transportation System, July 18, 2011.

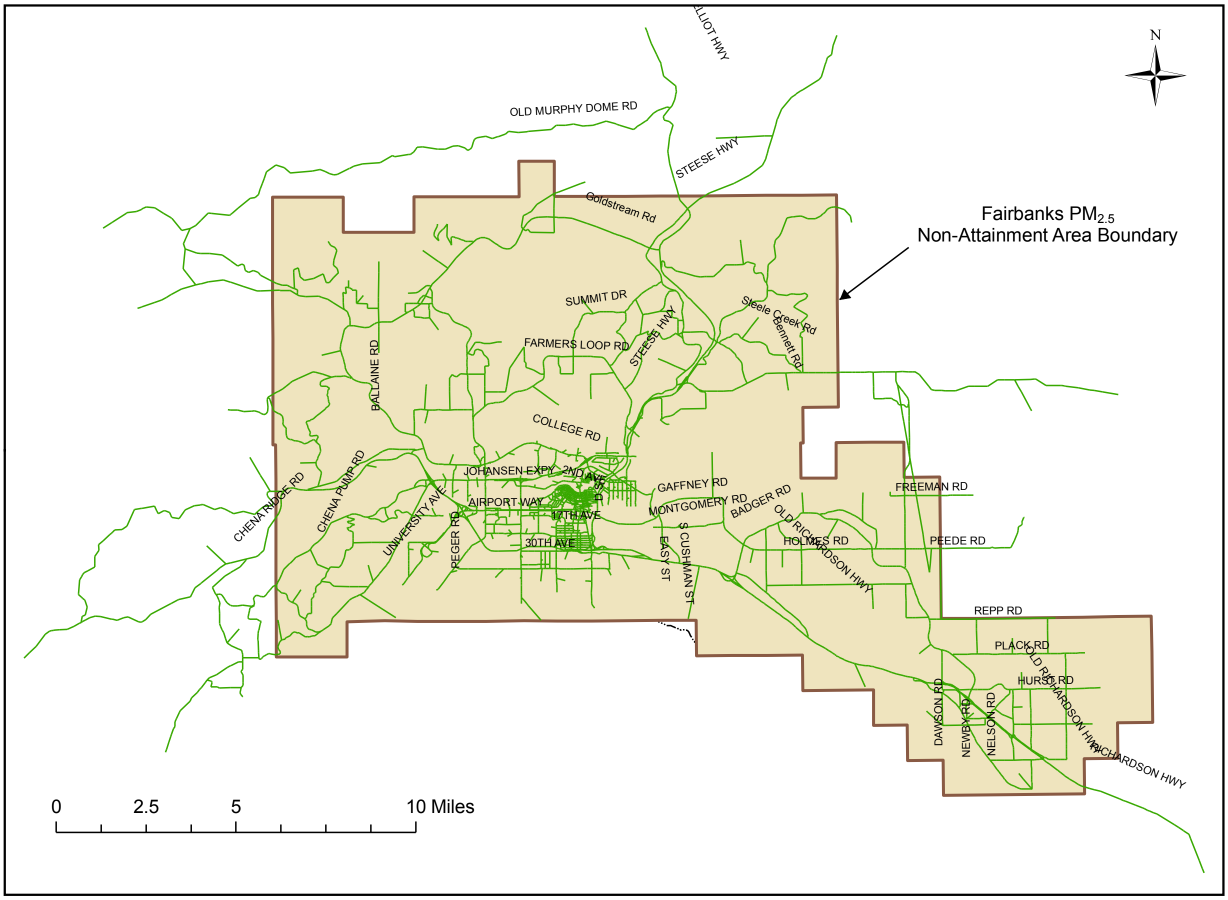

Figure 5.6-6. FMATS TransCAD Modeling Network

The TransCAD model was configured using 2010 U.S. Census-based socioeconomic data. TransCAD modeling was performed for a 2010 base year and a projected 2035 horizon year. Projected population and household data relied on Census 2010 projections and a 1% annual growth rate in forecasted employment based on the information from the Institute of Social and Economic Research (ISER) at the University of Alaska, Anchorage.

Link-level TransCAD outputs were processed to develop several of the travel activity related inputs required by MOVES. Vehicle miles traveled (VMT) tabulated across the TransCAD network for the 2010 base year and 2035 forecast year are presented in Table 5.6-6.

Table 5.6-6
TransCAD Average Daily VMT by Analysis Year, Daily Period and Fleet Category

Period / Vehicle Type	Entire Modeling Area (PM NA Area)		
	2010	**2035**	**% Change**
Daily Period[a]			
AM Peak (AM)	132,469	187,841	**41.8%**
PM Peak (PM)	380,135	509,440	**34.0%**
Off-Peak (OP)	1,206,159	1,587,234	**31.6%**
Vehicle Type			
Passenger VMT	1,718,763	2,284,514	**32.9%**
Truck VMT	105,132	104,201	**-0.9%**
Total VMT	**1,823,895**	**2,388,715**	**31.0%**

[a] VMT by daily period was developed for the passenger fleet; truck VMT was modeled only on a daily basis.

Vehicle Activity Beyond FMATS Network – The geographic extent of the FMATS network covers a small portion of the entire Grid 3 attainment modeling domain. Traffic density in the broader Alaskan interior is likely to be less than that concentrated in Fairbanks (and have less impact on ambient air quality in Fairbanks). Nevertheless, for completeness, link-level travel estimates for major roadways beyond the FMATS network (and Fairbanks NA Area) were developed using a spatial (ArcGIS-compatible) “Road Centerline” polyline coverage for the Interior Alaska region developed by the Alaska Department of Transportation and Public Facilities (ADOT&PF). This GIS layer identified locations of major highway/arterial routes within the Grid 3 domain broken down into individual milepost (MP) segments.

These road centerline segments are shown in red in Figure 5.6-7 along with the smaller FMATS link network (green lines) and the extent of the SIP Grid 3 modeling domain (blue rectangle). Annual average daily traffic volumes (AADT) and VMT (determined by multiplying volume by segment length) were assigned to each segment based on a spreadsheet database of calendar year 2007, 2008, and 2009 traffic volume data compiled by ADOT&PF’s Northern Region office. A Linear Reference System (LRS) approach was used to spatially assign volume and VMT data for each segment in the spreadsheet database to the links in the Road Centerline layer based on the route identifier number (CDS_NUM) and lineal milepost value.

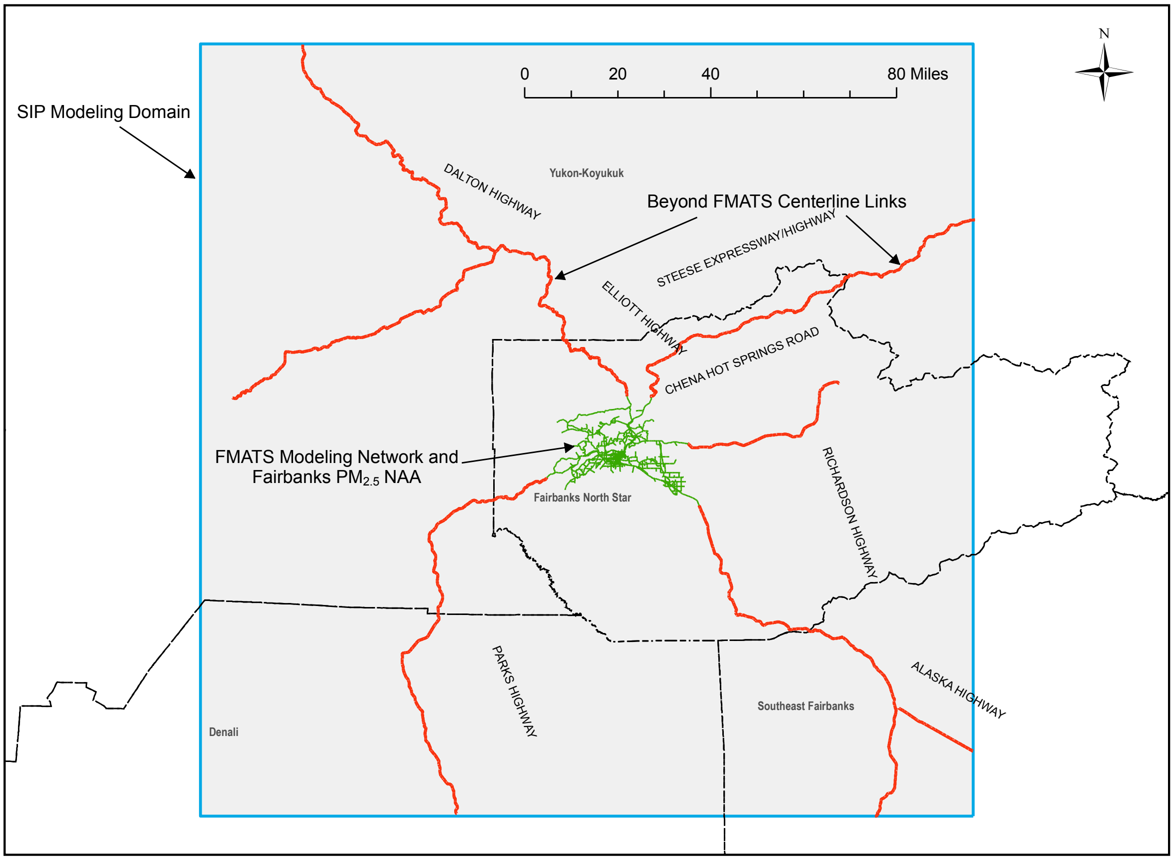

Figure 5.6-7. Additional ADOT&PF Roadway Links beyond FMATS Network

Non-Road Mobile Sources – Non-road sources encompass all mobile sources that are not on-road vehicles.[14] They include recreational and commercial off-road vehicles and equipment as well as aircraft, locomotives, recreational pleasure craft (boats) and marine vessels. (Neither commercial marine nor recreational vessel emissions are contained in the modeling inventory, as they do not operate in the arctic conditions experienced in the Fairbanks modeling domain during the winter.)

NONROAD Model-Based – EPA's latest NONROAD emissions model, NONROAD2008,[15] was used to generate emissions from the following types of non-road vehicles and equipment:

- Recreational vehicles (e.g., all-terrain vehicles, off-road motorcycles, snowmobiles);
- Logging equipment (e.g., chain saws);
- Agricultural equipment (e.g., tractors);

[14] Although recent versions of EPA's NEI inventories (2008 and 2011) treat emissions for aircraft and supporting equipment and rail yard locomotive emissions as stationary point sources, emissions from these sources were "traditionally" located within the Non-Road source sector.
[15] U.S. EPA NONROAD Model, Version 2008a, released July 2009.

- Commercial equipment (e.g., welders and compressors);
- Construction and mining equipment (e.g., graders and backhoes);
- Industrial equipment (e.g., forklifts and sweepers);
- Residential and commercial lawn and garden equipment (e.g., leaf and snow blowers);
- Locomotive support/railway maintenance equipment (but not locomotives); and
- Aircraft ground support equipment[16] (but not aircraft).

It is important to note that none of these non-road vehicle and equipment types listed above were federally regulated until the mid-1990s. (As parenthetically noted for the last two equipment categories in the list above, the NONROAD model estimates emissions of support equipment for the rail and air sectors, but emissions from locomotives and aircraft are not addressed by NONROAD and were calculated separately using other models/methods as described in the sub-sections that follow.)

Default equipment populations and activity levels in the NONROAD model are based on national averages, then scaled down to represent smaller geographic areas on the basis of human population and proximity to recreational, industrial, and commercial facilities. EPA recognizes the limitations inherent in this "top-down" approach, and realizes that locally generated inputs to the model will increase the accuracy of the resulting output. Therefore, in cases where data were available (most notably snowmobiles and snow blowers), locally derived inputs that more accurately reflect the equipment population, growth rates, and wintertime activity levels in the Fairbanks area were substituted for EPA's default input values.

Nonexistent Wintertime Activity – Due to the severe outdoor weather conditions present in Fairbanks during the winter months, Fairbanks Borough staff determined that there is zero wintertime activity for a number of different equipment categories. Therefore, all activity and corresponding emissions for the following non-road equipment categories were removed from the episodic wintertime modeling inventory:

- Lawn and Garden;
- Agricultural Equipment;
- Logging Equipment;
- Pleasure Craft (i.e., personal watercraft, inboard and sterndrive motor boats);
- Selected Recreational Equipment (i.e., golf carts, ATVs, off-road motorcycles); and
- Commercial Equipment (i.e., generator sets, pressure washers, welders, pumps, A/C refrigeration units).

Locomotive Emissions – Emissions for two types of locomotive activity were included in the emissions inventory:

1) *Line-Haul* – locomotive emissions along rail lines within the modeling domain (from Healy to Fairbanks and Fairbanks to Eielson Air Force Base); and

[16] Although NONROAD can be configured to also estimate emissions from airport ground support equipment (GSE), GSE emissions were estimated using the EDMS model as described later.

2) *Yard Switching* – locomotive emissions from train switching activities within the Fairbanks and Eielson rail yards.

Information on wintertime train activity (circa 2010) was obtained from the Alaska Railroad Corporation[17] (ARRC), the sole rail utility operating within the modeling domain, providing both passenger and freight service. These activity data were combined with locomotive emission factors published by EPA[18] to estimate rail emissions within the emissions inventory.

Aircraft and Associated Airfield Emissions – Emissions were estimated from aircraft operations at three regional airfields within the modeling domain: (1) Fairbanks International Airport (FAI); (2) Fort Wainwright Army Post[19] (FBK); and (3) Eielson Air Force Base (EIL). The aircraft emissions were developed using the Federal Aviation Administration's (FAA) Emission and Dispersion Modeling System (EDMS). EDMS considers the physical characteristics of each airport along with detailed meteorological and operations information in order to estimate the overall emissions of aircraft, ground support equipment (GSE), and auxiliary power units (APUs) at each airport. At the time the analysis was performed, EDMS 5.1.3 was the latest available version.

The EDMS model requires as input detailed information on landings and take-offs (LTO) for each aircraft type in order to assign GSE and estimate the associated emissions. Each LTO is assumed to comprise six distinct aircraft related emissions modes: startup, taxi out, take off, climb out, approach, and taxi in. The EDMS modeled defaults for time in mode and angle of climb out and approach were used for purposes of this analysis. In order to properly allocate aircraft emissions to each vertical layer of analysis (elevation above ground level), aircraft emissions were estimated for each mode and ascribed to a specific vertical layer.

Appendix III.D.5.6 provides detailed descriptions of the activity inputs and NONROAD, EDMS, and locomotive emission modeling used to generate emissions for the Non-Road sector of the modeling inventory.

<u>Modeling Inventory Assembly and Pre-Processing</u> – Emissions estimates across all sectors of the modeling inventory were generated at the SCC level and either directly gridded into the 1.3 km cells of the Grid 3 modeling domain (e.g., for point and space heating area sources) or assembled into spatial surrogate profiles for use within the SMOKE inventory pre-processing model.

For the three key source sectors (Point, Space Heating Area and On-Road Mobile), emissions were also temporally supplied to SMOKE on a day- and an hour-specific basis for each of the 35 historical days encompassing the two attainment modeling episodes. For the remaining two source sectors (Other Area and Non-Road Mobile), emissions were temporally supplied to

[17] Email from Greg Lotakis, Alaska Railroad Corporation to Bob Dulla, Sierra Research, May 10, 2011.
[18] "Emission Factors for Locomotives," U.S. Environmental Protection Agency, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009.
[19] Formerly Ladd Air Force Base.

SMOKE using SCC-specific monthly, day of week and diurnal profiles based on surrogates described in Appendix III.D.5.6.

2008 Baseline Modeling Inventory Emissions – 2008 Baseline modeling inventory emissions calculated using the data sources and methodologies summarized in the preceding paragraphs were tabulated by source sector and key subcategory and are presented as follows.

Table 5.6-7 and Table 5.6-8 show 2008 Baseline emissions tabulated by source sector with actual (green shaded) and allowable (red shaded) emissions, respectively, for the Point source sector. (The Space Heating and On-Road sectors are further broken out into key subcategories.) Emissions are shown in both tables for the entire Grid 3 modeling domain and the smaller $PM_{2.5}$ non-attainment area and are presented on an average daily basis over the 35 episode days.

Table 5.6-7
2008 Baseline Episode Average Daily Emissions (tons/day) by Source Sector, Actual Point Source Emissions

	Grid 3 Domain Emissions (tons/day)					*NA Area Emissions (tons/day)*				
Source Sector	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**
Point (Actual)	1.423	8.380	13.395	0.096	n/a	1.412	8.167	13.285	0.096	n/a
Area, Space Heating	3.098	4.286	2.391	12.369	0.149	2.756	3.865	2.182	11.058	0.136
Area, Space Heat, Wood	2.986	0.095	0.421	12.207	0.110	2.656	0.084	0.373	10.914	0.098
Area, Space Heat, Oil	0.062	4.121	1.774	0.098	0.003	0.056	3.719	1.617	0.088	0.003
Area, Space Heat, Other	0.050	0.070	0.196	0.065	0.037	0.043	0.062	0.192	0.056	0.035
Area, Other	0.064	0.000	0.003	0.692	0.000	0.061	0.000	0.002	0.569	0.000
On-Road	0.811	0.057	5.743	7.439	0.088	0.676	0.046	4.625	5.725	0.071
On-Road, Running Exh	0.503	0.050	4.322	0.941	0.088	0.435	0.040	3.561	0.765	0.071
On-Road, Start & Idle Exh	0.308	0.008	1.421	6.410	0.000	0.242	0.006	1.064	4.894	0.000
On-Road, Evap	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.238	0.151	2.135	12.262	0.005	0.027	0.077	1.088	0.451	0.003
TOTALS	**5.633**	**12.875**	**23.667**	**32.859**	**0.242**	**4.932**	**12.155**	**21.182**	**17.898**	**0.210**

n/a – Not available.

Table 5.6-8
2008 Baseline Episode Average Daily Emissions (tons/day) by Source Sector, Allowable (PTE) Point Source Emissions

Source Sector	Grid 3 Domain Emissions (tons/day)					NA Area Emissions (tons/day)				
	$PM_{2.5}$	SO_2	NOx	VOC	NH_3	$PM_{2.5}$	SO_2	NOx	VOC	NH_3
Point (Allowable, PTE)	2.773	26.612	29.609	0.845	n/a	1.595	22.973	27.393	0.826	n/a
Area, Space Heating	3.098	4.286	2.391	12.369	0.149	2.756	3.865	2.182	11.058	0.136
Area, Space Heat, Wood	2.986	0.095	0.421	12.207	0.110	2.656	0.084	0.373	10.914	0.098
Area, Space Heat, Oil	0.062	4.121	1.774	0.098	0.003	0.056	3.719	1.617	0.088	0.003
Area, Space Heat, Other	0.050	0.070	0.196	0.065	0.037	0.043	0.062	0.192	0.056	0.035
Area, Other	0.064	0.000	0.003	0.692	0.000	0.061	0.000	0.002	0.569	0.000
On-Road	0.811	0.057	5.743	7.439	0.088	0.676	0.046	4.625	5.725	0.071
On-Road, Running Exh	0.503	0.050	4.322	0.941	0.088	0.435	0.040	3.561	0.765	0.071
On-Road, Start & Idle Exh	0.308	0.008	1.421	6.410	0.000	0.242	0.006	1.064	4.894	0.000
On-Road, Evap	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.238	0.151	2.135	12.262	0.005	0.027	0.077	1.088	0.451	0.003
TOTALS	**6.983**	**31.107**	**39.881**	**33.607**	**0.242**	**5.115**	**26.961**	**35.290**	**18.628**	**0.210**

n/a – Not available.

To provide a clearer picture of the relative emissions contributions of each source sector, Figure 5.6-8 through Figure 5.6-12 provide "pie chart" breakdowns (as a percentage of total emissions) for $PM_{2.5}$, SO_2, NOx, VOC, and NH_3 emissions, respectively, within the non-attainment area based on actual point source emissions. (The breakdowns are similar for the larger Grid 3 domain and thus are not shown.)

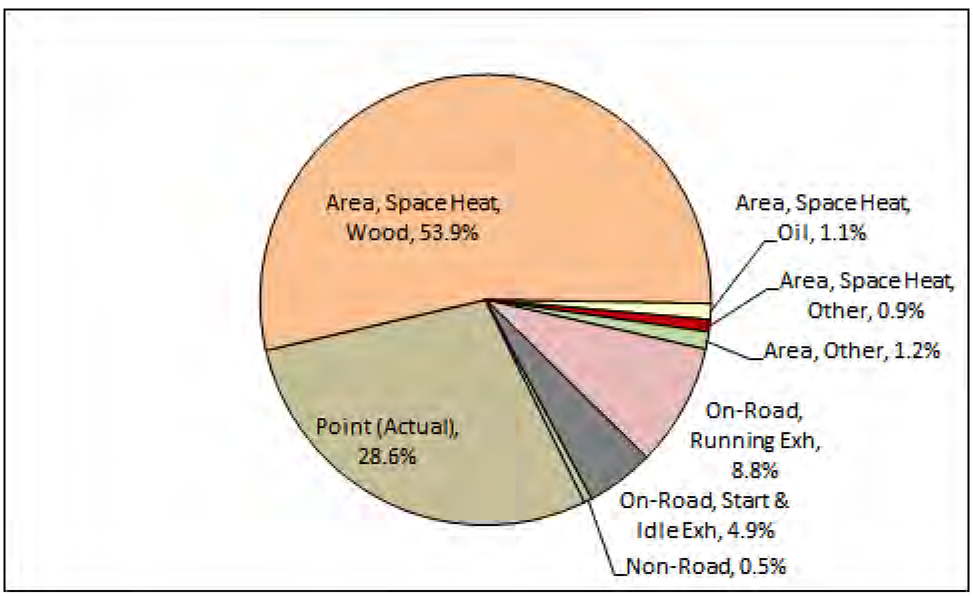

Figure 5.6-8. 2008 Baseline Episodic Non-Attainment Area Emissions, Actual Point Source Emissions, Relative $PM_{2.5}$ Contributions (%)

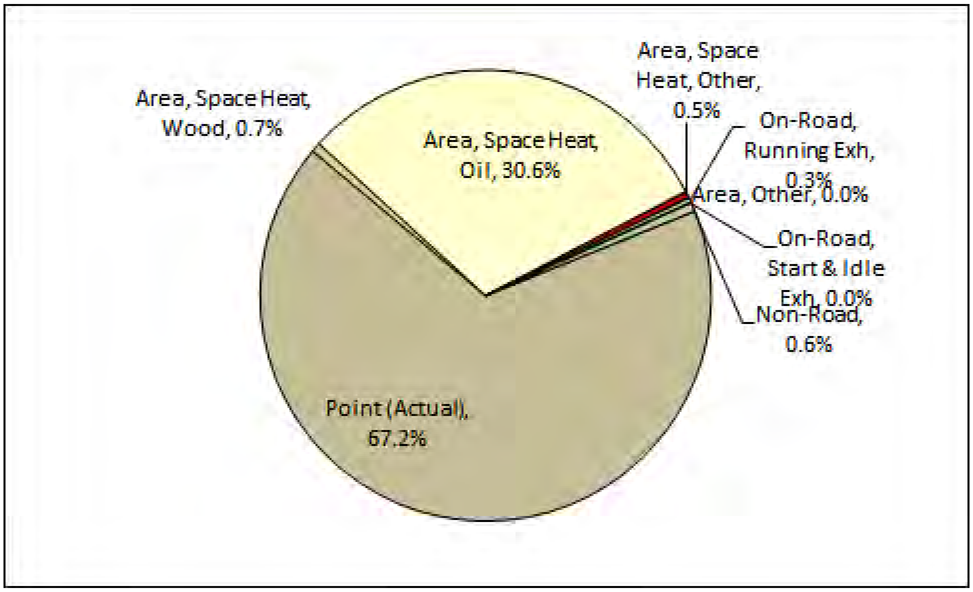

Figure 5.6-9. 2008 Baseline Episodic Non-Attainment Area Emissions, Actual Point Source Emissions, Relative SO_2 Contributions (%)

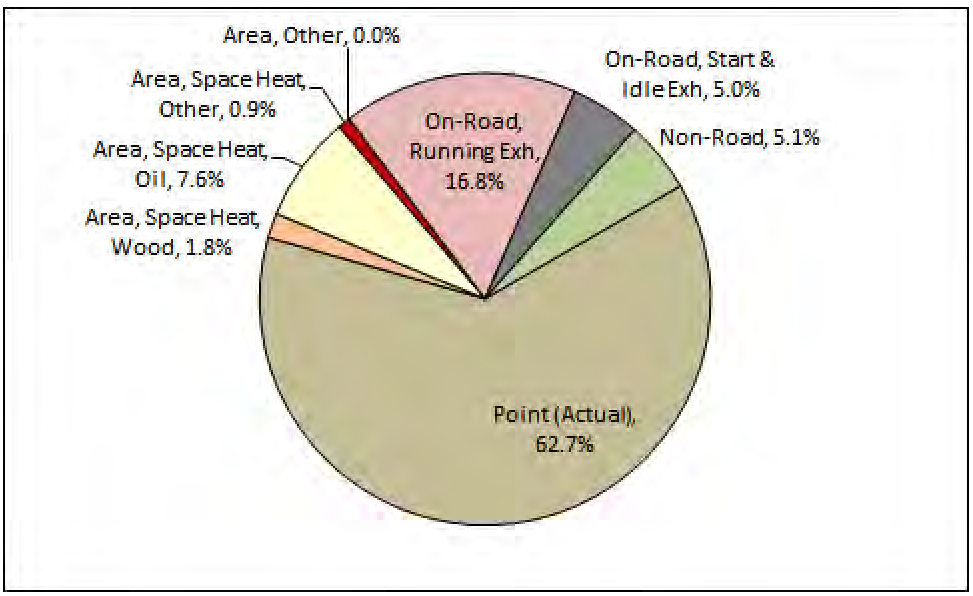

Figure 5.6-10. 2008 Baseline Episodic Non-Attainment Area Emissions, Actual Point Source Emissions, Relative NOx Contributions (%)

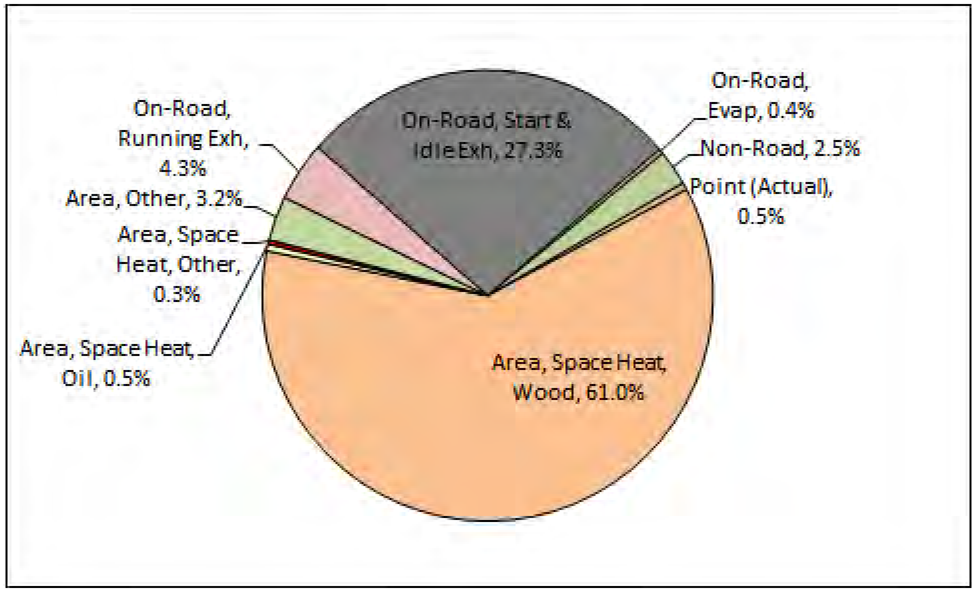

Figure 5.6-11. 2008 Baseline Episodic Non-Attainment Area Emissions, Actual Point Source Emissions, Relative VOC Contributions (%)

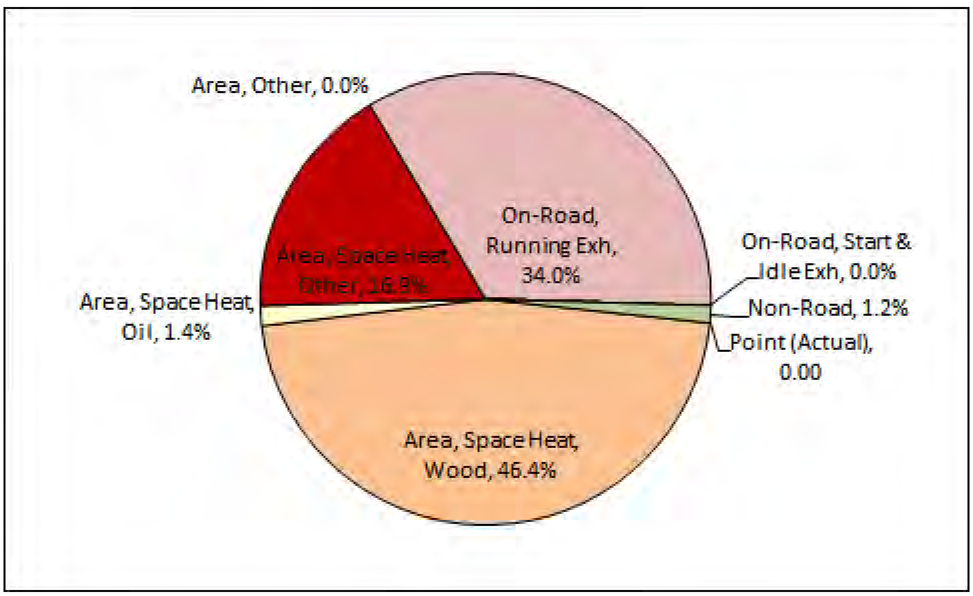

Figure 5.6-12. 2008 Baseline Episodic Non-Attainment Area Emissions, Actual Point Source Emissions, Relative NH_3 Contributions (%)

As seen in Figure 5.6-8, space heating dominates episodic emissions of $PM_{2.5}$, representing roughly 56% of total $PM_{2.5}$ emitted within the non-attainment area. Wood-burning alone contributes nearly 54% to total $PM_{2.5}$. Point sources and on-road vehicles comprise 29% and 14% of total $PM_{2.5}$, respectively. All other area sources and non-road mobile sources combined encompass under 2%.

As shown in Figure 5.6-9 through Figure 5.6-12, the predominant source category for each gaseous precursor pollutant varies. Emissions of SO_2 largely come from point sources and secondarily from oil-burning heating devices. Point sources are the major contributors of episodic NOx, while wood-burning space heating is the largest source of VOC and NH_3.

Figure 5.6-13 through Figure 5.6-17 provide similar source contribution breakdowns using allowable (PTE) rather than actual point source emissions. Not surprisingly, point sources represent a larger share relative to total emissions when using their allowable, rather than actual, emissions.

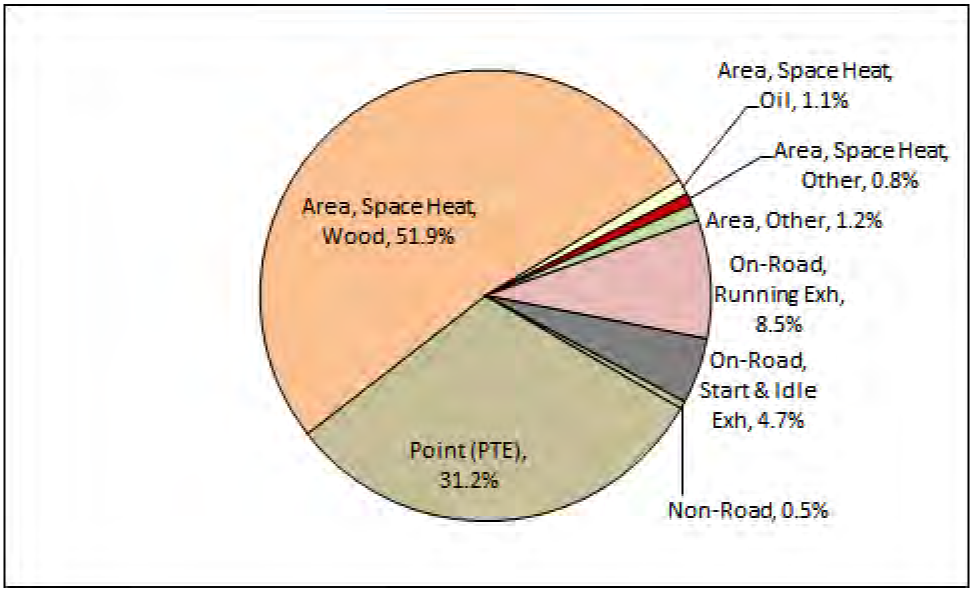

Figure 5.6-13. 2008 Baseline Episodic Non-Attainment Area Emissions, Allowable (PTE) Point Source Emissions, Relative $PM_{2.5}$ Contributions (%)

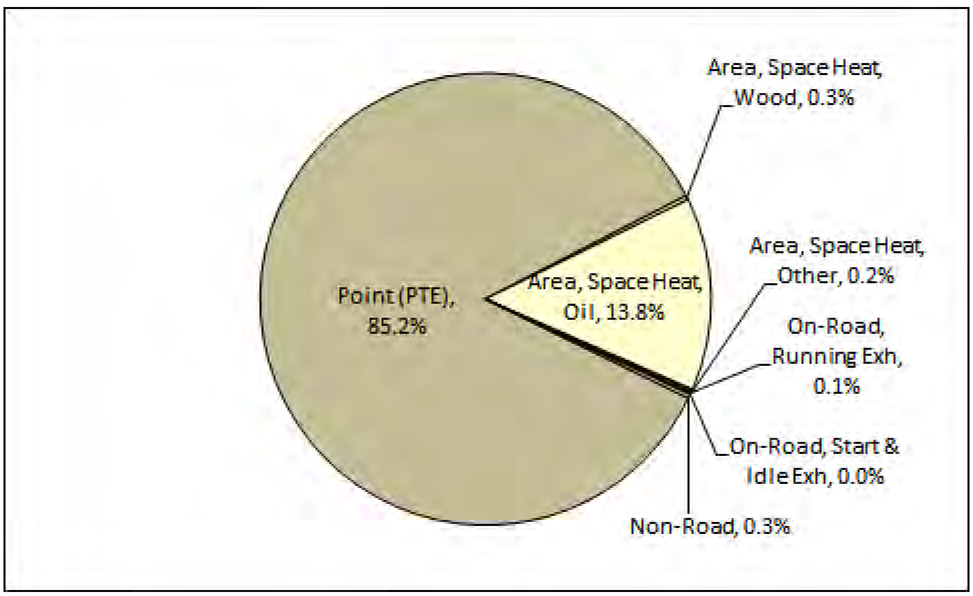

Figure 5.6-14. 2008 Baseline Episodic Non-Attainment Area Emissions, Allowable (PTE) Point Source Emissions, Relative SO_2 Contributions (%)

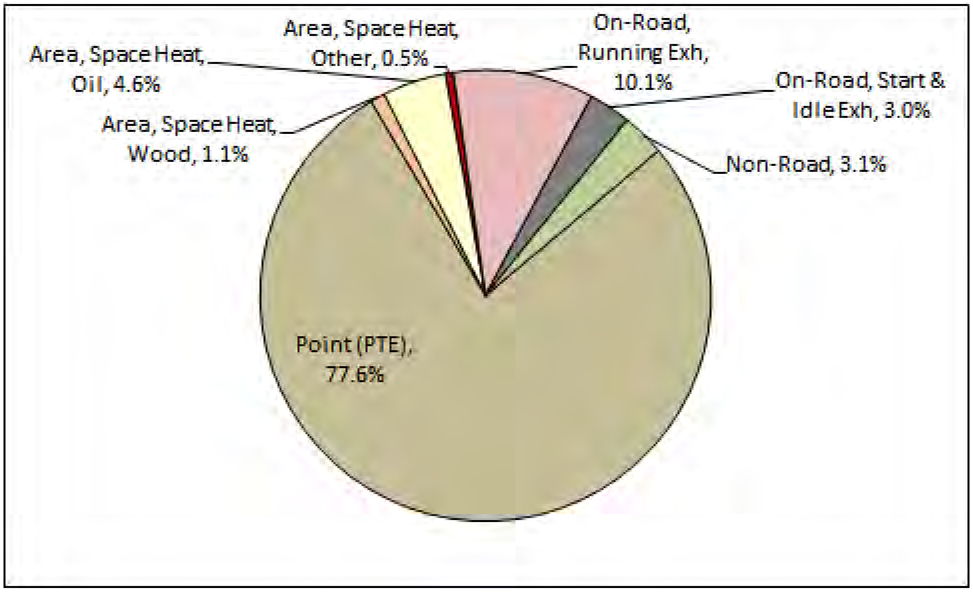

Figure 5.6-15. 2008 Baseline Episodic Non-Attainment Area Emissions, Allowable (PTE) Point Source Emissions, Relative NOx Contributions (%)

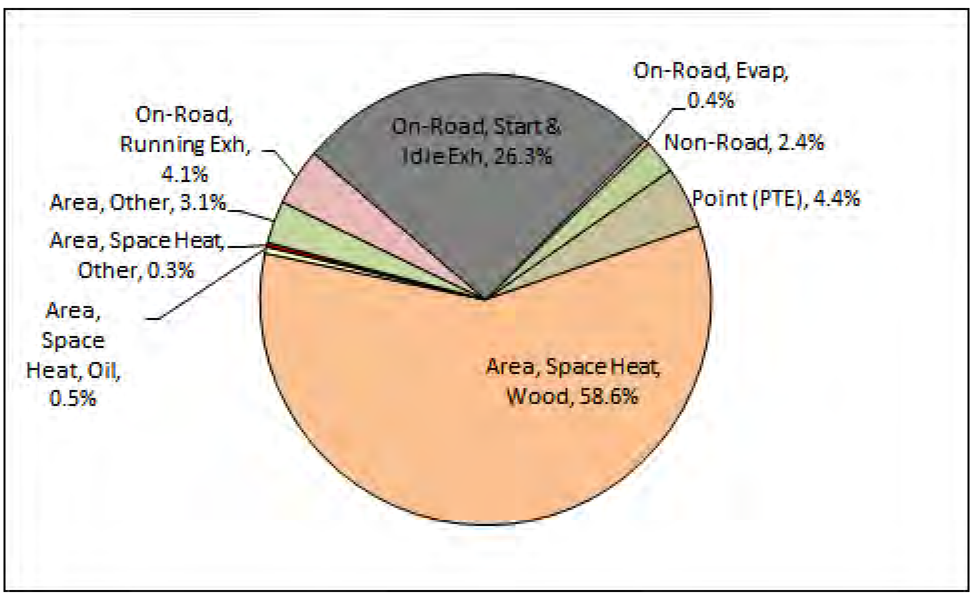

Figure 5.6-16. 2008 Baseline Episodic Non-Attainment Area Emissions, Allowable (PTE) Point Source Emissions, Relative VOC Contributions (%)

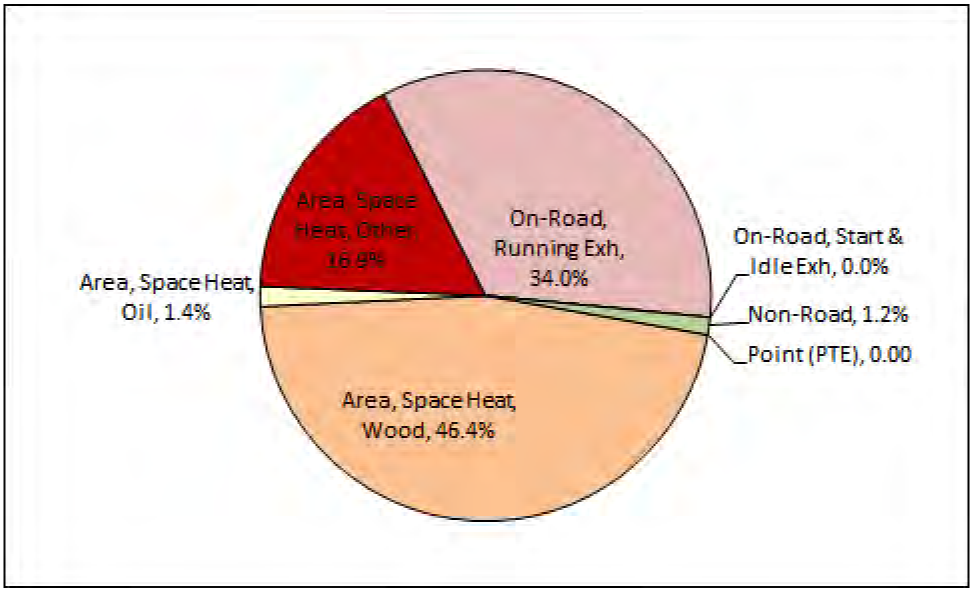

Figure 5.6-17. 2008 Baseline Episodic Non-Attainment Area Emissions, Allowable (PTE) Point Source Emissions, Relative NH_3 Contributions (%)

Finally, Figure 5.6-18 through Figure 5.6-22 illustrate how $PM_{2.5}$ emissions under episodic wintertime conditions are spatially distributed across the non-attainment area and immediately surrounding region. In each figure, the density or amount of emissions within each 1.3 km grid cell is depicted using color shaded intervals shown on the legend of each plot. Dark green cells represent regions of little or no emissions, ramping up through yellow and orange to red, which identifies cells with the highest $PM_{2.5}$ emissions. The emission units used are pounds (lb) per day and represent averaged values across all 35 modeling episode days.

First, Figure 5.6-18 presents the spatial emissions distribution for all inventory sources within each grid cell. Figure 5.6-19 through Figure 5.6-22 then show individual distributions for each source sector (using some aggregation of earlier tabulations and plots) as follows:

- Figure 5.6-19 – Space Heating sources;
- Figure 5.6-20 – Point sources;
- Figure 5.6-21 – On-Road Mobile sources; and
- Figure 5.6-22 – Other Area and Non-Road mobile sources.

The same color-shaded emission density intervals are used across both the “all sources” and individual source sector plots to visually identify both the areas where modeled emissions are highest as well as indicate which source sector(s) contribute to total emissions in those grid cells.

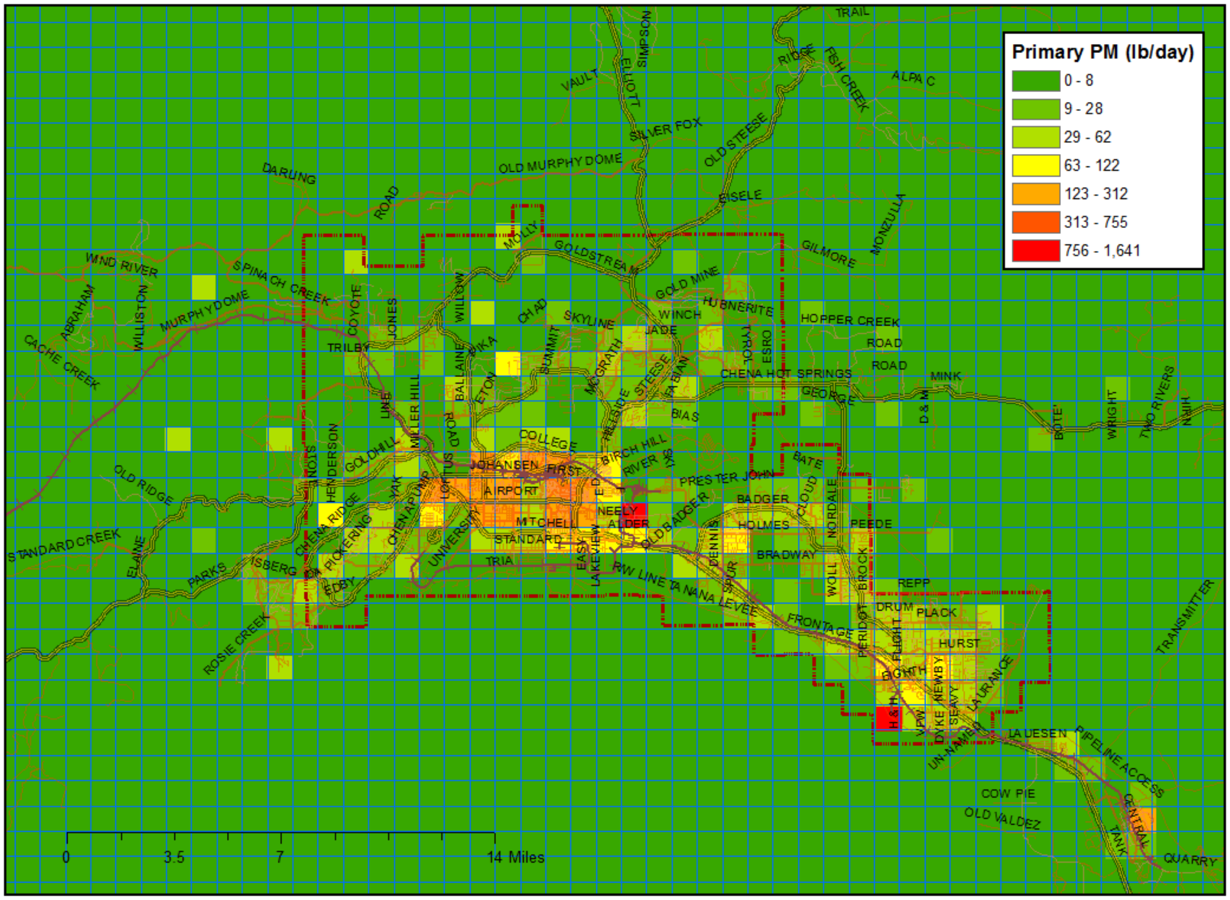

Figure 5.6-18. 2008 Baseline Gridded $PM_{2.5}$ Emissions, All Sources

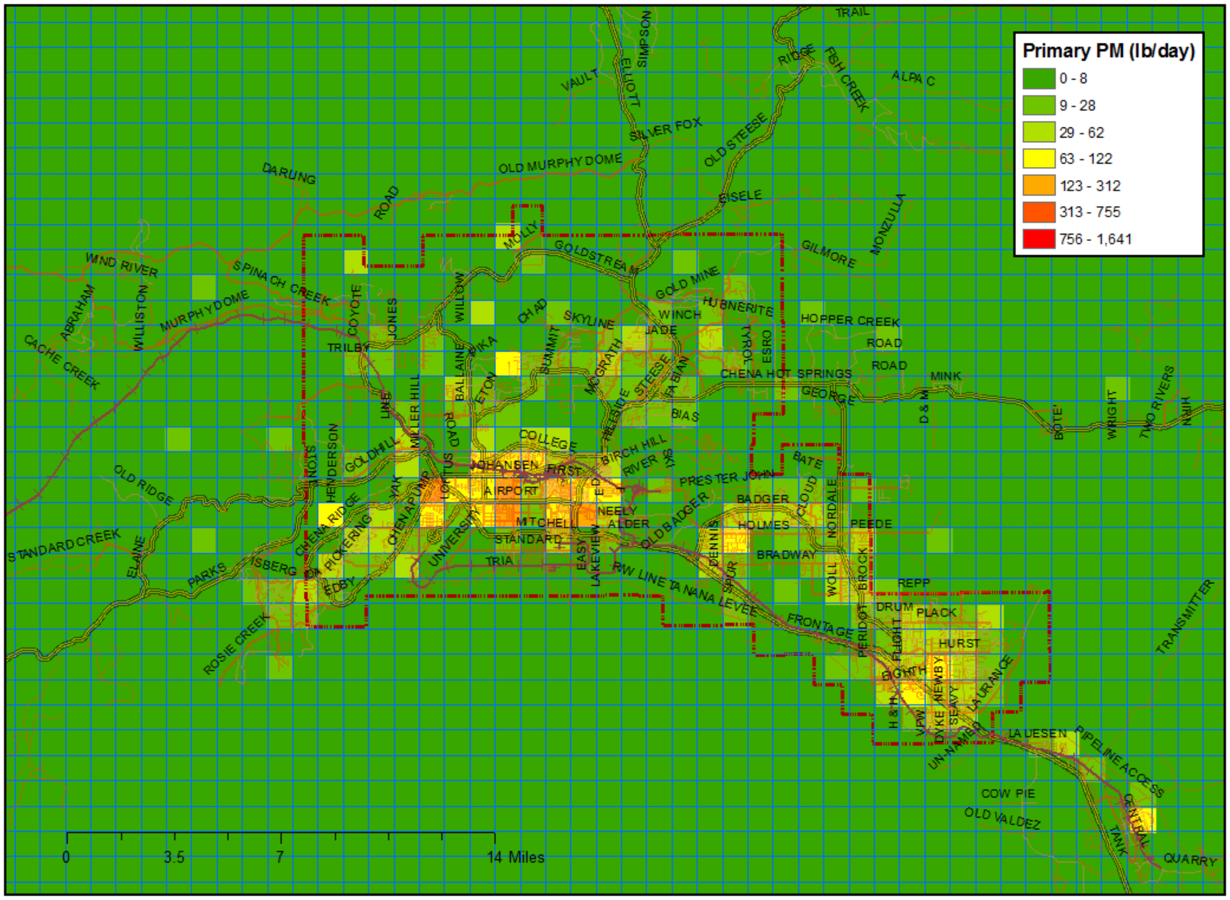

Figure 5.6-19. 2008 Baseline Gridded $PM_{2.5}$ Emissions, Space Heating Sources

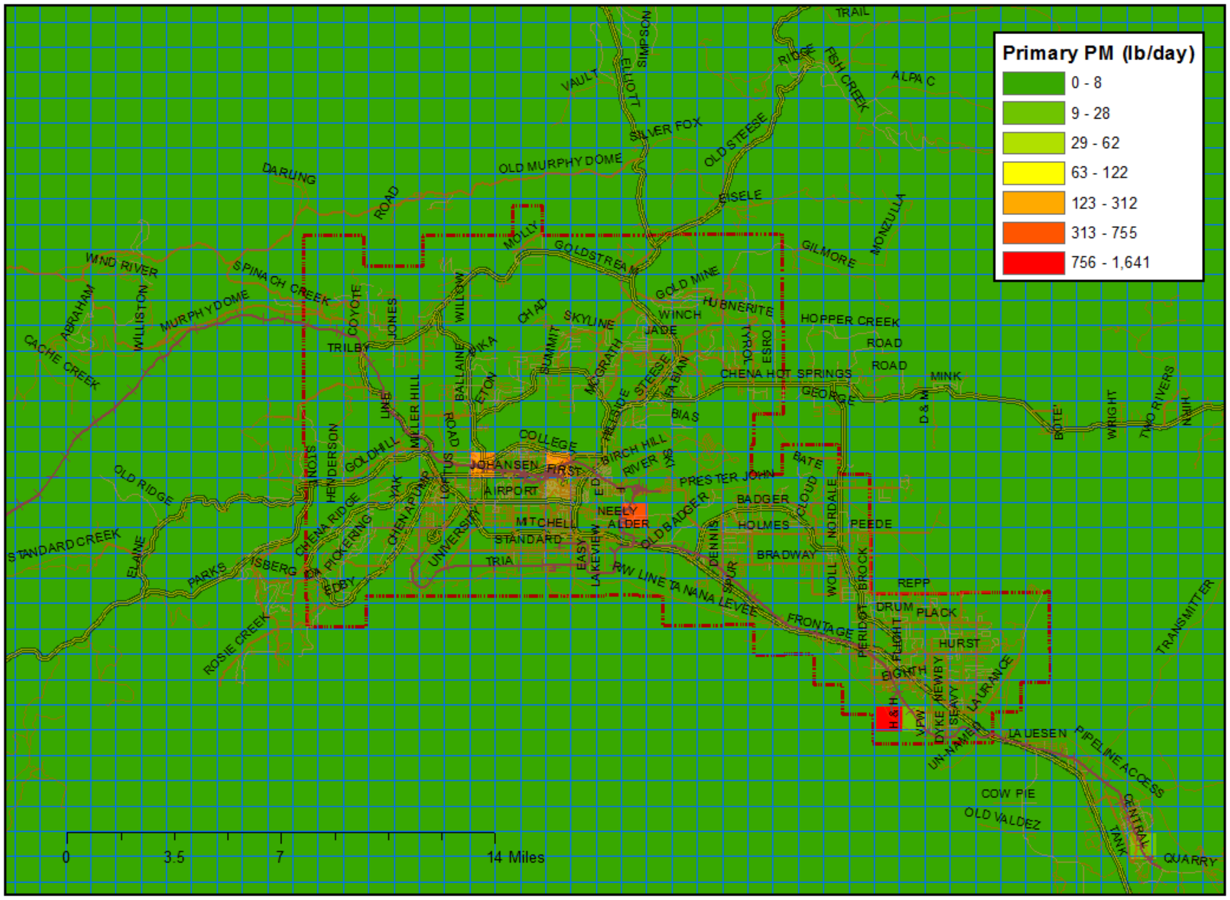

Figure 5.6-20. 2008 Baseline Gridded $PM_{2.5}$ Emissions, Point Sources

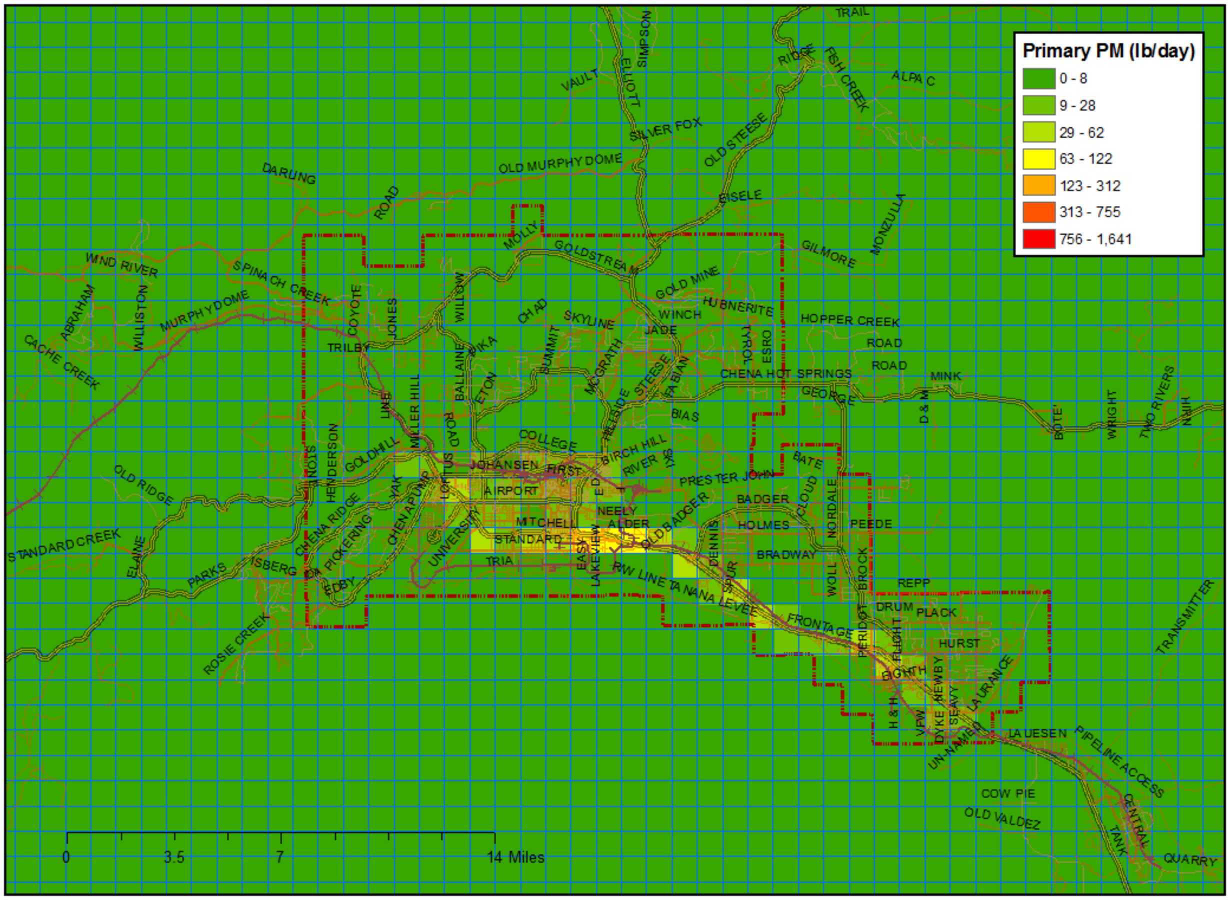

Figure 5.6-21. 2008 Baseline Gridded $PM_{2.5}$ Emissions, On-Road Sources

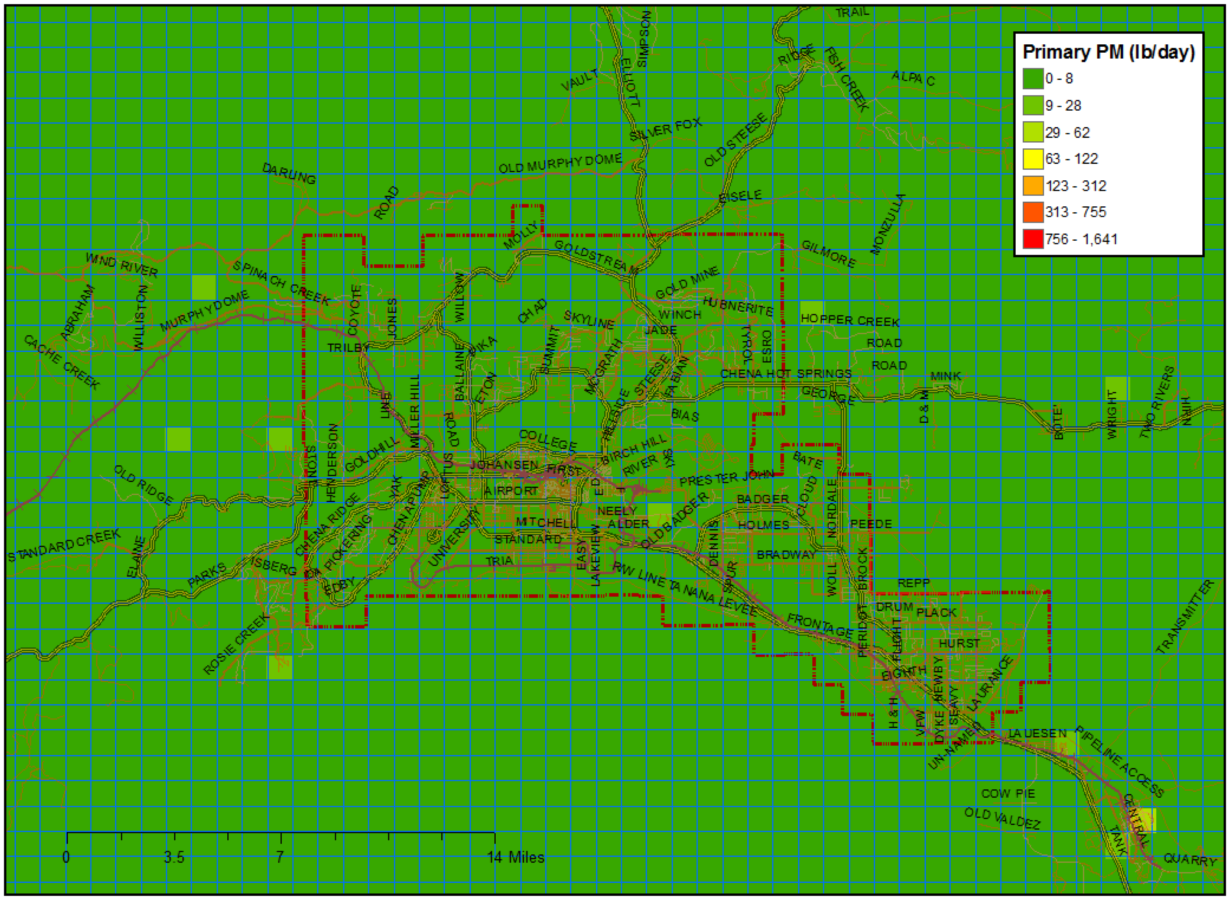

Figure 5.6-22. 2008 Baseline Gridded $PM_{2.5}$ Emissions, Other Area and Non-Road Sources

5.6.2.2. Base Year Planning Inventories

In addition to the 2008 Baseline modeling inventory used to support the attainment analysis, two 2008 base year emission inventories were developed as listed earlier in Table 5.6-1 to satisfy EPA regulatory and CAA requirements: (1) a <u>statewide</u> annual inventory to satisfy EPA regulations; and (2) a <u>non-attainment</u> area inventory to meet CAA 172(c)(3) requirements. Each of these planning inventories is described separately below.

<u>2008 Statewide Base Year Planning Inventory</u> – The statewide Base Year inventory compiled to satisfy EPA regulations was developed simply from EPA's 2008 National Emissions Inventory (NEI). The NEI is a comprehensive nationwide inventory compiled by EPA at the state and county level based on emissions data and source activity inputs provided every three years by state, local, and tribal agencies that is reviewed and supplemented with EPA's own estimates for specific source categories (e.g., on-road mobile sources).

As required under EPA regulations, the statewide Base Year inventory represents emissions on an annual (tons per year) basis, representing both summer and winter activity and emissions, and contains estimates of actual (rather than permitted or allowable) emissions from stationary point sources.

Table 5.6-9 presents Alaska statewide annual emissions for all criteria pollutants based on EPA's 2008 NEI Version 3[20] inventory. The estimates in Table 5.6-9 were developed by culling records for Alaska emission sources from the "All Sector" National-County aggregated sector database downloaded from the 2008 NEI website.[21]

These NEI emissions were compiled by EPA by Emission Inventory Sector (EIS) as shown in Table 5.6-9. The data are summarized by EIS to provide a more detailed breakdown of emissions by each of the nearly 50 sector categories and to avoid confusion with subsequent inventory estimates presented for the Fairbanks $PM_{2.5}$ non-attainment area that are summarized in the traditional "Point, Area (Nonpoint), Onroad, Nonroad" source type basis. In the 2008 NEI (and subsequent NEI inventories), EPA relocated emissions from aircraft takeoff/landing operation, airport Ground Support Equipment (GSE) and Auxiliary Power Unit (APU) activity, and rail yard locomotive emissions from the Non-Road sector to the Stationary Point sector. Thus, the NEI-based statewide 2008 Base Year inventory is summarized by EIS category rather than the traditional data category groups.

[20] Version 3 version of the 2008 NEI was released in March 2013 and included updated estimates of on-road mobile source emissions using EPA's latest (at the time) MOVES2010b vehicle emissions model.
[21] http://www.epa.gov/ttn/chief/net/2008inventory.html.

Table 5.6-9
2008 Base Year Alaska Statewide Annual Emissions Inventory

Emission Inventory Sector (EIS)	Annual Emissions (tons/year)						
	VOC	CO	NOx	SO_2	PM_{10}	$PM_{2.5}$	NH_3
Agriculture - Crops & Livestock Dust	0	0	0	0	0	0	0
Bulk Gasoline Terminals	25	4	2	0	0	0	0
Commercial Cooking	25	65	0	0	175	175	0
Dust - Construction Dust	0	0	0	0	7,954	795	0
Dust - Paved Road Dust	0	0	0	0	1,950	487	0
Dust - Unpaved Road Dust	0	0	0	0	84,484	8,401	0
Fires – Wildfires	2,159	46,498	899	247	4,499	4,149	209
Fuel Comb - Comm/Institutional - Coal	2	185	510	253	7	4	0
Fuel Comb - Comm/Institutional - Natural Gas	2	35	42	1	3	3	0
Fuel Comb - Comm/Institutional - Oil	10	84	322	122	15	13	0
Fuel Comb - Comm/Institutional - Other	16	305	39	3	1	1	0
Fuel Comb - Electric Generation - Coal	91	1,583	1,437	990	116	101	164
Fuel Comb - Electric Generation - Natural Gas	401	2,542	9,996	134	278	278	5
Fuel Comb - Electric Generation - Oil	404	1,925	14,459	1,499	308	290	0
Fuel Comb - Electric Generation - Other	0	0	0	0	0	0	0
Fuel Comb - Industrial Boilers, ICEs - Coal	14	616	676	733	14	9	0
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	512	8,841	36,959	921	1,059	1,054	0
Fuel Comb - Industrial Boilers, ICEs - Oil	108	1,020	4,023	392	210	204	0
Fuel Comb - Industrial Boilers, ICEs - Other	1	2	5	2	3	3	0
Fuel Comb - Residential - Natural Gas	57	412	969	6	5	4	206
Fuel Comb - Residential – Oil	32	231	831	1,966	110	98	46
Fuel Comb - Residential – Other	226	6,157	268	215	140	86	45
Fuel Comb - Residential – Wood	1,112	6,186	94	17	899	898	51
Gas Stations	2,979	0	0	0	0	0	0
Industrial Processes - Chemical Manuf	0	1	34	0	0	0	7
Industrial Processes – Mining	0	0	0	0	5,265	673	0
Industrial Processes – NEC	40	20	35	19	621	274	0
Industrial Processes - Non-ferrous Metals	0	0	3	2	1	1	0
Industrial Processes - Oil & Gas Production	721	2,678	1,499	151	190	181	1
Industrial Processes - Petroleum Refineries	989	251	683	90	90	70	1
Industrial Processes - Storage and Transfer	1,306	0	0	0	19	16	0
Miscellaneous Non-Industrial NEC	857	0	1	0	0	0	0
Mobile – Aircraft	950	10,644	3,020	296	172	70	0
Mobile - Commercial Marine Vessels	609	3,943	24,370	5,180	1,179	1,114	11
Mobile – Locomotives	73	203	1,730	15	42	41	0
Mobile - Non-Road Equipment - Diesel	290	2,752	2,583	361	214	207	2
Mobile - Non-Road Equipment - Gasoline	18,639	65,641	731	15	491	452	5
Mobile - Non-Road Equipment - Other	40	913	187	8	11	11	0
Mobile - On-Road Diesel Heavy Duty Vehicles	453	1,923	7,516	207	695	651	13
Mobile - On-Road Diesel Light Duty Vehicles	19	72	125	5	16	15	1
Mobile - On-Road Gasoline Heavy Duty Vehicles	325	7,662	542	14	34	28	7
Mobile - On-Road Gasoline Light Duty Vehicles	5,943	108,088	7,513	265	612	500	209
Solvent - Consumer & Commercial Solvent Use	2,915	0	0	0	0	0	0
Solvent - Dry Cleaning	140	0	0	0	0	0	0
Solvent - Industrial Surface Coating & Solvent Use	4	0	0	0	0	0	0
Solvent - Non-Industrial Surface Coating	1,033	0	0	0	0	0	0
Waste Disposal	382	4,899	426	104	1,023	935	20
TOTALS	**43,902**	**286,381**	**122,530**	**14,234**	**112,905**	**22,295**	**1,003**

2008 Non-Attainment Area Base Year Planning Inventory – 2008 Base Year emission estimates were also compiled for the Fairbanks $PM_{2.5}$ Non-Attainment Area (shown earlier in Figure 5.6-1). These Fairbanks Non-Attainment Area (NA Area) planning inventory emissions were developed on both an annual average daily and a winter season average daily basis to address CAA 172(c)(3) requirements.

Two different approaches, summarized below, were considered in developing these NA Area Base Year planning emissions estimates.

1. *NEI-Based* – Spatial scaling of 2008 NEI emissions for the Fairbanks North Star Borough to the smaller NA Area and temporal scaling of annual NEI estimates to winter season average daily estimates.

2. *Modeling Inventory-Based* – Use of detailed "bottom-up" based emission estimates compiled by grid cell for both the entire modeling domain and the portion within the NA Area and temporal scaling of episodic daily emissions to annual and winter season average daily estimates.

The latter approach was determined to be the best alternative, utilizing detailed estimates of individual source category emissions based on locally collected activity data (and emission factor data for key source types) used to support the more rigorously developed modeling inventories, despite sacrificing potential consistency with the NEI.[22]

Table 5.6-10 presents estimates of 2008 Base Year NA Area annual and winter season average daily emissions (in tons/day) tabulated using the traditional "Point, Area, Onroad, Nonroad" source types. Within selected source types (Area and Onroad), emissions are further broken out into key source groups based on similar stratifications used in summarizing modeling inventory emissions. As noted in the first row of Table 5.6-10, allowable, rather than actual emissions are presented for the NA Area inventory in accordance with CAA 172(c)(3) requirements.

The annual average daily emissions shown in Table 5.6-10 were roughly estimated based on temporal scaling factors used to ratio average daily episodic emissions from the modeling inventory. The winter season average daily emissions for the NA Area planning inventory were simply estimated as equal to average daily episodic emissions. For emission sources whose activity or emission factors are dependent on ambient temperature, these simplistic estimates of winter season average daily emissions would actually be lower than those listed in the rightmost columns of Table 5.6-10.

[22] In developing the NEI, EPA has not fully accounted for Alaska-specific conditions. Although the NEI itself includes data submitted by Alaska State, local, and tribal air agencies, it often utilizes emission factors for some source categories based on Lower-48 conditions. Moreover, ancillary inventory spatial/temporal allocation databases either do not extend to Alaska or are not adequately representative of strong seasonal source activity variations (e.g., space heating) resulting from harsh Arctic winters. The purpose of this footnote is not to criticize EPA's efforts, but to clarify the underlying rationale for utilizing locally developed emission estimates.

Table 5.6-10
2008 Non-Attainment Area Base Year Planning Emissions Inventory

Source Type/Category	Annual Average Day (tons/day)					Winter Season Average Day (tons/day)				
	$PM_{2.5}$	SO_2	NOx	VOC	NH_3	$PM_{2.5}$	SO_2	NOx	VOC	NH_3
Point (Allowable)	1.595	22.973	27.393	0.826	n/a	1.595	22.973	27.393	0.826	n/a
Area, Space Heating	1.481	2.351	1.322	5.901	0.073	2.756	3.865	2.182	11.058	0.136
Area, Space Heat, Wood	1.427	0.051	0.226	5.824	0.053	2.656	0.084	0.373	10.914	0.098
Area, Space Heat, Oil	0.030	2.262	0.980	0.047	0.002	0.056	3.719	1.617	0.088	0.003
Area, Space Heat, Other	0.023	0.038	0.117	0.030	0.019	0.043	0.062	0.192	0.056	0.035
Area, Other	22.499	0.000	3.645	13.354	0.000	0.061	0.000	0.002	0.569	0.000
On-Road	0.772	0.070	4.966	8.212	0.072	0.676	0.046	4.625	5.725	0.071
On-Road, Running Exh	0.496	0.062	3.823	1.098	0.072	0.435	0.040	3.561	0.765	0.071
On-Road, Start & Idle Exh	0.276	0.009	1.143	7.019	0.000	0.242	0.006	1.064	4.894	0.000
On-Road, Evap	0.000	0.000	0.000	0.095	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.019	0.073	1.112	0.270	0.003	0.027	0.077	1.088	0.451	0.003
TOTALS	**26.364**	**25.468**	**38.438**	**28.563**	**0.148**	**5.115**	**26.961**	**35.290**	**18.628**	**0.210**

n/a – Not available.

Table 5.6-11 lists the scaling factors that were developed and applied by pollutant within each source type/group to generate the estimates of annual average daily emissions shown in Table 5.6-10 by applying these factors to average daily episodic emission estimates from the modeling inventory. For Space Heating Area sources, the scaling factors were developed based on comparisons of winter, summer, and annual average Fairbanks space heating emissions generated for Fairbanks under the aforementioned Big 3 inventory study, coupled with a Heating Degree Day (HDD) adjustment to account for differences between temperature under the modeling episodes versus the six-month (Oct-Mar) winter season estimates from the Big 3 study. The On-Road Mobile scaling factors were similarly developed from earlier Big 3 estimates, but without the HDD adjustment. For the Other Area and Non-Road Mobile sectors, the scaling factors were calculated directly from winter and annual emission estimates generated for those sectors.

Table 5.6-11
Temporal Scaling Factors for Non-Attainment Area Annual Planning Emissions

Source Type/Group	Episodic/Annual Scaling Factors				
	$PM_{2.5}$	SO_2	NO_X	VOC	NH_3
Point	N/A	N/A	N/A	N/A	N/A
Area, Space Heating	1.862	1.644	1.650	1.874	1.857
Area, Other	0.003	0.000	0.001	0.043	0.000
Mobile, On-Road	0.876	0.655	0.931	0.697	0.994
Mobile, Non-Road	1.456	1.046	0.979	1.669	1.022

N/A – Not applicable.

Based on the manner in which they were calculated, the scaling factors represent ratios of winter episodic-to-annual emissions. Thus, annual emissions in Table 5.6-10 were calculated from episodic emissions by dividing by the scaling factors in Table 5.6-11. (For example, annual average daily space heating emissions for $PM_{2.5}$ were estimated as 2.756 ÷ 1.862 = 1.481 tons/day.)

5.6.3. 2015 AND 2019 PROJECTED BASELINE INVENTORIES

Emission inventories for the two future years examined in this SIP—2015 (the Moderate Area attainment target year) and 2019 (the year in which attainment is projected to occur)—were developed in two stages. The first stage, referred to as the Project Baseline inventories, consists of forecasting emissions from the baseline year (2008) into future years (2015 and 2019) based only on the effects of projected demographic/economic trends and already adopted federal, State, and local control measures that existed prior to the development of this SIP. (The second and final stage, referred to as Control inventories, incorporates incremental emission reductions from control programs and measures adopted under this SIP and are discussed in the following sub-section.)

5.6.3.1. Emissions Projection Methodology

Growth Factors – Levels of projected source activity growth can vary depending upon the type of source category. A series of potential growth factors were assembled from several sources for use in forecasting the activity component of 2008 baseline emissions forward to 2015 and 2019. Table 5.6-12 below summarizes the growth rates applied to project activity by source sector and the sources or assumptions upon which they were based.

Table 5.6-12
Summary of Growth Rates Applied in Projected Baseline Inventories

Source Type/Group	Annualized Growth Rate (% per year)	Growth Rate Source/Assumptions
Point, Actual	Zero	Assumed held constant at 2008 levels due to uncertainty of activity growth and fuel switching for specific facilities
Point, Allowable	Zero	DEC Permit files, generally reflecting no significant changes in permitted emission limits from 2008 through 2014
Area, Space Heating	1.2% average over domain	Projected household growth rates (2010-2030) by Census block group developed by the FNSB Community Planning Department, annualized growth rates ranged from 0.3% to 3.5%
Area, Other	1.0%	Projected 2010-2030 population growth rate for FNSB developed by the FNSB Community Planning Department
Mobile, On-Road	1.1%	Developed from FMATS 2010 and 2035 travel model outputs supporting the 2012-2015 TIP
Mobile, Non-Road Equip.	Ranged from -0.4% to +1.6%	County-level long-term population projections developed by the Alaska Department of Labor and Workforce Development for each of four counties in Grid 3 modeling domain
Mobile, Aircraft & Rail	Zero	Assumed held constant at 2008 levels, based on discussions with local rail and airport personnel

Existing Controls – Effects of emission controls from adopted control programs (that reduce unit emission factors for specific source categories in future years) were also accounted for in the projected baseline inventories. These adopted control programs and how they were modeled are listed below:

- *On-Road Vehicles* – Effects of federal Motor Vehicle Control Program and Diesel Emission Reduction Programs and fuel standards, coupled with Alaska Ultra Low Sulfur Diesel (ULSD) phase in were accounted for within EPA's MOVES2010a model.

- *Non-Road Vehicles and Equipment* – Effect of federal fuel and Alaska ULSD programs for non-road fuel were modeled using EPA's NONROAD2008a model.

- *Open Burning* – The Projected Baseline (and Baseline) inventories incorporated effects from Borough and State measures that ban open burning during the winter season.

- *Space Heating and Solid Fuel Heating Programs* – Effects of the Alaska Housing Finance Corporation (AHFC) Home Energy Rebate and Weatherization programs were assumed to be implicitly accounted for through use of recently-collected residential home heating surveys. In other words, the mix of devices and usage rates obtained from these surveys were assumed to account for historical effects of device replacements and weatherization efficiency improvements from the AHFC programs. (An analysis of AHFC program data collected from program inception in 2008 through 2011[23] found very modest emission reduction benefits from four years of accumulated participation in the program based on these data. As a result, projected additional benefits beyond 2011 were excluded from the 2015 and 2019 Projected Baseline inventories.)

Other Adjustments – In addition to the effects of these adopted controls, an activity reduction factor was applied for wood-burning devices within the space heating sector in projecting 2008 baseline emissions forward to 2015 and 2019. This factor accounts for a trend toward lower average wood moisture content (which reduces wood use and per unit emissions) measured in multiple local home heating telephone surveys toward greater use of owner-cut, rather than commercially purchased, wood. From local moisture measurement studies, owner-cut wood was found to be significantly drier on average than commercially purchased wood because of longer drying times and more effective storage practices.

Table 5.6-13 shows the splits between the "Cut Own" and "Buy" wood source groups, their estimated average moisture levels, and how the shift toward greater use of owner-cut wood after 2008 affected composite moisture content and wood-burning emissions. Wood moisture was estimated to be much higher (64.2%) for commercially purchased wood compared to owner-cut and dried wood (26.6% as shown in in the Moisture Content column of Table 5.6-13).

[23] Email from Nathan Wiltse, CCHRC to Bob Dulla, Sierra Research, February 13, 2012.

Table 5.6-13
Wood Source Shift Adjustment Effects on Projected Baseline Emissions

Wood Source Group	Moisture Content (%)*	2008 Baseline Usage Mix	2015 and Later Usage Mix (from multiple 2013 surveys)
Buy	64.2%	35.0%	26.2%
Cut Own	26.6%	65.0%	73.8%
Composite Avg. Moisture Level:		39.7%	36.4%
Relative Reduction in Wood Energy Use & Emissions:			2.4%

* Moisture content on a dry basis.

From surveys conducted between 2007 and 2013, a shift has been observed in greater use of owner cut wood (73.8% from multiple 2013 surveys vs. 65.0% in 2008). The effects of this overall reduction in average moisture content (from 39.7% to 36.4%) was calculated to result in a 2.4% reduction in wood use (and emissions) due to the fact that drier wood loses less latent heat, supplying greater effective heating energy. This 2.4% moisture-driven wood usage reduction was applied in calculating wood-burning device emissions in the 2015 and 2019 projected baseline inventories.

A second adjustment factor was also applied for wood-burning devices in the space heating sector to account for “natural” turnover of older uncertified wood stoves and fireplace inserts over time based on clear trends observed from the residential home heating surveys that preceded the Borough’s Wood Stove Change Out (WSCO) program, which began in mid-2010.

In 1988, EPA adopted[24] New Source Performance Standards (NSPS) for new residential wood-burning heaters (stoves and fireplace inserts) under 40 CFR §60.530-539b that require devices to meet EPA-certified $PM_{2.5}$ emission standards of 7.5 grams/hour (g/hr) for non-catalytic devices and 4.1 g/hr for catalytic devices. Over time, older uncertified wood heating devices are being replaced as homeowners purchase new wood heaters.[25]

Figure 5.6-23 shows the downward trend or natural turnover in the fraction of indoor wood heaters (stoves and inserts) that are uncertified. The data points shown for calendar years 2006 through 2012 represent uncertified device fractions calculated from annual residential Home Heating (HH) surveys. The black line is an exponential “best fit” curve of these data. The dashed red line represented an extension of this fitted curve out to 2019. (The data in Figure 5.6-23 have not been adjusted to account for the effect of currently sold exempted devices. However, as explained in Appendix III.D.5.6, these exempted devices are accounted for in the inventory.)

[24] Federal Register, Volume 53, pg. 5873, February 26, 1988.
[25] Not all indoor wood burning devices currently sold are EPA-certified. The 1988 (and 1998 amended) NSPS contains language that exempts certain wood-burning devices. As described in Appendix III.D.5.6, special survey data were collected to account for the fraction of the exempted wood devices that are still currently sold.

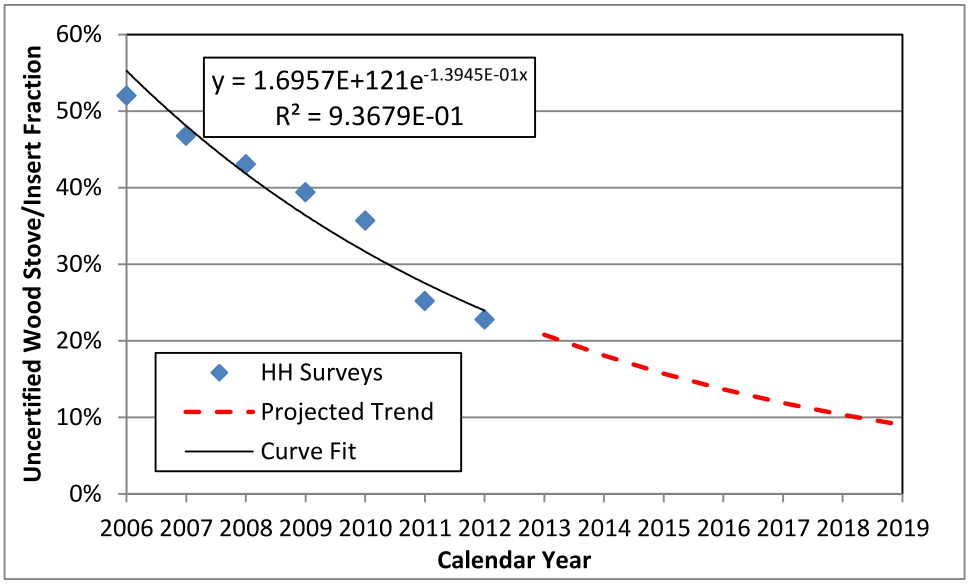

Figure 5.6-23. Fairbanks Home Heating Survey-Based Trend in Uncertified Wood Stoves/Inserts

The adjustment factor for natural turnover of uncertified wood stoves/insert was calculated based on the declining percentage of these devices over time as shown in Figure 5.6-23. Since the EPA-certified non-catalytic and catalytic stoves are projected to represent an increasing fraction of wood stoves/inserts over time and have lower emission factors than uncertified devices, average wood stove/insert emissions are projected to decrease over time due to this natural turnover. Appendix III.D.5.6 contains these detailed calculations.

5.6.3.2. Projected Baseline Inventory Summaries

Using the projected activity growth factors (and wood usage adjustment) and emission factors representing future effects of adopted mobile source control programs as summarized in the preceding sub-section, project baseline inventories were developed for 2015 and 2019.

Table 5.6-14 and Table 5.6-15 present summaries of the 2015 Projected Baseline modeling inventory with actual and allowable emissions from point sources, respectively. Even though emissions were generated at the SCC level by modeling episode day and hour, emissions are shown in the same tabulated source sector and daily average structure as the earlier 2008 Baseline inventory.

Comparing emissions between these tables and those for the 2008 Baseline presented earlier in Section 5.6.2, $PM_{2.5}$ emissions decrease by roughly 3% over the Grid 3 modeling domain due to the trends of lower wood moisture and reduced fractions of uncertified wood stoves/inserts factored into the projected baseline (coupled with demographic/economic growth factors).

Table 5.6-14
2015 Projected Baseline Episode Average Daily Emissions (tons/day) by Source Sector, Actual Point Source Emissions

	Grid 3 Domain Emissions (tons/day)					*NA Area Emissions (tons/day)*				
Source Sector	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**
Point (Actual)	1.423	8.380	13.395	0.096	n/a	1.412	8.167	13.285	0.096	n/a
Area, Space Heating	3.173	4.768	2.639	11.695	0.152	2.834	4.303	2.409	10.520	0.139
Area, Space Heat, Wood	3.048	0.104	0.466	11.515	0.111	2.723	0.093	0.414	10.359	0.099
Area, Space Heat, Oil	0.070	4.587	1.974	0.109	0.004	0.063	4.143	1.800	0.098	0.003
Area, Space Heat, Other	0.055	0.076	0.200	0.071	0.037	0.048	0.068	0.195	0.062	0.036
Area, Other	0.067	0.000	0.003	0.735	0.000	0.065	0.000	0.002	0.604	0.000
On-Road	0.552	0.022	3.127	4.424	0.063	0.461	0.017	2.503	3.405	0.051
On-Road, Running Exh	0.351	0.019	2.157	0.425	0.063	0.303	0.015	1.776	0.346	0.051
On-Road, Start & Idle Exh	0.201	0.003	0.970	3.912	0.000	0.158	0.002	0.726	2.993	0.000
On-Road, Evap	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.197	0.158	2.154	9.401	0.006	0.025	0.082	1.062	0.403	0.003
TOTALS	**5.413**	**13.327**	**21.318**	**26.351**	**0.221**	**4.796**	**12.569**	**19.261**	**15.027**	**0.193**

n/a – Not available.

Table 5.6-15
2015 Projected Baseline Episode Average Daily Emissions (tons/day) by Source Sector, Allowable (PTE) Point Source Emissions

	Grid 3 Domain Emissions (tons/day)					*NA Area Emissions (tons/day)*				
Source Sector	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**
Point (Allowable, PTE)	2.773	26.612	29.609	0.845	n/a	1.595	22.973	27.393	0.826	n/a
Area, Space Heating	3.173	4.768	2.639	11.695	0.152	2.834	4.303	2.409	10.520	0.139
Area, Space Heat, Wood	3.048	0.104	0.466	11.515	0.111	2.723	0.093	0.414	10.359	0.099
Area, Space Heat, Oil	0.070	4.587	1.974	0.109	0.004	0.063	4.143	1.800	0.098	0.003
Area, Space Heat, Other	0.055	0.076	0.200	0.071	0.037	0.048	0.068	0.195	0.062	0.036
Area, Other	0.067	0.000	0.003	0.735	0.000	0.065	0.000	0.002	0.604	0.000
On-Road	0.552	0.022	3.127	4.424	0.063	0.461	0.017	2.503	3.405	0.051
On-Road, Running Exh	0.351	0.019	2.157	0.425	0.063	0.303	0.015	1.776	0.346	0.051
On-Road, Start & Idle Exh	0.201	0.003	0.970	3.912	0.000	0.158	0.002	0.726	2.993	0.000
On-Road, Evap	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.197	0.158	2.154	9.401	0.006	0.025	0.082	1.062	0.403	0.003
TOTALS	**6.763**	**31.559**	**37.532**	**27.100**	**0.221**	**4.979**	**27.376**	**33.369**	**15.758**	**0.193**

n/a – Not available.

Similar tabulations for the 2019 Projected Baseline inventory are presented in Table 5.6-16 and Table 5.6-17.

Table 5.6-16
2019 Projected Baseline Episode Average Daily Emissions (tons/day) by Source Sector, Actual Point Source Emissions

Source Sector	*Grid 3 Domain Emissions (tons/day)*					*NA Area Emissions (tons/day)*				
	$PM_{2.5}$	**SO_2**	**NOx**	**VOC**	**NH_3**	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**
Point (Actual)	1.423	8.380	13.395	0.096	n/a	1.412	8.167	13.285	0.096	n/a
Area, Space Heating	3.284	5.021	2.774	11.843	0.156	2.937	4.537	2.535	10.674	0.143
Area, Space Heat, Wood	3.153	0.110	0.492	11.654	0.115	2.821	0.098	0.438	10.506	0.103
Area, Space Heat, Oil	0.073	4.832	2.081	0.115	0.004	0.066	4.369	1.900	0.103	0.004
Area, Space Heat, Other	0.058	0.079	0.201	0.075	0.038	0.050	0.070	0.197	0.065	0.037
Area, Other	0.071	0.000	0.003	0.773	0.000	0.068	0.000	0.002	0.634	0.000
On-Road	0.485	0.021	2.350	2.934	0.058	0.406	0.017	1.872	2.258	0.048
On-Road, Running Exh	0.318	0.018	1.514	0.313	0.058	0.275	0.015	1.246	0.255	0.048
On-Road, Start & Idle Exh	0.167	0.003	0.837	2.533	0.000	0.131	0.002	0.626	1.937	0.000
On-Road, Evap	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.172	0.172	2.278	7.712	0.006	0.024	0.090	1.094	0.405	0.003
TOTALS	**5.435**	**13.594**	**20.800**	**23.358**	**0.221**	**4.846**	**12.810**	**18.788**	**14.067**	**0.194**

n/a – Not available.

Table 5.6-17
2019 Projected Baseline Episode Average Daily Emissions (tons/day) by Source Sector, Allowable (PTE) Point Source Emissions

Source Sector	*Grid 3 Domain Emissions (tons/day)*					*NA Area Emissions (tons/day)*				
	$PM_{2.5}$	**SO_2**	**NOx**	**VOC**	**NH_3**	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**
Point (Allowable, PTE)	2.773	26.612	29.609	0.845	n/a	1.595	22.973	27.393	0.826	n/a
Area, Space Heating	3.284	5.021	2.774	11.843	0.156	2.937	4.537	2.535	10.674	0.143
Area, Space Heat, Wood	3.153	0.110	0.492	11.654	0.115	2.821	0.098	0.438	10.506	0.103
Area, Space Heat, Oil	0.073	4.832	2.081	0.115	0.004	0.066	4.369	1.900	0.103	0.004
Area, Space Heat, Other	0.058	0.079	0.201	0.075	0.038	0.050	0.070	0.197	0.065	0.037
Area, Other	0.071	0.000	0.003	0.773	0.000	0.068	0.000	0.002	0.634	0.000
On-Road	0.485	0.021	2.350	2.934	0.058	0.406	0.017	1.872	2.258	0.048
On-Road, Running Exh	0.318	0.018	1.514	0.313	0.058	0.275	0.015	1.246	0.255	0.048
On-Road, Start & Idle Exh	0.167	0.003	0.837	2.533	0.000	0.131	0.002	0.626	1.937	0.000
On-Road, Evap	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.172	0.172	2.278	7.712	0.006	0.024	0.090	1.094	0.405	0.003
TOTALS	**6.784**	**31.826**	**37.014**	**24.106**	**0.221**	**5.029**	**27.617**	**32.896**	**14.797**	**0.194**

n/a – Not available.

5.6.4. 2015 and 2019 Control Inventories

The second and final stage of estimating emissions in the two future years examined under this SIP (2015 and 2019) consisted of applying adjustments to the Projected Baseline inventories to reflect additional incremental effects of State and local control measures not included in those baselines. These final future year inventories are called the Control inventories and are discussed separately below.

5.6.4.1. 2015 Control Modeling Inventory

Within this SIP, a Control inventory was prepared for 2015, the required attainment year, and used to support the attainment modeling analysis to find that either (1) attainment is projected to occur by 2015; or (2) attainment by 2015 is impracticable as discussed earlier in Section 5.6.1.

The control measures accounted for in this 2015 Control inventory (and that were not included in the Projected Baseline inventory) are summarized below.

Hydronic Heater Retrofit Program (ARA OHH Retrofits) – The Alaska Resource Agency (ARA) secured funding to identify and retrofit 40 outdoor hydronic heaters[26] (OHHs) with ClearStak or similar pollution control devices (PCDs). The retrofits were performed in late 2011 and 2012. The effects of these retrofits were not captured in the early 2011 Fairbanks Home Heating survey that was used to estimate the mix and number of devices in the SIP inventory and thus were treated as a control program with "fixed" benefits from those retrofits.

ARA estimated these retrofits provide an 80-90% reduction in particulate emissions based on testing conducted under a NESCAUM study. Based on visual observations/follow-up by Fairbanks Borough staff after retrofits were installed, a "real world" emission reduction of 30% per retrofit was assumed that accounted for imperfect compliance and use.

$PM_{2.5}$ emission reductions from these devices were estimated to be 0.2% of projected baseline space heating emissions and roughly 0.1% of total emissions in the non-attainment area. (No benefits were assumed for gaseous pollutants.)

FNSB Wood Stove Change Out Program (WSCO Program) – Beginning in June 2010, the Fairbanks Borough has operated a program within the non-attainment area designed to provide incentives for the replacement of older, higher-polluting residential wood-burning devices with new cleaner devices, or removal of the old devices. Table 5.6-18 presents a historical summary of how the WSCO program was originally designed and how it has been modified over time since it began.

As summarized in Table 5.6-18, the design of the WSCO program has evolved over time, but these changes have generally consisted of both increasing the financial incentives as well as expanding the types of solid fuel burning appliances (SFBAs) or devices that are eligible to participate in the program.

Emission control benefits were calculated for the program based on transaction data collected by the Borough since its inception, through mid-August 2014. (Data for the partial 2014 calendar year were extrapolated to the end of 2014 based on the expected number of applications projected by the Borough to be completed and change outs validated by the end of the year.)

Table 5.6-18
Fairbanks Borough Wood Stove Change Out Program Historical Summary

[26] Also called outdoor wood boilers (OWBs).

Program	Old Appliance Type	New Appliance Type Allowed	Payout
JUNE 2010 – Original program. Limited to $PM_{2.5}$ non-attainment area. Participants in the removal program signed deed restriction in which they agree they would not install another solid fuel burning appliance for 10 years.			
Removal	OHH (Outdoor Hydronic Heater)	No solid fuel burning appliances	$7,500 cash
Removal	IHH (Indoor Hydronic Heater)	No solid fuel burning appliances	$4,000 cash
Removal	Other SFBA	No solid fuel burning appliances	$3,000 cash
Replacement	HH (outdoor or indoor) – non EPA Phase II	EPA Phase II, EPA cert SFBA or any pellet	Up to $2,500
Replacement	Other SFBA – non EPA cert	EPA cert SFBA or any pellet	Up to $2,500
Repair	Catalytic Converter	n/a	Up to $750
Repair	Other Emissions Reducing Component	n/a	Up to $750
Repair	Chimney Repair	n/a	Up to $750
Repair	Retrofit Device	n/a	Up to $1,000
JANUARY 2013 – In October 2012, Citizens' Initiative Prop 3 passed (The borough shall not, in any way, regulate, prohibit, curtail, nor issue fines or fees associated with sale, distribution, or operation of heating appliances or any combustible fuel.*)* Program suspended Dec. 2012 while it was modified. Opened to all Borough properties. Devices ≤ 2.5 grams/hr eligible for higher payout. Replacement devices must be EPA certified.			
Replacement	HH (outdoor or indoor)	EPA cert SFBA or pellet	Up to $2,500
Replacement	Other SFBA – non EPA cert	EPA cert SFBA or pellet	75% of cost up to $2,500/$3,000**
Removal	Remove HH w/out replacement		$2,000
Repair	Catalytic Converter	n/a	Up to $750
Repair	Other Emissions Reducing Component	n/a	Up to $750
Repair	Chimney Repair	n/a	Up to $750
Repair	Retrofit Device		Up to $1,000
ENHANCED PROGRAM (May – Sept 2013) – Completely different program (operated in conjunction with the regular program), limited to 3 specific areas in the non-attainment area. Also, allowed for replacing EPA-certified SFBAs with emission rate ≤ 2.0 grams/hr (overall emissions reduction must be at least 50%).			
Replacement	OHH	EPA cert SFBA, any pellet, non-solid fuel burning appliances	Up to $10,000
Replacement	Other SFBA	EPA cert SFBA, any pellet, non-solid fuel burning appliances	Up to $4,000
Replacement	Fireplace	EPA cert SFBA, any pellet, non-solid fuel burning appliances	Up to $4,000
MARCH 2014 (Current Program) – Changed to limit to properties in non-attainment area, and includes $300 fuel voucher for pellets or compressed logs. Now allows for replacing EPA-certified SFBAs w/emissions of 2.5 grams/hr and greater (and requiring an emission reduction of at least 50%), and fireplaces.			
Replacement	OHH	EPA cert SFBA, any pellet, non-solid fuel burning appliances	Up to $10,000
Replacement	Other SFBA	EPA cert SFBA, any pellet, non-solid fuel burning appliances	Up to $4,000
Replacement	Fireplace	EPA cert SFBA, any pellet, non-solid fuel burning appliances	Up to $4,000
Removal	Remove HH w/out replacement	n/a	$2,000
Removal	Remove SFBA w/o replacement	n/a	$1,000
Repair	Catalytic Converter	n/a	Up to $750
Repair	Other Emissions Reducing Component	n/a	Up to $750

Source: Fairbanks North Star Borough.
SFBA – Solid Fuel Burning Appliance.

For devices that were replaced, emission reductions were calculated by replacing the emission factor for each device type (fireplace, insert, wood stove, OHH/OWB, coal stove) with an emission factor (in lb/ton of fuel) equivalent to the emission rate cutpoints (in grams/hour) based on emission factor vs. emission rate correlations developed from certification data published by EPA[27] for over 1,000 wood-burning devices. For devices that were removed, it was assumed that the heating energy from the removed device would be replaced with equivalent energy from an oil furnace or boiler (and accounting for the heating efficiency differences between the two devices). No emission reductions were assumed for repaired devices given the uncertainty of the type of repair performed and its effect on emissions. Appendix III.D.5.6 describes these calculations in greater detail.

Emission benefits from the WSCO program for the 2015 Control inventory were based on the accumulation of change outs from the start of the program through the end of 2014 (extrapolating the partial 2014 data as described above). In attainment modeling, eligible control measure benefits are those that exist at the beginning of the modeling year. Thus, in this case, WSCO program benefits accumulated through the end of 2014 (not 2015) were used to model attainment in calendar year 2015. A tabulation of the cumulative year-to-year completed transactions in the WSCO is presented below in Table 5.6-19. Within each year, transactions are broken down by operation type (Replacement or Removal) and device type.

Table 5.6-19
Fairbanks Borough Wood Stove Change Out Program Cumulative Transactions

Program Operation	Device Type	(end 2010) 2011	(end 2011) 2012	(end 2012) 2013	(end 2013) 2014	(end 2014) 2015
Replacement	Fireplace	0	0	0	0	74
Replacement	Stove/Insert	103	246	698	899	1,257
Replacement	OHH	1	3	5	22	43
Replacement	Coal Stove	0	0	1	3	10
Removal	Stove/Insert	10	44	184	190	194
Removal	OHH	8	32	68	70	74
Removal	Coal Stove	0	0	4	5	5
Replacements, Total		104	249	704	924	1,384
Removals, Total		18	76	256	265	273
Change-Outs, Total		**122**	**325**	**960**	**1,189**	**1,657**

Emission benefits from the WSCO program in 2015 were estimated to provide a 13.7% reduction in space heating $PM_{2.5}$ emissions in the non-attainment area relative to the projected baseline. Reductions for gaseous pollutants (relative to projected baseline space heating emissions) were estimated as 0.8% for SO_2, 1.4% for NOx, 19.3% for VOC and 10.3% for NH_3.

Measures Considered But not Modeled - In addition to the ARA and WSCO program benefits, further emission reductions may be achieved through emerging use of "energy logs" which are compressed, densified logs that have just begun being manufactured locally in Fairbanks (by

[27] http://www.epa.gov/burnwise/appliances.html.

Superior Pellet Fuels, LLC). Energy logs are made from local wood species and when produced, are denser and much drier that cut cordwood, and are potentially cleaner-burning than cordwood. Since the energy logs have just begun being sold in the local market, there is not yet sufficient usage data available to support development of emission reduction estimates in the 2015 Control inventory.

<u>2015 Control Inventory Summaries</u> – Table 5.6-20 and Table 5.6-21 present tabulated sector and geographic area summaries of the 2015 Control inventories based on actual and allowable point source emissions, respectively.

Table 5.6-20
2015 Control Episode Average Daily Emissions (tons/day) by Source Sector, Actual Point Source Emissions

	Grid 3 Domain Emissions (tons/day)					*NA Area Emissions (tons/day)*				
Source Sector	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**
Point (Allowable, PTE)	1.423	8.380	13.395	0.096	-	1.412	8.167	13.285	0.096	-
Area, Space Heating	2.779	4.733	2.606	9.642	0.138	2.440	4.268	2.376	8.467	0.125
Area, Space Heat, Wood	2.655	0.096	0.424	9.463	0.097	2.330	0.084	0.373	8.308	0.085
Area, Space Heat, Oil	0.070	4.562	1.983	0.109	0.004	0.063	4.118	1.809	0.099	0.003
Area, Space Heat, Other	0.054	0.075	0.199	0.070	0.037	0.047	0.066	0.194	0.061	0.036
Area, Other	0.067	0.000	0.003	0.735	0.000	0.065	0.000	0.002	0.604	0.000
On-Road	0.552	0.022	3.127	4.424	0.063	0.461	0.017	2.503	3.405	0.051
On-Road, Running Exh	0.351	0.019	2.157	0.425	0.063	0.303	0.015	1.776	0.346	0.051
On-Road, Start & Idle Exh	0.201	0.003	0.970	3.912	0.000	0.158	0.002	0.726	2.993	0.000
On-Road, Evap	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.197	0.158	2.154	9.401	0.006	0.025	0.082	1.062	0.403	0.003
TOTALS	**5.020**	**13.292**	**21.285**	**24.298**	**0.207**	**4.402**	**12.534**	**19.228**	**12.974**	**0.179**

n/a – Not available.

Table 5.6-21
2015 Control Episode Average Daily Emissions (tons/day) by Source Sector, Allowable (PTE) Point Source Emissions

	Grid 3 Domain Emissions (tons/day)					*NA Area Emissions (tons/day)*				
Source Sector	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**
Point (Allowable, PTE)	2.773	26.612	29.609	0.845	n/a	1.595	22.973	27.393	0.826	n/a
Area, Space Heating	2.779	4.733	2.606	9.642	0.138	2.440	4.268	2.376	8.467	0.125
Area, Space Heat, Wood	2.655	0.096	0.424	9.463	0.097	2.330	0.084	0.373	8.308	0.085
Area, Space Heat, Oil	0.070	4.562	1.983	0.109	0.004	0.063	4.118	1.809	0.099	0.003
Area, Space Heat, Other	0.054	0.075	0.199	0.070	0.037	0.047	0.066	0.194	0.061	0.036
Area, Other	0.067	0.000	0.003	0.735	0.000	0.065	0.000	0.002	0.604	0.000
On-Road	0.552	0.022	3.127	4.424	0.063	0.461	0.017	2.503	3.405	0.051
On-Road, Running Exh	0.351	0.019	2.157	0.425	0.063	0.303	0.015	1.776	0.346	0.051
On-Road, Start & Idle Exh	0.201	0.003	0.970	3.912	0.000	0.158	0.002	0.726	2.993	0.000
On-Road, Evap	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.197	0.158	2.154	9.401	0.006	0.025	0.082	1.062	0.403	0.003
TOTALS	**6.369**	**31.524**	**37.499**	**25.047**	**0.207**	**4.585**	**27.341**	**33.336**	**13.705**	**0.179**

n/a – Not available.

Comparing tabulated emissions between the 2015 Control (Table 5.6-20 and Table 5.6-21) and 2015 Projected Baseline inventories presented earlier in Section III.D.5.6.3 (Table 5.6-14 and Table 5.6-15), the emission reductions occur entirely within the Space Heating Area source sector, reflecting controls implemented to date (i.e., through the end of 2014).

Table 5.6-22 shows how the 2015 Control modeling inventory emissions (totaled across all source sectors) compare to the 2008 Baseline emissions based on allowable emissions for the point source sector. The comparison is presented as the percentage change in emissions relative to the 2008 Baseline and is based on allowable emissions for the point source sector. Thus negative percentages reflect emission reductions from the 2008 Baseline. Direct $PM_{2.5}$ emission reductions are highlighted in bold and just exceed 10% for the non-attainment area. Emission reductions for gaseous precursors NOx, VOC and NH_3 are 5.5%, 26.4% and 14.9%, respectively within the non-attainment area. Emissions of SO2 increase slightly (by just over 1%) relative to the 2008 Baseline due to the fact that heating energy from wood-burning devices removed under the WSCO program was assumed to be made up for with additional heating oil burning devices, which have higher SO_2 emission factors that are roughly ten times higher than wood devices (on a lb. per unit energy basis).

Table 5.6-22
2015 Control Modeling Emissions Relative to 2008 Baseline (Allowable Point Sources)

	% Change in Emissions (Relative to 2008 Baseline)				
Geographic Area	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**
Grid 3 Modeling Domain	**-8.8%**	+1.3%	-6.0%	-25.5%	-14.7%
$PM_{2.5}$ Non-Attainment Area	**-10.4%**	+1.4%	-5.5%	-26.4%	-14.9%

Again, the reductions presented in Table 5.6-22 are reductions for all inventory sources. Thus, the reductions noted earlier in this sub-section at the end of the discussions of the ARA and WSCO program do not add up to the totals in Table 5.6-22 since those reductions were relative to space heating emissions, not all emissions.

(Relative reductions are nominally higher than those shown if based on actual, rather than allowable point source emissions since actual point source emissions are lower and the control reductions occur outside the point source sector.)

5.6.4.2. 2015 Control Planning Inventory

Scaling similar to that described earlier in Section III.D.5.6.2.2 was applied to the 2015 Control episodic modeling emissions using temporal scaling factors listed in Table 5.6-11 to develop estimates of annual and winter season Planning emissions within the non-attainment area for the 2015 Control inventory. Table 5.6-23 summarizes these 2015 Control Planning inventory estimates.

Table 5.6-23
2015 Non-Attainment Area Control Planning Emissions Inventory

Source Type/Category	Annual Average Day (tons/day)					Winter Season Average Day (tons/day)				
	$PM_{2.5}$	SO_2	NOx	VOC	NH_3	$PM_{2.5}$	SO_2	NOx	VOC	NH_3
Point (Allowable)	1.595	22.973	27.393	0.826	n/a	1.595	22.973	27.393	0.826	n/a
Area, Space Heating	1.311	2.596	1.440	4.518	0.067	2.440	4.268	2.376	8.467	0.125
Area, Space Heat, Wood	1.252	0.051	0.226	4.433	0.046	2.330	0.084	0.373	8.308	0.085
Area, Space Heat, Oil	0.034	2.504	1.096	0.053	0.002	0.063	4.118	1.809	0.099	0.003
Area, Space Heat, Other	0.025	0.040	0.118	0.032	0.019	0.047	0.066	0.194	0.061	0.036
Area, Other	23.863	0.000	3.992	14.176	0.000	0.065	0.000	0.002	0.604	0.000
On-Road	0.526	0.027	2.687	4.885	0.052	0.461	0.017	2.503	3.405	0.051
On-Road, Running Exh	0.346	0.023	1.907	0.497	0.052	0.303	0.015	1.776	0.346	0.051
On-Road, Start & Idle Exh	0.180	0.003	0.780	4.294	0.000	0.158	0.002	0.726	2.993	0.000
On-Road, Evap	0.000	0.000	0.000	0.095	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.017	0.078	1.085	0.242	0.003	0.025	0.082	1.062	0.403	0.003
TOTALS	**27.312**	**25.674**	**36.596**	**24.647**	**0.122**	**4.585**	**27.341**	**33.336**	**13.705**	**0.179**

n/a – Not available.

5.6.4.3. 2019 Potential Control Modeling Inventory

As discussed earlier in Section III.D.5.6.1, development of a 2019 Control inventory was not a mandatory requirement for this SIP because of the finding (discussed in Section III.D.5.9) that attainment of the $PM_{2.5}$ NAAQS by the required 2015 calendar year was impracticable. A 2019 "Potential" Control inventory was developed to examine the potential for attainment by 2019.

Forecasts of Existing Programs – The first step in generating the 2019 Potential Control inventory consisted of forecasting the benefits from the two existing control measures, the ARA and WSCO programs. The ARA program was a "one-time" measure based on OHH retrofits performed in 2011-2012 that were not included in the projected baselines. Thus, its emission benefits were assumed to be fixed or held constant in both 2015 and 2019 and, as summarized earlier in Section III.D.5.6.4.1, to provide a 0.2% reduction in space heating $PM_{2.5}$ emissions across the non-attainment area.

Emission benefits from continuation of the Borough's WSCO through 2019 were estimated by projecting additional annual change outs (either replacement of uncertified or higher-emitting certified devices with cleaner devices meeting a 2.5 gram/hour $PM_{2.5}$ standard, or removal of devices with their displaced heating energy replaced by heating from oil-fired units). Rather than simply assuming that annual WSCO program device replacements/removals would occur at their actual 2014 rate (or the average over the program's four-year history), a decreasing exponential curve was applied to account for the fact that as fewer and fewer uncertified devices exist over time, it will be harder to maintain existing annual participation levels or "throughput" in the program. This is depicted in Figure 5.6-24, which presents incremental annual change outs over time and shows the 2014 throughput as a constant horizontal blue line going forward and the assumed declining year-to-year trend shown below it in green. Calendar years shown reflect the start of the year, i.e., calendar year 2015 refers to change outs through the end of 2014.

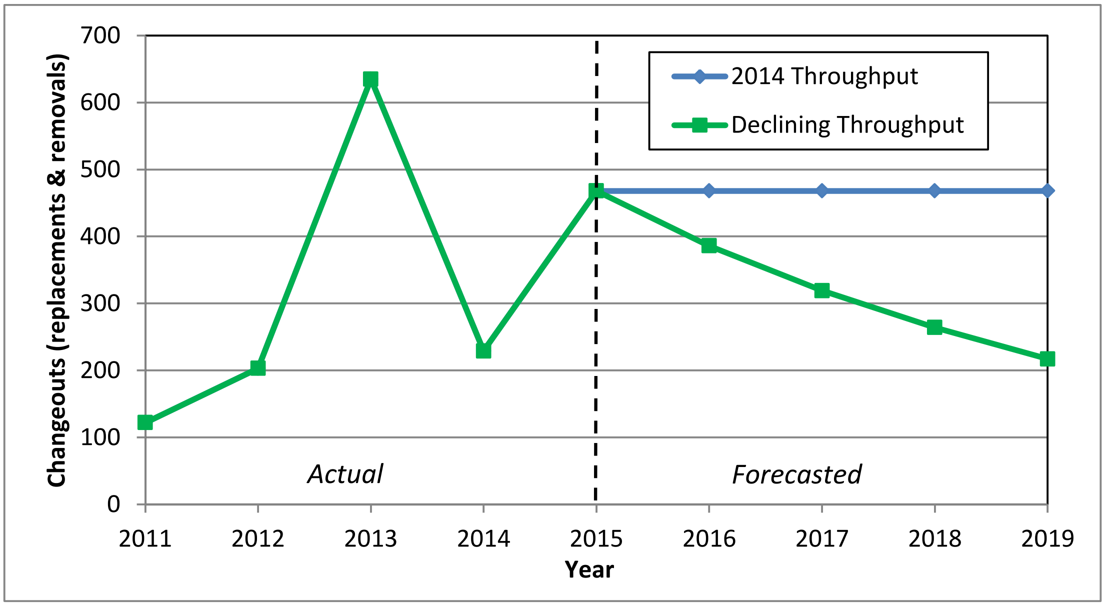

Figure 5.6-24. Incremental Annual Change Outs, Actual Through 2014 and Forecasted

To ensure that this declining throughput forecast properly accounted for the finite population of uncertified devices projected in the Borough in 2019 in the absence of the WSCO program, its rate of decline was set such that the forecasted number of uncertified wood stove and insert change outs in 2019 would approximately reach the "cap" of projected available population of those uncertified devices in that year (after accounting for natural turnover occurring outside the program). This is shown in Figure 5.6-25, which displays cumulative change outs of uncertified stoves and inserts over time and is seen where the green declining throughput forecast meets the projected uncertified stove/insert cap in 2019 (shown in red).

Figure 5.6-26 shows a similar plot of actual and forecasted cumulative annual WSCO program change outs for all uncertified devices. (All uncertified devices were represented as the sum of uncertified stoves/inserts, unqualified outdoor hydronic heaters, fireplaces, and coal heaters.) When all uncertified devices are plotted, there is still a margin between the projected number of cumulative change outs and the cap for all uncertified devices targeted under the current design of the WSCO program.

Again, calendar years shown refer to conditions as of the start of each year—i.e., calendar year 2019 refers to cumulative change outs through the end of 2018.

Using these assumptions of declining future throughput, cumulative $PM_{2.5}$ emission reductions in 2019 from the WSCO program were estimated to be 25.4% of projected baseline emissions in that year.

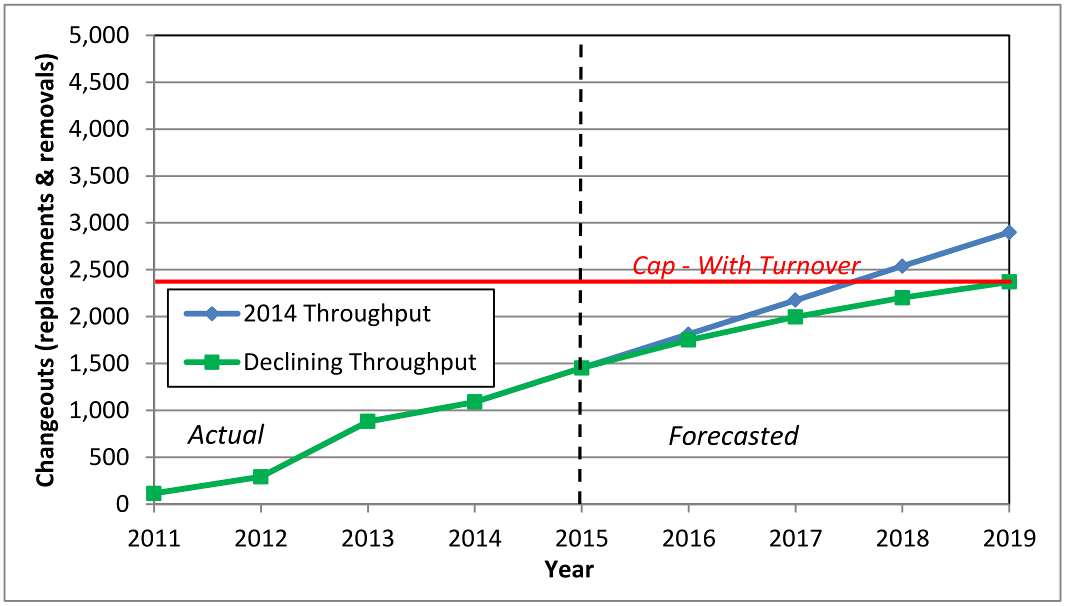

Figure 5.6-25. Cumulative Annual Change Outs, Actual Through 2014 and Forecasted, Uncertified Wood Stoves and Inserts

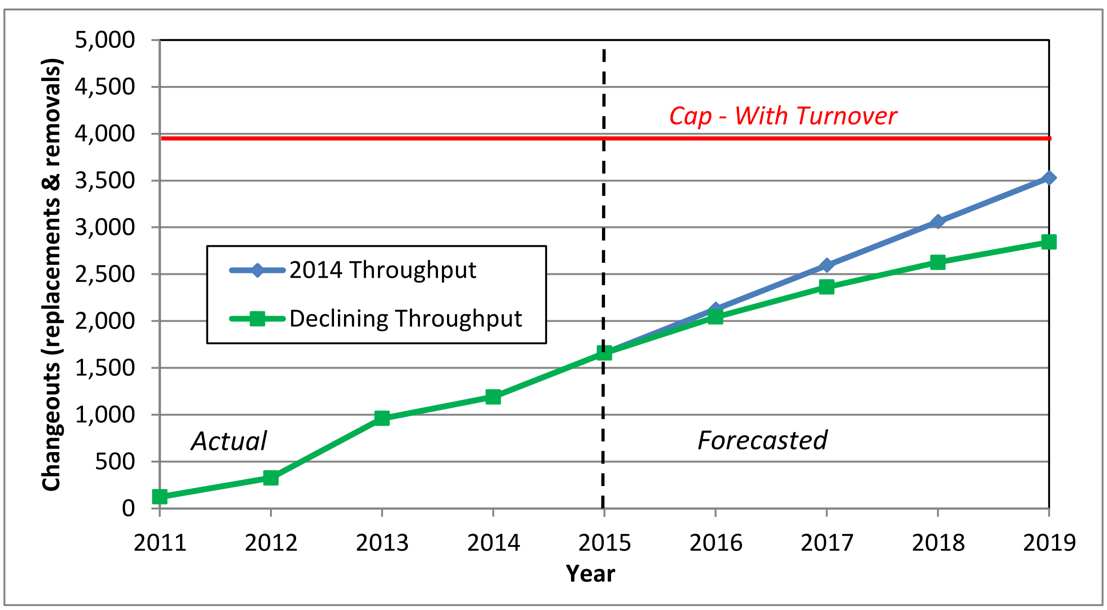

Figure 5.6-26. Cumulative Annual Change Outs, Actual Through 2014 and Forecasted, All Uncertified Devices

In addition to accounting for further benefits from continuation of the WSCO programs, the 2019 Potential Control inventory incorporated reductions from three other measures described below.

State Space Heating Device Standards in New Homes – This DEC-headed program would require that space heating devices installed in new residential homes in the Fairbanks non-attainment area be EPA-certified devices meeting a 2.5 gram/hour $PM_{2.5}$ certification standard.

Emission control benefits of such a program were developed using projections from the Borough's Community Research Quarterly publications.[28] Residential new homes were projected from 358 units in 2012 (actual) to 661 units in 2019 (start of calendar year) based on the long-term 2000-2012 trend published in the Quarterly. Emission reductions of $PM_{2.5}$ (no reductions were assumed for gaseous pollutants) were then estimated for 2.5 gram/hour devices relative to the typical mix of uncertified/certified heating devices projected in 2019 and accounting for the overlapping effects of natural turnover and the WSCO program.

$PM_{2.5}$ space heating emission reductions from the State Standards were estimated to provide an additional 1.6% in 2019 (over and above the ARA and WSCO programs).

State-Coordinated Wintertime Dry Wood Use Program – A second potential DEC-led program would consist of a coordinated program designed to promote and potentially incentivize greater use of "dry" wood (defined as wood with a moisture content [MC] that does not exceed 20% on a dry basis). The projected wood moisture content in 2019 in the absence of such as program is 36.4%, averaged across the two wood source groups: (1) Buy (those who purchase wood commercially) and (2) Cut Own (those who cut, stack, and store their own wood).

Because such a program has not yet been adopted and is currently being evaluated by DEC, a series of plausible assumptions based on existing survey data were used to develop estimates of potential emission reduction benefits. From the 2013 Wood Tag survey, 34.3% of wood-using survey respondents indicated a willingness to pay up to $50 more per cord for dry wood knowing that dry wood provides roughly 25% more heating energy than wet wood (as explained in the Tag survey question). As a result, it was assumed that a coordinated wintertime Dry Wood Use program would result in 34% more homeowners from both the Buy and Cut Own wood source groups burning dry (20% MC) wood. Under this assumption, the composite wood moisture content would drop to 30.8% and result in a heating energy reduction in wood use of roughly 4%.

This translates to an incremental $PM_{2.5}$ space heating emission reduction (on top of the preceding local and state measures) of 2.8% in 2019.

Expansion of Natural Gas Availability in Fairbanks – A portion of the non-attainment area includes a limited delivery infrastructure for residential and commercial natural gas use from the existing Fairbanks Natural Gas (FNG) private utility. Plans are being coordinated and funding made available through several state agencies, led by the Alaska Industrial Development and Export Authority (AIDEA), to provide a sufficiently expanded infrastructure and delivery via expansion of FNG's infrastructure within its service area and additional gas delivery from a new public entity, the Interior Gas Utility (IGU), across an expanded area roughly encompassing the remainder of the non-attainment area. AIDEA is stewarding this expanded service with a goal of

[28] http://co.fairbanks.ak.us/communityplanning/crc/

natural gas being priced at the retail, point of sale level of roughly half the existing cost of heating oil, or about $15-$17 per mcf (thousand cubic feet).

Estimates of emission reductions from natural gas expansion in 2019 (end of 2018) were developed based on forecasted residential and commercial penetration levels across the non-attainment area from a recent January 2014 AIDEA report prepared by Cardno-Entrix.[29] The Cardno report considered not just estimates of penetration (i.e. availability of gas at point of sale), but also addressed conversion/use for both the residential and commercial sectors and accounted for the costs of conversion for each sector. The combined residential household penetration and conversion to natural gas rate in 2019 estimated by Cardno was 36% at the end of 2018.

The Cardno report also included estimates of fuel use shifts (oil-to-gas, wood-to-gas) in converted households based on the targeted offering price for gas (about $2/gallon on a heating oil equivalent basis) and elasticity estimates that reflected a shift of roughly 77% of existing wood-burning homes to gas. This 77% estimate is very consistent with an 74% wood household shift to gas at $2/gallon oil equivalent developed from responses to a question in the 2013 Wood Tag survey. (These wood household shifts were based only on homes that had alternative heating sources beyond wood. In other words, they excluded homes solely heated using wood, which would be more difficult candidates for conversion to natural gas.)

These wood-to-gas household shifts were combined with an additional element from the 2013 Tag survey that found roughly 38% of wood users would still likely burn wood on extremely cold days (defined as days below -30°F) to produce estimates of discount shifts to gas use on those cold days.

Using these data sources and assumptions, incremental $PM_{2.5}$ emission reductions from natural gas expansion across the non-attainment area in 2019 were found to be 16.4% on cold (<-30°F) days and 18.4% on warmer (≥-30°F) days relative to the 2019 projected baseline. These incremental reductions are those above that from preceding state and local measures after accounting for overlapping effects.

Other Measures Considered But not Modeled – As noted earlier in Section III.D.5.6.4.1, Superior Pellet Fuels began to locally manufacture and market densified energy logs in 2014. In addition to these potential programs the State is also evaluating potential emission benefits from use of "energy logs" which are compressed, densified logs that have just begun being manufactured locally in Fairbanks (by Superior Pellet Fuels). Energy logs have roughly 20% more energy content (in BTU/lb) than the most commonly used Fairbanks cordwood species (Birch) and have an extremely low moisture content of 7% (on a dry basis).

Potential emission reductions from an Energy Log Use program were not included in the 2019 Control inventory due to the fact that production of the logs just began earlier in 2014 and the

[29] "IEP Natural Gas Conversion Analysis, Fairbanks LNG Distribution System Demand Analysis," prepared by Cardno Entrix for Alaska Industry Development and Export Authority, January 2014.

market or demand for the logs is still uncertain. The State and Borough plan to conduct further evaluation of the benefits of locally manufactured energy logs before designing a program to expand and provide incentives for their use.

2019 Potential Control Inventory Summaries – Using the combined set of existing (ARA, WSCO) and potential future (State New Home Device Standards, Dry Wood, Natural Gas Expansion) programs, Table 5.6-24 and Table 5.6-25 present tabulated sector and geographic area summaries of the 2019 Potential Control inventories based on actual and allowable point source emissions, respectively.

Again, these are levels of control reduction that could be achieved by 2019 based on projected expansion of natural gas availability, coupled with State programs requiring (1) wood devices in new homes to meet a 2.5 gram/hour $PM_{2.5}$ emission standard and (2) expanded use of dry wood through education and/or incentives and continuation of the Borough's WSCO program

Table 5.6-26 shows how the 2019 Potential Control emissions compared to those of the 2008 Baseline inventory, listing emission reductions relative to the 2008 Baseline for both the entire Grid 3 modeling domain and the smaller non-attainment area. As noted in the table title, the comparisons are made based on allowable, rather than actual, point source emissions.

Table 5.6-24
2019 Potential Control Episode Average Daily Emissions (tons/day) by Source Sector, Actual Point Source Emissions

	Grid 3 Domain Emissions (tons/day)					*NA Area Emissions (tons/day)*				
Source Sector	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**
Point (Allowable, PTE)	1.423	8.380	13.395	0.096	-	1.412	8.167	13.285	0.096	-
Area, Space Heating	1.952	5.677	2.695	5.957	0.184	1.606	5.193	2.456	4.788	0.171
Area, Space Heat, Wood	1.828	0.074	0.317	5.767	0.065	1.496	0.062	0.263	4.619	0.053
Area, Space Heat, Oil	0.062	5.525	1.810	0.097	0.003	0.055	5.062	1.629	0.086	0.003
Area, Space Heat, Other	0.063	0.078	0.568	0.093	0.116	0.055	0.069	0.564	0.083	0.115
Area, Other	0.071	0.000	0.003	0.773	0.000	0.068	0.000	0.002	0.634	0.000
On-Road	0.485	0.021	2.350	2.934	0.058	0.406	0.017	1.872	2.258	0.048
On-Road, Running Exh	0.318	0.018	1.514	0.313	0.058	0.275	0.015	1.246	0.255	0.048
On-Road, Start & Idle Exh	0.167	0.003	0.837	2.533	0.000	0.131	0.002	0.626	1.937	0.000
On-Road, Evap	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.172	0.172	2.278	7.712	0.006	0.024	0.090	1.094	0.405	0.003
TOTALS	**4.104**	**14.250**	**20.721**	**17.472**	**0.249**	**3.515**	**13.467**	**18.709**	**8.181**	**0.222**

n/a – Not available.

Table 5.6-25
2019 Potential Control Episode Average Daily Emissions (tons/day) by Source Sector, Allowable (PTE) Point Source Emissions

Source Sector	*Grid 3 Domain Emissions (tons/day)*					*NA Area Emissions (tons/day)*				
	$PM_{2.5}$	**SO_2**	**NOx**	**VOC**	**NH_3**	**$PM_{2.5}$**	**SO_2**	**NOx**	**VOC**	**NH_3**
Point (Allowable, PTE)	2.773	26.612	29.609	0.845	n/a	1.595	22.973	27.393	0.826	n/a
Area, Space Heating	1.952	5.677	2.695	5.957	0.184	1.606	5.193	2.456	4.788	0.171
Area, Space Heat, Wood	1.828	0.074	0.317	5.767	0.065	1.496	0.062	0.263	4.619	0.053
Area, Space Heat, Oil	0.062	5.525	1.810	0.097	0.003	0.055	5.062	1.629	0.086	0.003
Area, Space Heat, Other	0.063	0.078	0.568	0.093	0.116	0.055	0.069	0.564	0.083	0.115
Area, Other	0.071	0.000	0.003	0.773	0.000	0.068	0.000	0.002	0.634	0.000
On-Road	0.485	0.021	2.350	2.934	0.058	0.406	0.017	1.872	2.258	0.048
On-Road, Running Exh	0.318	0.018	1.514	0.313	0.058	0.275	0.015	1.246	0.255	0.048
On-Road, Start & Idle Exh	0.167	0.003	0.837	2.533	0.000	0.131	0.002	0.626	1.937	0.000
On-Road, Evap	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.066	0.000
Non-Road	0.172	0.172	2.278	7.712	0.006	0.024	0.090	1.094	0.405	0.003
TOTALS	**5.453**	**32.482**	**36.935**	**18.220**	**0.249**	**3.698**	**28.273**	**32.817**	**8.912**	**0.222**

n/a – Not available.

Table 5.6-26
2019 Control Modeling Emissions Relative to 2008 Baseline (Allowable Point Sources)

Geographic Area	% Change in Emissions (Relative to 2008 Baseline)				
	$PM_{2.5}$	**SO_2**	**NOx**	**VOC**	**NH_3**
Grid 3 Modeling Domain	**-21.9%**	**+4.4%**	**-7.4%**	**-45.8%**	**+2.6%**
$PM_{2.5}$ Non-Attainment Area	**-27.7%**	**+4.9%**	**-7.0%**	**-52.2%**	**+5.4%**

As seen in the highlighted column of Table 5.6-26, $PM_{2.5}$ reductions in 2019 of almost 28% relative to the 2008 baseline could be achieved within the non-attainment area.

Again, the reductions presented in Table 5.6-26 are reductions for all inventory sources. Thus, the emission benefits noted earlier in this sub-section at the end of the discussions of the ARA and WSCO programs potential 2019 control measures do not add up to the totals in Table 5.6-26 since those reductions were relative to space heating emissions, not all emissions.

5.6.5. 2017 Reasonable Further Progress (RFP) Inventory

Moderate Area RFP Planning Requirements – Section 172(c)(2) of the CAA requires that plans for non-attainment areas “shall require reasonable further progress” and include a “current inventory of actual emissions from all sources of relevant pollutants in such area … to assure that the requirements of this part are met.” The goal of RFP is to achieve generally linear progress toward attainment (as opposed to deferring implementation of some of all measures until the end or projected attainment date).

The pollutants addressed in the RFP inventory are limited to the two key pollutants for which control benefits were calculated: $PM_{2.5}$ (direct) and SO_2. (Quantified control inventory benefits were focused exclusively within the Space Heating, Area Source sector. Emission reductions for NOx and VOC are propotional to those for $PM_{2.5}$. Space heating emissions for these pollutants, however, represent a small share of total emissions.)

As noted earlier in Section 5.6.1, this Moderate Area SIP did not formally require an attainment projection once it was established that attainment by the 2015 deadline for moderate areas was impracticable. Nevertheless as explained there, a path toward attainment by 2019 was developed that incorporated additional measures and programs beyond those in effect in 2015. Thus this Moderate Area SIP included an attainment projection by 2019.

The SIP also includes an analysis that demonstrates adequate emission reductions will be achieved to comply the the goals of RFP beyond 2015.

The quantitative milestone requirements of CAA Section 189(c) dictate that the "milestone" year for this RFP progress assessement is 2017 (no later than three years from the Moderate Area SIP submittal date of December, 2014. Section 172(c)(2) indicates that the assessment be based on actual emissions. However for completeness (to be consistent with the fact that the 2015 and 2019 modeling inventory were examined both ways), the 2017 RFP inventories were also generated both ways, considering both actual episodic emission levels as well as allowable levels or PTE permit limits for point sources.

2017 RFP Inventory and Linear Progress Target – To evaluate RFP-mandated linear progress toward attainment beyond 2015, an analysis of emissions in 2017 associated with implementation of Reasonably Available Control Measures (RACM) and Reasonably Available Control Technologies (RACT) and additional reasonable measures for the area was performed to determine whether forecasted controls (and their benefits) in 2019 would be sufficient to ensure linear progress from 2015 to the projected 2019 attainment emission levels.

To address this requirement, 2015 and 2019 Control inventories were interpolated to 2017 to establish target emission levels representing a linear trajectory between the Moderate Area attainment deadline (2015) and the forecasted attainment year (2019). (Since 2017 is midway between 2015 and 2019, the linear progress target levels are simply the average of the 2015 and 2019 Control emission levels.)

Chapter 5.7 identifies and provides a detailed discussion of RACM measures for Fairbanks. (All RACT measures have already been implemented in Fairbanks.) Many of the RACM measures identified in Chapter 5.7 are either voluntary or have already been implemented prior to 2015. Thus, the remaining measures examined for the purpose of RFP are those non-voluntary measures slated for implementation or phase-in after 2015 and correspond to the list of measures for which quantitative emission benefits were calculated and incorporated into the Control inventories. These specific measures/programs are listed below:

- State Space Heating Device Standards in New Homes;
- State-Coordinated Wintertime Dry Wood Use Program; and
- Expansion of Natural Gas Availability in Fairbanks.

Since these measures were restricted to the Space Heating (Area) source sector, the RFP progress assessment was conducted by analysis of emissions at the source sector level (although areas sources were split into Space Heating and Other sub-sectors). The analysis was based on average daily episodic emissions over the non-attainment area.

Figure 5.6-27 presents the results of the analysis of projected control emissions in 2017 relative to linearly-interpolated targets for $PM_{2.5}$ based on actual emissions for point sources. The vertical bars include the 2015 and 2019 Control inventory emissions (labeled "2015" and "2019") are shown at each end of the figure. The middle bar, labeled "2017-Lnr" represents the linearly-interpolated RFP-targeted emission levels in 2017. Each bar includes elements that show the breakdown of sector-specific emissions (in tons/day). Above each of these bars, the values in bold italics represent total emissions summed across all sectors. The dashed line shows the linear progress trajectory (for total emissions) from 2015 to 2019 (and this intersects the top of the "2017-Lnr" bar.

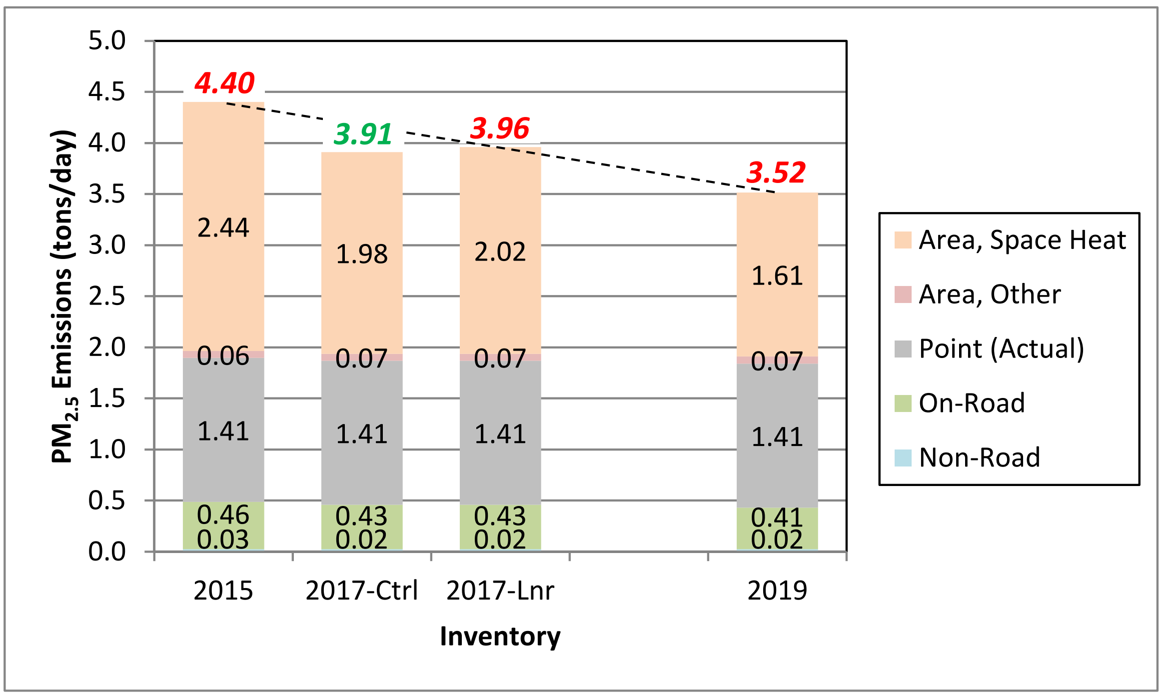

Figure 5.6-27. Comparison of 2017 $PM_{2.5}$ RFP Inventory to Linear Target in 2017, Actual Point Source Emissions

Next to this bar, a fourth bar labeled "2017-Ctrl" represents emissions by sector reflecting forecasted control measure benefits in 2017 based on expected implementation dates and/or phase-in schedules for each of the three measure listed earlier. (Since these measures are all restricted to the Space Heating sector, only the Space Heating segment is different between the 2017-Crtl and 2017-Lnr bars. As seen in comparing these two bars in Figure 5.6-27, combined control benefits from these measures are projected to result in total inventory emissions that are lower than the linear RFP target (3.91 vs. 3.96 tons/day). (The space heating emissions are 1.98 tons/day compared to the target for the sector of 2.02 tons/day.)

Figure 5.6-28 presents a similar comparison for SO_2, although the linear trend from 2015 to 2019 reflects increasing levels of SO_2. (Coupled with the direct $PM_{2.5}$ emission reductions attainment is projected in 2019 based on atmospheric/chemical modeling described in Chapter 5.8.)

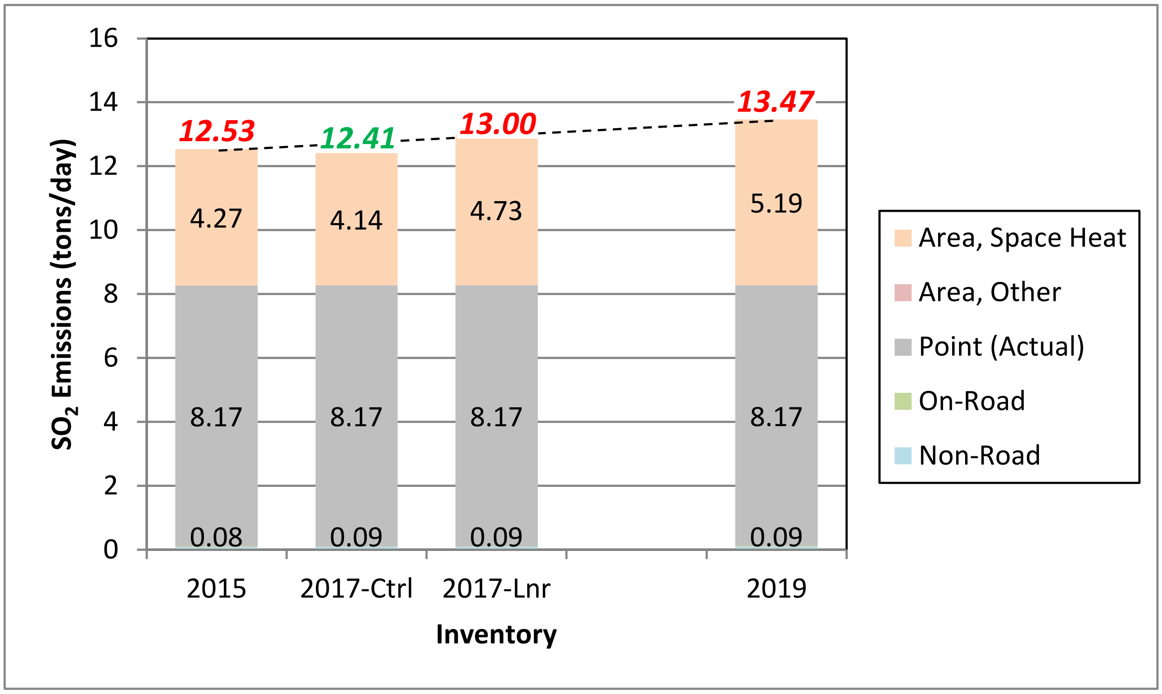

Figure 5.6-28. Comparison of 2017 SO_2 RFP Inventory to Linear Target in 2017, Actual Point Source Emissions

As seen in Figure 5.6-28, 2017-Ctrl emission levels for SO_2 are also below the linear RFP target (12.41 vs. 13.00 tons/day).

The reason the 2017-Ctrl emissions for both $PM_{2.5}$ and SO_2 are below their linear target levels is twofold:

1. The first two measures (State Device Standards in New Homes and Dry Wood Use) were assumed to be fully phased in by 2017 with the same level of participation assumed in 2019. Most of the benefits come from the Dry Wood Use program, and as explained earlier in Section 5.6.4.3, the participation rate of 34.3% was also applied in 2017.

2. The WSCO program continues to provide "better than linear" incremental benefits between 2015 and 2019. Even though the benefits are projected to decline each year relative to the prior year, the benefits accumulated from 2015 to 2017 exceed those projected from 2017 to 2019.

The combination of these two factors is more than enough to overcome benefits from Natural Gas Expansion that are projected to increase at faster rates from 2017 to 2019. (The penetration rates for expanded natural gas availability are projected to rise from 0% in 2015 to 14% by 2017 and 36% by 2019.)

Figure 5.6-29 and Figure 5.6-30 present similar comparisons of RFP progress in 2017 for $PM_{2.5}$ and SO_2, respectively based on allowable PTE levels for point sources. These comparisons directionally match those shown earlier in Figure 5.6-27 and Figure 5.6-28 that were based on actual emissions for the point source sector. In each case, forecasted emissions in 2017 due to projected implementation of control measures will be below the linear progress targets as seen in comparing the 2017-Ctrl and 2017-Lnr emission levels in each figure..

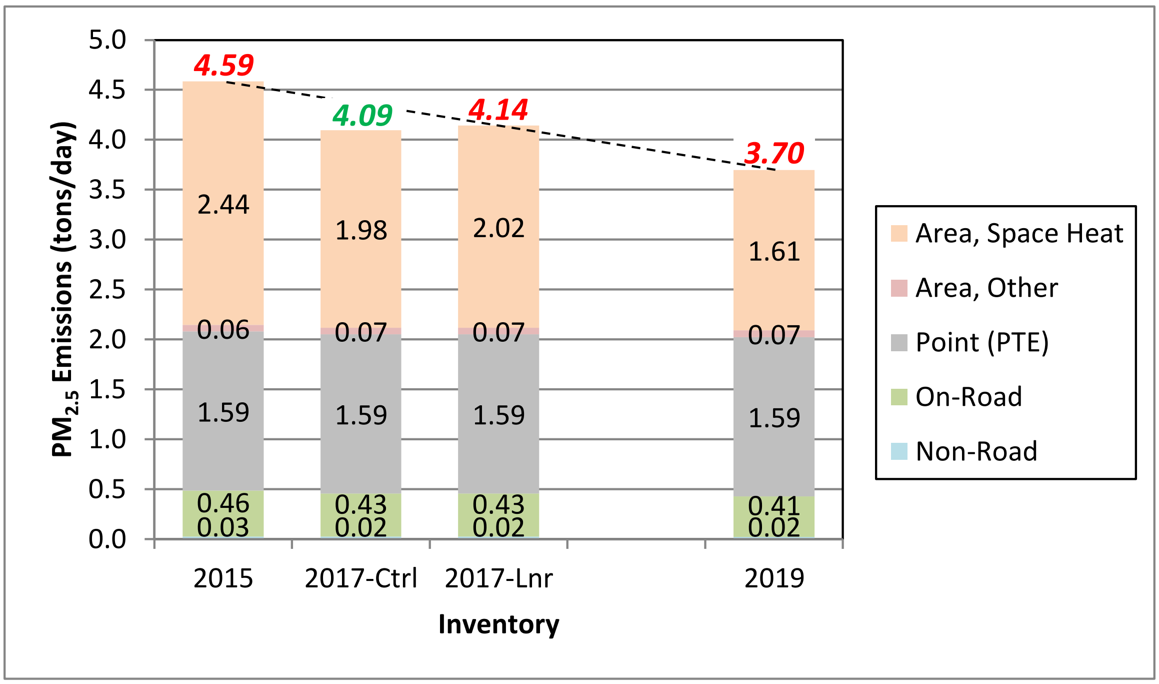

Figure 5.6-29. Comparison of 2017 $PM_{2.5}$ RFP Inventory to Linear Target in 2017, Allowable PTE Point Source Emissions

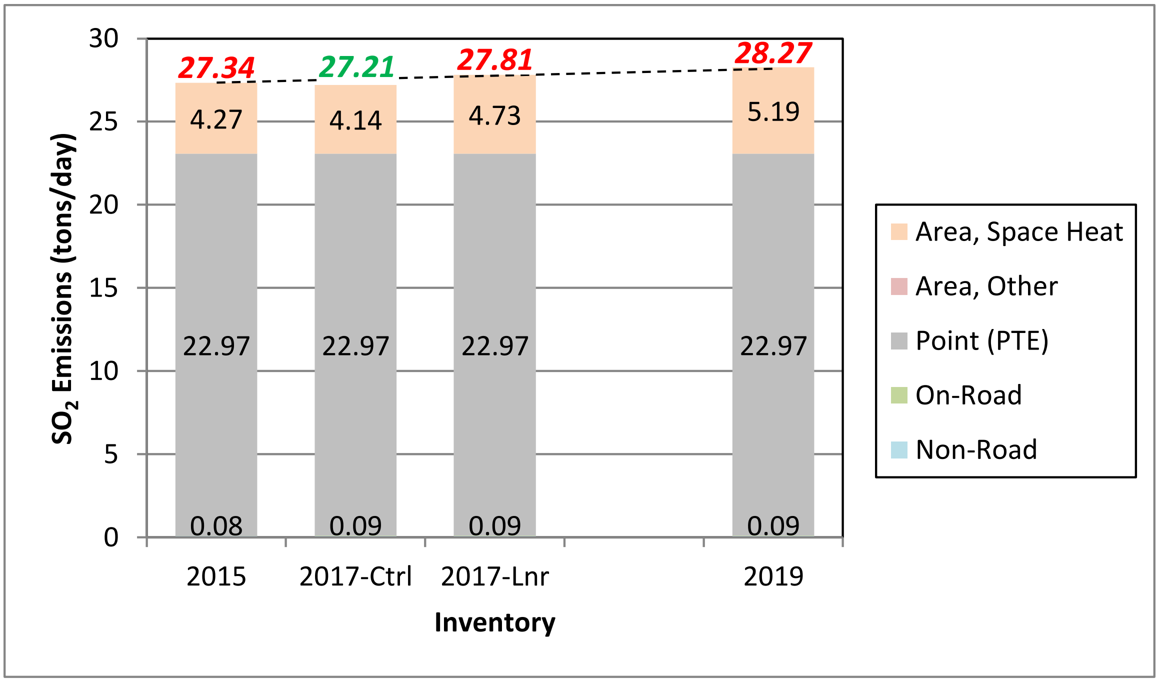

Figure 5.6-30. Comparison of 2017 SO_2 RFP Inventory to Linear Target in 2017, Allowable PTE Point Source Emissions

The above analysis demonstrates that the control measures leading to attainment in 2019 will yield better than linear progress in 2017.

5.6.6. 2017 Motor Vehicle Emissions Budget

Need for MVEBs – Generally, motor vehicle emission budgets (MVEBs) must be established within a SIP for use in subsequent regional transportation conformity analysis that is tied to the SIP's attainment demonstration and the on-road vehicle emissions share of the overall attainment inventory. However as discussed in Chapter 5.9, the central finding of this Moderate Area SIP is that attainment of the $PM_{2.5}$ NAAQS by the required 2015 deadline will be impracticable in Fairbanks due to the magnitude of required reductions and the difficulty and the cost of implementing measures that achieve these reductions in the near term (i.e., by 2015).

A control strategy implementation plan revision and MVEB is defined under 40 CFR §93.101 as follows:

> *Motor vehicle emissions budget is that portion of the total allowable emissions defined in the submitted or approved control strategy implementation plan revision or maintenance plan for a certain date for the purpose of meeting reasonable further progress milestones or demonstrating attainment or maintenance of the NAAQS, for any criteria pollutant or its precursors, allocated to highway and transit vehicle use and emissions.*

EPA's Office of Transportation and Air Quality (OTAQ) and Office of Air Quality Planning and Standards (OAQPS) through EPA Region 10 were consulted to assess the need for MVEBs within this SIP. EPA confirmed the need for MVEBs within this "impracticability" SIP, citing language in the 1992 General Preamble[30] for Title I implementation of the CAA. Under the Reasonable Further Progress (RFP)/Quantitative Milestone (QM) Requirements portion of the Particulate Matter, Statutory Background section [III.C(1)(f)], the Preamble contains the following language:

> *The PM-10 non-attainment area SIP's must include quantitative emissions reductions milestones which are to be achieved every 3 years and which demonstrate RFP, as defined in section 171(1) until the area is redesignated attainment [section 189(c)].*

and

> *There is a gap in the law that the text of section 189(c) does not articulate the starting point for counting the 3-year period. The EPA believes it is reasonable to begin counting the 3-year milestone deadline from the due date for applicable implementation plan revisions containing the control measures for the area. The EPA believes it is reasonable to key the milestone clock to the SIP revision containing control measures which will give rise to emission reductions.*

Although this Preamble was written prior to development and implementation of separate ambient standards for $PM_{2.5}$, EPA has confirmed that the language above for PM_{10} also applies to $PM_{2.5}$ SIPs. Thus, EPA guidance was that MVEBs must be developed under this SIP pursuant to the RFP/QM requirements of Section III.C(1)(f) of the Preamble.

MVEB Calendar Year and Pollutants – EPA has interpreted the three-year milestone deadline for Fairbanks as the 2014 due date for this Moderate Area SIP. Thus, MVEBs were established for calendar year 2017. Separate budgets of on-road motor vehicle emissions occurring within the non-attainment area were set for both directly-emitted $PM_{2.5}$ and NOx, the latter based on EPA's interpretation of applicable precursor requirements under 40 CFR §93.102(b)(1) and §93.102(b)(2)(iv).

Summary of MVEB Methodology – The MVEBs were calculated using the same approach applied in modeling motor vehicle emissions within the SIP emission inventories. However, the 2017 MVEBs were not an interpolation of 2015 and 2019 on-road emissions as developed for RFP progress analysis as described in Section 5.6.5. Instead the 2017 MVEBs were calculated based on a calendar year 2017 emission modeling run and differ nominally from the on-road emissions presented in that section. The MVEB modeling is summarized below.

- *Emissions Model* – Emissions were calculated using the MOVES2010a vehicle emissions model, executed in county-wide "Inventory" mode. The model was run to generate emissions over the six-month non-attainment season (October through March).

[30] Federal Register, Vol. 57, No. 74, April 16, 1992.

- *Activity Inputs* – Vehicle activity inputs (VMT by vehicle type, speed distributions, road type VMT distributions) for calendar year 2017 were developed by interpolating activity between the 2010 and 2035 calendar years for which regional travel demand model outputs supporting FMATS.

- 2012-2015 TIP modeling were available. The same locally developed seasonal, weekly, and diurnal travel activity profiles used in the SIP inventories were also used to generate the MVEBs. Default MOVES activity was assumed for heavy-duty trucks (with no explicitly input extended idling).

- *Fleet Characteristics Inputs* – 2017 vehicle populations were extrapolated from actual 2010 registrations using the same growth rate assumptions used to generate the 2015 and 2019 Projected Baseline inventories. Vehicle age distribution and Alternative Vehicle and Fuel Technology (AVFT) inputs were based on the calendar year 2010 registration data, with an exception for light-duty vehicle age distributions explained as follows. Age distribution inputs for light-duty vehicles were based on wintertime parking lot survey data collected by ADEC, rather than registration data. Multiple parking lot surveys have consistently found that older vehicles are operated less during winter due to drivability concerns. In developing winter non-attainment season inputs, motorcycles were assumed to not operate during harsh winter conditions. Thus their populations were zeroed out.

- *Meteorology Inputs* – Based on interagency consultation guidance from EPA and FWHA, single hourly ambient temperature and relative humidity profiles were developed from hourly temperatures (and humidity data) averaged across the 35 modeling episode days and used as the meteorology inputs to the MVEB modeling. The average ambient temperature across all hours of the 35 modeling episode days was -11.8°F. This was consistent with episodic modeling inventory development in the SIP although the average meteorology profile across the 35 episode days was used for the MVEB while individual day meteorology (for each of the 35 days) was used to establish the MVEB and was agreed upon in consultation with EPA and FHWA.

- *Plug-In Adjustments to $PM_{2.5}$ Emissions* – Finally, starting exhaust $PM_{2.5}$ emissions for light-duty gasoline vehicles were adjusted to account for the effects of wintertime vehicle plug-in block heater use in Fairbanks. These adjustments were applied using an EPA-accepted approach that consisted of modifying the MOVES soak time distribution inputs for light-duty vehicles contained in *OpModeDistribution* table in the model's default database. Appendix III.D.5.6 provides further details on these plug-in adjustments. Note that EPA's approval of the methodology for modeling the adjustments only extends to analyses conducted using MOVES2010; additional interagency consultation will be needed to identify a methodology for use with MOVES2014.

<u>Motor Vehicle Emission Budgets</u> – Using the modeling methodology outlined above, MOVES2010a was executed with locally developed inputs representative of wintertime calendar year 2017 conditions. Table 5.-27 summarizes the resulting regional average winter day on-road vehicle $PM_{2.5}$ and NOx emissions, which represent the applicable MVEBs under the SIP.

Table 5.-27
Fairbanks Non-Attainment Area Motor Vehicle Emission Budgets

Calendar Year	Motor Vehicle Emission Budgets (tons/day)	
	$PM_{2.5}$	NOx
2017 and later	**0.33**	**2.13**

The $PM_{2.5}$ MVEB shown in Table 5.6-27 includes the plug-in adjustment effects. (As noted earlier, the plug-in adjustments are applied only to starting exhaust emissions for light-duty gasoline vehicles. Plug-ins reduced vehicle fleet-wide $PM_{2.5}$ emissions by 5.4%.) The $PM_{2.5}$ MVEB assumed zero contribution from fugitive road dust, consistent with the SIP inventory assumption that road dust emissions do not occur during winter in Fairbanks when road surfaces are snow- and ice-covered. The emissions budget also does not include construction dust for the same reason.

5.6.7. Inventory Validation and Quality Assurance

5.6.7.1. Introduction

This sub-section describes the quality assurance (QA), quality control (QC), and data validation procedures that were applied in constructing the emission inventories for the Fairbanks $PM_{2.5}$ SIP. The QA and QC procedures used were based on guidance[31] developed by EPA under its Emission Inventory Improvement Program (EIIP), specifically under Volume VI (Quality Assurance Procedures).

Under the EPA guidance, QA and QC are defined as two separate components of an integrated approach in ensuring proper emission inventory (EI) development. QA is a pre-developed system of data handling, review, and audit procedures, generally conducted by personnel not actively involved in the detailed EI calculations. QA can include development of a formally documented Quality Assurance Plan (QAP). (Although a formal QAP was not developed to support the EI work under this SIP, an earlier QAP developed by DEC and used to compile and prepare emission estimates for three-year NEI submittals to EPA was utilized and supplemented with SIP-specific procedures described later in this sub-section.)

QC is typically a subset of an overall QA system and consists of activities that include technical reviews, accuracy checks, and use of approved standardized procedures for emission calculations. Thus, QA includes both establishing QC procedures and identifying personnel to conduct the QC as well as actual QA auditing and data checking.

[31] Emission Inventory Improvement Program (EIIP), EPA, Office of Air Quality Planning and Standards, Emission Factor and Inventory Group, Research Triangle Park, NC. Volumes I – X, http://www.epa.gov/ttn/chief/eiip/techreport/.

5.6.7.2. Responsible Personnel

Alice Edwards of the Alaska Department of Environmental Conservation (DEC) and Robert Dulla of Sierra Research, Inc. (Sierra)—both with emission inventory, regulatory policy, and control measure evaluation experience—served as co-Quality Assurance Coordinators. Ms. Edwards handled data prepared or obtained directly by the State, while Mr. Dulla was responsible for QA of Borough and all other externally developed or acquired data.

Frank Di Genova of Sierra, who along with Mr. Dulla, was not directly involved in actual inventory data development and EI calculations, performed independent internal review of the detailed EI calculations and source methodologies.

5.6.7.3. Data Collection and Analysis

Both to ensure the comprehensive assessment of sources within the emission inventory as well as to assure properly assembled source activity and emission factor data, EPA's aforementioned EIIP QA/QC documentation was used to guide EI data collection and analysis.

As discussed in Section III.D.5.6.1, the source categories were divided into stationary point source, stationary area source, non-road mobile, and on-road mobile. Stationary point source information is maintained by DEC down to 100 tons per year, so no surveys were needed to explicitly identify stationary area and point sources. Emissions from stationary point sources were calculated on the basis of 2008 production levels and the best available emission factors.

Area source emissions estimates were based on a variety of sources of activity and emission factors that maximized utilization of an extensive amount of locally collected activity data and testing measurements, especially within the space heating sector.

Within the mobile source sector, both on-road and non-road emissions were calculated using the latest (at the time) available emissions models: MOVES2010a for on-road vehicles, NONROAD2008a for non-road vehicles and equipment, and EDMS 5.1.3 for airfield emission sources. The SMOKE Version 2.7.5b inventory pre-processing model was used to grid, speciate, and format the EI estimates into photochemical model-ready structures.

Across all source sectors, special attention was given to strong seasonal activity and emission factor variations largely driven by the harsh Arctic climate but that differed by source category even within a source sector. Attention was also given on a source category basis to evaluation of default assumptions or activity/emission factor estimates based on "Lower-48" conditions that were clearly not applicable to wintertime Alaskan conditions.

5.6.7.4. Data Handling and Validation

Elements of the emission inventory data handling procedure are outlined below.

1. Assembly and review of various sources of external or "raw" data (including both electronic databases as well as individual data elements lifted from various publications and research materials)

2. Data tracking (coordination of different inventory elements as well as refinements of initial draft estimates with newer or updated data)

3. QA/QC and data validation, which consisted of data checking and correcting and proper substitution of corrected data.

Additional data review and validation procedures consisted of review focused on identifying gaps or double-counting of source emissions as well as separate tabulations of emissions by sector and category at several stages of the EI development, from raw and calculation spreadsheets to SMOKE processing model inputs and outputs.

Each of the data handling and validation elements is further discussed below.

Data Assembly and Review – Initial data assembly and review was performed for each piece of external data. This included structuring data for specific source types into a unified spreadsheet structure. (For example, facility-specific episodic data were supplied in a range of spreadsheet layouts and data units.) It included explicit assignments of SCC codes to data for each category or sector. It also consisted of a preliminary review of data validity using a combination of range/unit checks and independent corroboration (e.g., Tier 1 or EIS/SCC-level comparisons to NEI estimates).

Data Tracking – Data obtained externally from a variety of agencies, other outside entities, and literature review sources were gathered and organized into hierarchical folders based on source sector classifications. To account for the need for data collection, EI calculation, and then QA/QC review by multiple and disparate personnel, both "working" and "final" versions of this hierarchical structure were utilized. In addition, procedures were employed whereby earlier draft estimates and supporting data were periodically offloaded to separate folders marked as "Draft" to ensure there was no confusion as to the elemental supporting files of a finalized EI element as well as to preserve an evolutionary archive/revision history of the EI revisions throughout the inventory development process. Daily and weekly file backups were performed using Sierra's network backup system.

QA/QC and Data Validation – The principal QA/QC methods and data validation techniques employed in development of the Fairbanks $PM_{2.5}$ SIP inventories included the following:

- Reality, limit and unit checks;
- Peer review;
- Sample calculations;
- Sensitivity analysis; and
- Independent audits/validation of emission estimates.

Some of these elements are further explained below.

Peer Review – Peer review was a regular and integral part of the process utilized to assure the quality and validity of the inventories. For nearly the last three years of the SIP development, weekly and monthly conference calls were held by DEC with participation by their consultant Sierra, FNSB, and EPA Region 10 staff to discuss emergent data sources or study reports and discuss analytical approaches and calculation methods/assumptions. In addition to these weekly calls, intermediate EI data elements and calculation spreadsheets were also circulated between DEC, FNSB, Sierra and Region 10 to perform independent review and evaluation. The participants in these weekly and monthly exchanges are listed below.

- Alice Edwards, DEC
- Cindy Heil, DEC
- Deanna Huff, DEC
- Jim Conner, FNSB
- Ron Lovell, FNSB
- Todd Thompson, FNSB
- Rob Elleman, EPA Region 10
- Lucy Edmonson, EPA Region 10
- Jeff Houk, FWHA Resource Center (monthly)
- Kris Reisenberg, FHWA (monthly)
- Bob Dulla, Sierra Research
- Tom Carlson Sierra Research
- Mark Hixson, Sierra Research

In addition to these weekly and monthly calls, several coordinated in-person meetings were held either in Alaska or at EPA Region 10's Seattle office to provide detailed technical briefings on EI and other SIP elements. Finally, preliminary reviews of EI technical documentation were provided by Rob Elleman and Bob Kotchenruther of EPA Region 10.

Independent Audits and Emission Estimation Validation – Independent audits largely included review of spreadsheet calculations by a second or third person beyond the initial preparer of emission estimates for each individual source category. Emission estimation validation consisted of a series of corroboratory checks at both the source category and broader source sector level. At the source category (e.g., SCC) level, NEI estimates were used to initially validate the EI estimates. Although this often proved problematic because the NEI estimates were county-wide annual averages and were often initially found to be in significant disagreement with the episodic estimates, especially those entirely developed using locally collected activity data or test measurements, it forced the data validation to back track through the calculations (including accounting for strong seasonal variations) to affirm the findings. Validation procedures applied at the broader source sector/type level included corroboration of source contributions to total inventory emissions with independent source apportionment techniques that included Positive Matrix Factorization (PMF) and Chemical Mass Balance (CMB) analyses performed to support the SIP.

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5.7 Control Strategies

CAA section 172(c)(1) describes the general attainment plan requirement for reasonably available control measures (RACM). Attainment plan submissions must "provide for the implementation of all reasonably available control measures as expeditiously as practicable (including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of reasonably available control technology) and shall provide for attainment" of the NAAQS.

CAA Part D, Subpart 4 has also been determined to apply to $PM_{2.5}$ attainment plans.[1] Section 189 (a)(1)(C) requires that RACM measures in designated Moderate nonattainment areas be implemented no later than 4 years after designation.

5.7.1 Reasonably Available Control Technology (RACT)

Large stationary sources are a subgroup of emissions sources that are given special attention in the RACM analysis. These units are subject to site-specific review for Reasonably Available Control Technology. The U.S. EPA has defined RACT as "the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility." [2]

Per EPA guidance, DEC evaluated all emission units with emissions greater than 5 tons per year (TPY) of $PM_{2.5}$ (see Appendix III.D.5.7 for RACT details) or its precursors (NOx and SO_2). All $PM_{2.5}$ precursors were addressed (NOx, SO_2, NH3, VOCs), but only NOx and SO_2 were addressed on an emission unit basis. Based upon that analysis, FNSB has concluded that the current level of controls meets RACT for all of the pollutants from all of the emission units.

See the section on RACT for more details

5.7.2 Reasonably Available Control Measures (RACM) for other sources

Identification of RACM is a 5-step process:

- Step 1: Identify source categories with non-trivial emissions of $PM_{2.5}$ or its precursors.
- Step 2: For each source category, source, or activity from Step 1, develop a list of technologically feasible emission control technologies and/or measures.
- Step 3: For each technologically feasible control measure, evaluate emission reductions and costs. Identify and exclude economically infeasible measures.
- Step 4: Determine whether control measure can be implemented within 4 years of designation.
- Step 5: Identify Reasonably Available Control Measures.

1 *Natural Resources Defense Council(NRDC) v. EPA,* No. 08-1250 (D.C. Cir., Jan. 4, 2013)
2 44 FR 53762 (September 17, 1979)

The following source categories were evaluated for RACM. This list is based on emissions inventory information and other technical analyses that identify the most important sources for PM2.5 in the nonattainment area.

- Wood burning
  - Outdoor wood-burning boilers (hydronic heater)
  - Wood stoves
  - Fireplaces
  - Burn barrels, residential open burning
  - Agricultural and forest burns
- Residential fuel oil combustion
- Transportation
  - Automobiles
  - Heavy-duty vehicles

DEC, in consultation with the FNSB, has determined that the following control measures are RACM. Details of the analysis supporting these determinations are provided in Appendix III.D.5.7.

- Education and outreach programs for wood combustion.
- Voluntary curtailment of wood burning on episode days.
- Require new wood combustion units to be EPA-certified.
- Provide subsidies to encourage retirement/replacement of old, noncertified wood-burning equipment.
- Open-burning bans on episode days.
- Prohibit the use of burn barrels.
- Subsidize heating upgrades and weatherization

Many of these measures are already implemented. Details of current and planned programs are provided below.

The FNSB $PM_{2.5}$ nonattainment area relies on several primary control strategies coupled with additional voluntary measures to mitigate $PM_{2.5}$ air pollution.

During the period 2008-2013, a number of programs were implemented to encourage changes in behavior that produce emission reductions. The FNSB and DEC continue to operate these programs and plan to do so in the future. Since these programs are voluntary and it is difficult to quantify their impact on behavior, the attainment demonstration and weight of evidence discuss the likely impacts of voluntary measures on attainment. The total credit taken for all voluntary measures is 0.5 $\mu g/m^3$.

5.7.2.1 Space Heating and Solid Fuel Heating Controls

The use of solid fuels, wood and coal, for home heating is an important source of $PM_{2.5}$ air pollution in the nonattainment area. Winter heating costs are high and many residents rely on solid fuel burning as an economic way to heat their homes, often as a supplement to heating with more expensive fuel oil. In order to reduce $PM_{2.5}$ emissions from solid fuel heating devices, the FNSB and DEC have developed a number of measures that work together to lower emissions from this important source in a manner that accounts for an on-going need to use wood and coal as an economical heating source either as their sole source of heat or, more typically, as a supplement to fuel oil or electric heat. These measures will:

- upgrade solid fuel heating devices in the community with new, cleaner burning units,
- encourage best burning practices for solid fuel heating devices through the use of appropriate fuels, maintenance, and operation,
- encourage switching to fuel oil, electricity, propane, or natural gas fuels for space heating on days with poor air quality, and
- address heaters with excessive smoke through a combination of public education, compliance assistance, and regulatory enforcement.

At the same time, the local and state government are working to encourage energy efficiency and weatherization to reduce heating needs. In the long term, efforts are underway to bring economical natural gas to the community to help reduce resident's energy costs and allow for a cleaner burning fuel for space heating. The following subsections describe space heating control programs, with an emphasis on the solid-fuel heating programs, that are being implemented or that are planned for implementation in the 2008-2019 time period.

5.7.2.2 Solid-fuel Fired Heating Devices Upgrades and Emission Standards

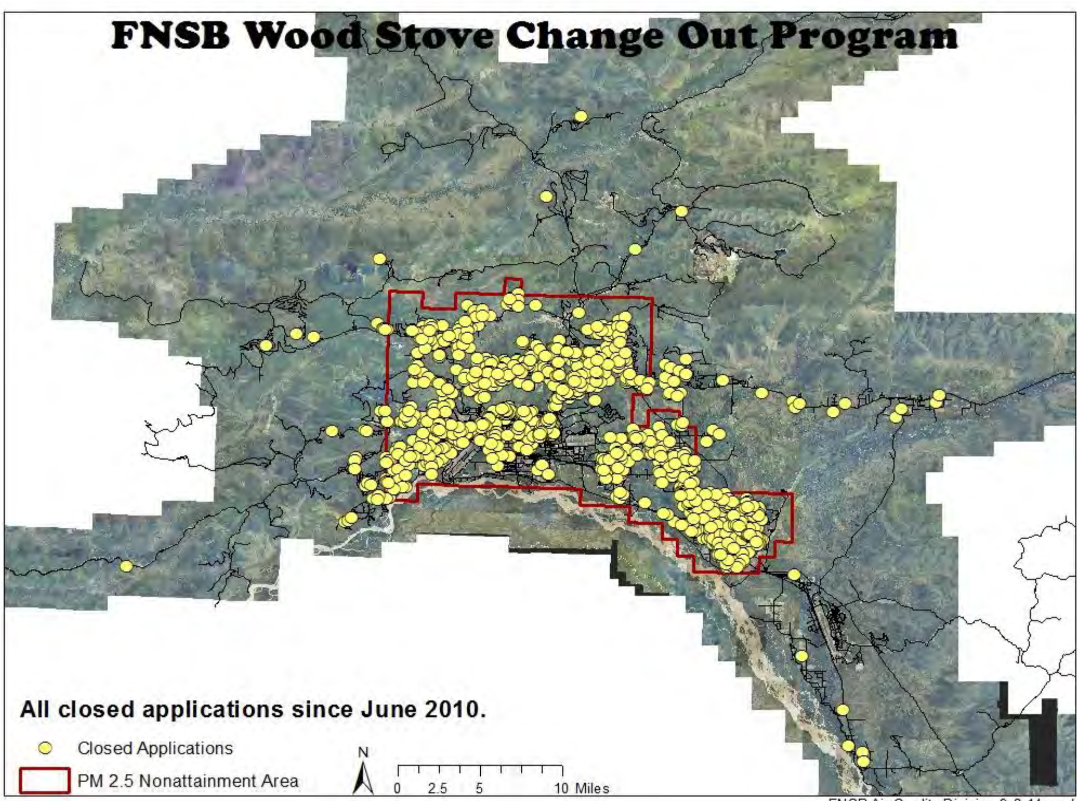
Starting in June of 2010, the FNSB established an incentive program to encourage homeowners to replace their old, uncertified solid-fuel heaters with new EPA certified heaters. Upgrade or removal of solid-fuel heaters provides for immediate and long term emission reductions in $PM_{2.5}$. As heating fuel costs increased during the past 5 years, a large number of outdoor wood and coal boilers were installed by residents seeking to reduce their heating costs. These large units have proven problematic in some neighborhoods creating significant localized smoke impacts. The volume of solid fuel heaters, whether large or small, have combined to increase $PM_{2.5}$ levels significantly and the Borough has identified a number of "hot spot" neighborhoods. In its implementation of the change out program, the Borough has sought to prioritize their funds for upgrading units into areas with high $PM_{2.5}$ concentrations.

The change-out program has been popular with local residents and has evolved between 2010 and 2014 as the FNSB adapted and improved the program to create additional incentives for participation. From inception through August 2014, the Borough has repaired, replaced, or removed significant numbers of solid-fuel heaters. Table 5.7-1 provides the numbers of heaters changed out in various categories. Figure 5.7-1 provides a map of the locations of change outs or heater removals throughout the nonattainment area. Between 2008 and 2019, the Borough plans to incentivize the replacement of nearly all the uncertified wood heating devices in the nonattainment area. An estimated 4,640 heater replacements or removals will be completed by 2019 (2,760 from the Borough's program and 1,880 from natural turnover).

Table 5.7-1

Woodstove Change Out Statistics		(as of 9/9/14)
Device Type	**Total Devices Removed, Replaced, or Repaired**	**Percentage of Total Change Outs**
Replace Solid Fuel Burning Device (SFBD)	1130	74.7%
Replace Outdoor Hydronic Heater (HH)	37	2.4%
Removal of SFBD (not replaced)	195	12.6%
Removal of Outdoor Hydronic Heater (not replaced)	72	4.8%
Remove of Indoor Hydronic Heater (not replaced)	16	1.1%
Repairs to EPA certified devices	48	3.2%
Fireplace Replacements	17	1.5%

Figure 5.7-1



In addition to the Borough's change out program, the Alaska Legislature also funded the Alaska Resource Agency (ARA) to conduct a project that resulted in the retrofit of outdoor hydronic heaters (OHHs) within the nonattainment area. ARA identified and retrofitted 40 outdoor hydronic heaters with ClearStak or similar pollution control devices. The retrofits were performed in late 2011 and 2012 resulting in emission improvements for these heating units which are further described in the Emission Inventory, Section III.D.5.6.

In order to provide support for the Borough's change out program, in <INSERT DATE> the state adopted a new regulation that requires that all new wood-fired heating devices being installed within the nonattainment area meet emission standards more stringent than the 1988 EPA New Source Performance Standards. A copy of the regulation, 18 AAC 50.077, is included in Appendix III.D.5.7. Under the regulation, new wood-fired heating devices in the nonattainment area meet the following emission standards:

Table 5.7-2

Device Type	$PM_{2.5}$ Emission Standard
Woodstoves*	2.5 grams/hour
Wood Hydronic Heaters	2.5 grams/hour
Wood Heating Appliances Greater than 350,000 BTU/hr heat output	2.5 grams/hour

*Woodstoves covered by this emission standard are defined in the same manner as wood heaters defined and certified by EPA under 40 CFR Part 60.531

The emission standards are set at a level of 2.5 gram/hour for wood stoves, wood-fired outdoor hydronic heaters, and larger wood-fired heaters (greater than 350,000BTU heat output). The state regulatory program relies on EPA and ASTM test methods. Testing of wood stoves and outdoor wood hydronic heaters is already being conducted by manufacturers to determine compliance with EPA certification and voluntary approval programs and can be relied upon to demonstrate compliance with the state regulation assuming the unit being tested is found to meet the 2.5 g/hr limit. ADEC's analysis of these emission standards showed that wood-fired heaters of various sizes meeting these standards are available in the marketplace at a variety of price points.

By setting an emission standard, ADEC's regulations help ensure that the Borough's on-going change out program will replace wood-fired heaters with units that are cleaner burning. The regulations also help to ensure that replacements of wood-fired heaters occurring outside of the change out program are also moving toward the cleanest burning heaters available in the marketplace. The 2014 ADEC regulations do not mandate any change out of existing wood-fired heating devices and allow existing heaters to continue to be used in area homes. The Borough's state-funded change out program, described previously, will continue to be used to incentivize a higher than normal rate of wood heater replacements within the area. ADEC will work with retailers of wood heating devices in the implementation of the emission standards to ensure compliance for units being sold for installation in the nonattainment.

Efforts at the federal level also play a role in providing emission reductions from wood-fired heating devices, through programs that reduce emissions at the point of manufacture. The EPA has an existing certification program for new woodstoves and a voluntary program for outdoor hydronic heaters. The rules governing emissions from new woodstoves (New Source Performance Standards or NSPS) were established in 1988 and have not been significantly revised since that time. Wood heating technology has advanced significantly during the intervening period and a variety of wood heating devices exist that are not covered by the NSPS. On January 3, 2014, EPA proposed revisions to the NSPS for wood heating devices. If enacted as proposed, the revised NSPS would ensure that all wood-fired heating devices are part of the EPA certification program. PM emissions limits would be put in place for woodstoves, pellet stoves, wood-fired hydronic heaters, forced-air wood furnaces, masonry wood heaters, and single burn rate wood stoves. The revised NSPS proposal included two tiers of emission reductions with the first step taking place 60 days after the final rule is published and the second step occurring five years later. The proposed NSPS emission limits for wood-fired heating devices are summarized in Table 5.7-3.

Table 5.7-3
Summary Overview of Proposed EPA NSPS for Wood-Fired Heaters [3]

Wood Heating Device	Step 1 Emission Limit	Step 2 Emission Limit
Existing EPA-Certified Room Heaters	4.1 g/hr catalytic 7.5 g/hr non-catalytic	
Room Heaters – Newly certified	4.5 g/hr	1.3 g/hr
Hydronic Heaters	0.32 lb/MMBtu heat output & cap of 7.5 g/hr for any individual test run	0.06 lb/MMBtu heat output for each burn rate
Forced Air Furnaces	0.93 lb/MMBtu heat output & cap of 7.5 g/hr for any individual test run	0.06 lb/MMBtu heat output for each run
Masonry Heaters	0.32 lb/MMBtu heat output (for 15 heaters or more)	0.32 lb/MMBtu heat output (for fewer than 15 heaters)

The finalization of EPA's wood heater NSPS is anticipated in 2015. While DEC may implement more stringent requirements for wood stoves and hydronic heaters through state regulation in the short term, it appears that the federal NSPS will be more stringent for some types of wood heating devices and emission limits overall will become more stringent in the proposed second step of the NSPS. If more stringent NSPS requirements are implemented, there will be additional long term benefits to the nonattainment area through the routine turnover and installation of cleaner burning heating devices as older wood-fired heaters are replaced by homeowners.

[3] 79 FR 6329, pages 6329-6416, published February 3, 2014.

5.7.2.3 Improving Solid-Fuel Heating Device Operations

In order to achieve the greatest $PM_{2.5}$ emission reductions, it is critical that solid-fuel fired heating devices be operated correctly by local residents. The Borough and ADEC have developed a set of complementary measures to help improve the operation of these heating devices within the nonattainment area. These measures include extensive public education, incentives for the use of wood pellets or energy logs, and regulations addressing visible emissions from stacks and the use of appropriate fuels in solid-fuel heating devices.

Public outreach is an important component of the Fairbanks air quality program with respect to improving resident's use of solid-fuel heating devices thereby reducing $PM_{2.5}$ emissions. Public outreach efforts focus on measures residents can take to protect themselves and to reduce $PM_{2.5}$ emissions from activities like wood and coal burning. The Borough and ADEC have developed and implemented an extensive outreach effort to encourage residents to employ "best burning" practices when using wood heating devices. In 2011 the Borough started the "Split,Stack,Store, & Save" campain which encourages residents to plan ahead by cutting and properly storing a winter seasons worth of wood a full year before they plan to use it. In 2014 the Borough instituted the Volunatry Burn Cessation Program which alerts residents to current or inpending Air Quality advisories and asks them to volunarily cease burning wood during the episode. And just recently the Borough started giving away wood moisture meters and "Burn Wise"® CD's to each applicant to the Woodstove Exchange Program. Air Quality staff adminster a quiz based on the content of the CD and go over any incorrect answers to ensure the applicant understands the correct way to operate their new EPA certified device and the benefits to operating it in the correct manner. This outreach will continue and be improved upon based on experience in the coming years.

In addition to public outreach, it is critically important that individuals use the appropriate fuels in their wood-fired heating device. To promote cleaner burning devices and practices, the Borough is providing incentives through the change out program for wood pellets and energy logs. When used appropriately in wood-fired heating devices, these manufactured dry wood products signficantly reduced emissions. In 2014, the Borough supplied vouchers for 210 tons of energy logs and pellets to indivuals who participated in the woodstove exchange program. Each participant currently receives one ton of product when they have met all requirements of the program.

To further support the efforts to reduce emissions through the proper operation of solid-fuel heating devices, the ADEC is implementing programs and regulations to address this issue. These programs primarily promote the use of correct fuels, especially related to dry wood.

In 2014, ADEC established a voluntary program (Moisture Disclosure Program) to register wood sellers that sell dry wood or that agree to provide wood moisture content information to consumers at the time they purchase wood. This voluntary program is meant to encourage a dry wood market and provide additional information to residents that buy wood for use in the nonattainment area. By registering and publishing information on vendors that sell dry wood or that verify moisture content, consumers are made aware of whether the wood they purchase needs to be seasoned or whether it is ready for burning immediately. Burning dry wood is important for correct operation of both newer and older wood-fired heating devices. Not only is the burning of dry wood more efficient it signficantly reduces $PM_{2.5}$ emissions.

In <INSERT DATE> the state adopted a new regulation that requires that individuals operating a solid fuel burning device inside the nonattainment area use the appropriate fuel (wood or coal) in their device and a requirement that dry wood be burned in the winter months. A copy of the regulation, 18 AAC 50.076 is included in Appendix III.D.5.7. This regulation is meant to ensure that residents do not burn inappropriate materials, such as trash, in their solid fuel heating devices. The regulation also requires that only dry wood products, 20% moisture content or less, be burned in wood-fired heating devices during the winter period inside the nonattainment area. Recognizing the potential difficulty for residents to season or buy dry wood, a provision is included that would allow for a mix of wet wood and compressed wood “energy” logs provided smoke coming out of the stack meets specific visible emission (opacity) limits.

To further assure that wood heating devices are being operated properly, the ADEC adopted regulations in 18 AAC 50.075 (see Appendix III.D.5.7) that set standards for visible emissions or opacity of smoke from stacks. These regulations were expanded in 2014 to include all solid-fuel fired heating devices during periods of air quality advisories. The revisions reflect improvements in wood heating technology and the need to burn cleanly particularly during air quality episodes. Newer wood-fired heating devices emit much less smoke than those manufactured decades ago. When operating properly, new wood stoves have little to no visible smoke emissions. If devices are operated improperly or with wet wood, dense smoke can be emitted from stacks. In addition, regulatory revisions were made to address community concerns that visible emissions for coal-fired heaters also be addressed. Although not a major contributor to local $PM_{2.5}$ emissions at this time, the use of coal for heating residential homes and businesses has seen an increase and resulted in localized nuisance complaints related to smoke from these heating devices. The opacity regulations for solid fuel-fired heating devices assist the ADEC in responding to citizen complaints about smoky stacks in their neighborhoods and in addressing high emitting devices, particularly during periods of poor air quality.

ADEC is responsible for enforcing compliance with the state regulations. The department’s compliance activities are conducted using the tools and authorities provided under the state statutes. The Division of Air Quality does not have statutory authority to issue administrative penalties for violations of Alaska environmental law.This means that ADEC staff cannot simply write “tickets” to individuals that are found to be violating state regulations. All compliance and enforcement activities are case specific, however, ADEC generally initiates compliance activities in response to complaints received that indicate the potential for violations of a state regulation. ADEC staff investigate complaints to verify or corroborate a problem or violation of a state requirement. In most cases, the department finds that compliance can be achieved through assistance to businesses and individuals in understanding the regulatory requirements and how they can comply. In the event that compliance assistance is not successful in resolving a compliance issue, department staff use administrative enforcement tools such as written notices of violation, compliance agreements, nuisance abatement orders, and in rare cases, civil court actions.

5.7.2.4 Encouraging Reduced Use of Solid-Fuel Heaters During Air Pollution Episodes

The FNSB and ADEC Air Programs work together to forecast daily air quality during the winter and asks citizens to curtail their use of wood fired heating devices on days projected to have poor dispersion and higher $PM_{2.5}$ concentrations. Public outreach is an important component of this strategy. Public outreach efforts focus on informing the public of air quality alerts, explaining why they were called, and giving residents options in the case of an alert. Advisories are called during winter months when forecasts indicate that the 24-hour average $PM_{2.5}$ standard is likely to be exceeded. During an episode, the Borough will notify local media that conditions exist that can cause a violation of the ambient $PM_{2.5}$ standard. As part of the advisory, the public is informed of voluntary measures they can take to protect themselves and to reduce $PM_{2.5}$ emissions from activities like wood and coal burning.

Surveys have shown that less than 4% of residences (1,280) located within the nonattainment area rely on wood as their only source of heat. However the high cost of heating oil and extreme cold temperatures force many residents to rely heavily on solid fuels to supplement their base fuel oil heating to prevent freezing homes. This makes mandatory wood heating curtailment unreasonable to implement during extreme cold temperatures. However, surveys have revealed a willingness on the part of some residents to shift away from solid fuel use during periods of poor air quality. It is therefore projected that a voluntary episodic wood and coal burning curtailment program could have benefit in reducing air pollution during poor air quality episodes. Greater numbers of residents are more likely to shift from wood or coal to another heating fuel when temperatures are warmer (e.g. warmer than -10 degrees F) as they may be less reliant on supplemental heat during these warmer episodes. During 2014, the Borough increased its efforts in this area by instituting a voluntary burn cessation program (VBCP).

The FNSB has established a program to encourage, incentivize, and facilitate the voluntary cessation of the use of wood burning appliances (i.e., wood stoves, wood-fired hydronic heaters, wood-fired furnaces, fireplaces, fireplace inserts, masonry heaters or pellet fuel burning appliances) in the nonattainment area during air quality alerts. It is recognized that it will be difficult or impossible for some households to participate in this program (e.g., those that heat solely with wood or for which wood is a necessary supplement during periods of cold weather). Therefore, this program is intended for households that are able to use space heating alternatives with significantly lower $PM_{2.5}$ emissions, including those fueled by gas, oil, electricity, propane or district heat.

The VBCP consists of 5 separate components; an Alert System, Social Media, Public Awareness, Marketing, and Incentive program.

- **Alert System:** Alert media selected as the notification platform. Alert messages during episodes are sent out through email, text messaging and social media.
- **Social Media:** Alerts, daily forecast, and program signup are available via Facebook.
- **Public Awareness:** 4 updateable reader-boards and 10 static sandwich board signs placed alongside roads in Fairbanks and North Pole displaying VBCP activity.

- **Marketing:** Radio, TV, and Newspaper advertising to create awareness of the VBCP and current air quality.
- **Incentives:** The Borough will recognize all participants of the program at the end of the year through a Fairbanks Daily Newsminer advertisement.

In addition to the Borough's voluntary programs, starting in 2015, the ADEC will implement regulations that provide for increasingly more stringent visible emission (opacity) requirements for solid-fuel fired smoke stacks on days exceeding the ambient air quality standard 18 AAC 50.075(d). The public health concerns associated with poor air quality episodes, require a response that mitigates impacts from air pollution sources in a manner that balances the health benefits from reducing the use of wood heaters with the potential negative health and safety impacts from a lack of supplemental or primary wood heat during extreme cold periods. Given the community concerns about the reasonableness of requiring residents to cease use of solid fuel-fired heating devices during periods of extreme cold, the state regulations would focus on ensuring that heating units can only be used during periods of poor air quality if they are operated in a clean and efficient manner. When operated properly, solid-fuel fired heating devices emit little or no smoke. Efficient operation not only reduces air pollution but allows for the burning of less wood, an economic or time savings to residents who buy or cut wood.

ADEC will use the following approaches to notify the public of requirements and address any compliance issues. The public will be notified of an air quality episode that has specific opacity level requirements utilizing several outreach methods. All episode announcements are emailed to ADEC's up-to-date distribution list. This distribution list contains all local media outlets (radio, TV), the FNSB Air Quality Program Staff, elected officials, and anyone who signs up for electronic notices. ADEC has online sign-up capabilities for various electronic notices and alerts through its *Air Online Services* accessible through the Division of Air Quality's home page at: http://dec.alaska.gov/air. In addition to these electronic emailed announcements, all advisories (alert and episode) are posted to the Division's Air Quality Advisories web page at: http://dec.alaska.gov/Applications/Air/airtoolsweb/Advisories/, which includes the actual advisory, the start and end dates, the area, and status (expired, active) of the advisory. ADEC will also post advisories on its Burn Wise Alaska face book page as well as the department's Twitter account.

In addition to providing notification when the opacity requirements are in effect, the department plans to provide on-going public information on the opacity requirements and ways that residents can comply. Difficulty meeting opacity could be due to wet wood. Residents will be encouraged to find dry wood or purchase manufactured wood logs (e.g. energy logs) to mix with their wet wood to assist in bringing down emissions. Residents will be directed to those wood sellers participating in the voluntary *Moisture Disclosure Program* where wood sellers either disclose the moisture content of purchased wood or agree to provide dry wood. Brochures on proper maintenance and operation of a solid-fuel fired device will also be available. To the extent that ADEC resources allow, staff can assist residents who request help in determining in advance of episode conditions whether their typical burning operations meet the opacity levels outlined in this plan.

If a resident is found to be out of compliance with the visible emission levels identified for a specific episode, ADEC is responsible for taking actions to enforce the requirement. The department's compliance activities are conducted using the tools and authorities provided under the state statutes. The Division of Air Quality does not have statutory authority to issues administrative penalties for violations of Alaska environmental law. This means that ADEC staff cannot simply write "tickets" to individuals that are found to be violating the opacity levels. All compliance and enforcement activities are case specific, however, ADEC generally initiates compliance activities in response to complaints received that indicate the potential for violations of a state regulation. ADEC staff investigate complaints to verify or corroborate a problem or violation of a state requirement.

In most cases, the department finds that compliance can be achieved through assistance to businesses and individuals in understanding the regulatory requirements and how they can comply. In the case of problem burners failing to meet these opacity levels during air quality episodes, it is important to bring a unit into compliance quickly to reduce smoke and assist in bringing levels of $PM_{2.5}$ into compliance in the local area. As a result, if a resident working with or without the assistance of ADEC staff is unable to bring a unit into compliance within a reasonable period, AQ staff would request that the resident stop burning for the duration of the air quality episode unless it is the sole source of heat for the structure. In the event that compliance assistance is not successful in resolving a recurring smoke concern at a specific residence or business, the department staff may use additional administrative enforcement tools, such as nuisance abatement orders, to address the concern.

5.7.2.5 AHFC Energy Programs

The Alaska Housing Finance Corporation (AHFC) implements several energy programs that are designed to make homes more energy efficient. As homeowners make energy efficiency improvements they reduce the amount of fuel and electricity needed for power and heat leading to corresponding air quality benefits due to the reduced fuels being burned for space heating and power generation. Information on AHFC energy programs is available on the internet at: www.ahfc.us/efficiency/energy-programs/

Under the AHFC Home Energy Rebate Program, home owners may receive up to $10,000 for making energy-efficient improvements to their existing home based on before and after energy ratings made by Energy Raters. Homeowners must get an initial energy rating and apply for the program. Eighteen months is provided to complete improvements with a second energy rating after the improvements are done. Homeowners are reimbursed (up to a specified amount) for the energy ratings and receive a rebate based on their home's improved energy-efficiency and eligible receipts. Only those improvements recommended by the rater are eligible for the rebate.

There is also a Home Rebate program that provides a $10,000 rebate for 6 Star homes and $7,000 for 5 Star Plus homes (the highest AHFC energy rating categories). In addition, AHFC offers interest rate reductions when individuals finance new or existing energy efficient homes or when borrowers purchase and make energy improvements to an existing home. Any property that can be energy rated and is otherwise eligible for AHFC financing may qualify for the energy efficiency interest rate reduction program.

Individuals who meet income limits are eligible to apply for the AHFC Weatherization Assistance Program. Local weatherization providers provide program services at no cost to qualified homeowners and renters including single and multifamily homes, mobile homes, apartments, and condominiums. The Weatherization Assistance Program provides low and moderate income households with improvements to their homes which increase the energy efficiency of their dwelling, including measures such as:

- Airsealing attics, crawlspaces, etc.
- Insulating and weatherstripping
- Repair and replacement of heating systems
- Replacement of doors and windows
- Installation of fans, smoke alarms, CO detectors

5.7.2.6 *Expanded Availability and Use of Natural Gas*

Key to reducing fine particulate matter air pollution in the long term is expanding the availability of affordable, cleaner burning fuel options within the nonattainment area. The Interior Energy Project provides the financial tools needed to bring natural gas to the Fairbanks and North Pole area. The project was established through Senate Bill 23 which passed the Alaska Legislature unanimously in April 2013. The legislation authorizes the Alaska Industrial Development and Export Authority (AIDEA) to provide the financing package to partner with the private sector to build a liquefied natural gas (LNG) plant on the North Slope and natural gas heating distribution system in Fairbanks and North Pole. The current projections indicate that the earliest this project will provide additional natural gas into the community is 2016. As a result of this timing, the project will not provide certainty of meaningful emission reductions in the short term prior to the 2015 moderate area attainment date but it will provide significant emission benefits between 2015 and 2019. Further discussion of this program is included in the contingency measure section of this plan (Section III.D.5.10).

5.7.2.7 Transportation Control Strategies

5.7.2.7.1 *Expanded Availability of Plug-Ins*

Engine preheaters are used extensively throughout Fairbanks when ambient temperatures drop below 0° F to ensure that vehicles exposed to these temperatures can be easily started. Local testing programs have confirmed that preheating vehicles, a practice commonly referred to as "plugging-in," provides a substantial reduction in motor vehicle cold start emissions. Recognizing the many benefits of plugging-in (e.g., reduced emissions, lower need for maintenance, fuel economy, startability, etc.), the Borough has a long-standing practice of expanding the number of parking spaces equipped with electrical outlets. This has been achieved by securing funds for retrofitting existing facilities (e.g., school renovations) and including outlets in new public facilities (e.g., the construction of new schools). It has also been achieved by encouraging the private sector to retrofit existing facilities (e.g., hospital expansions) and including outlets in new private facilities (e.g., Home Depot). This strategy was made more viable with Congress' passage of the Transportation Equity Act for the 21st Century that removed the restriction on the use of Congestion, Mitigation and Air Quality (CMAQ) funds for the Section 108(f) transportation control measure (xii) that reduces motor vehicle emissions under extreme cold start conditions.

In support of their previous carbon monoxide attainment plan, the Borough conducted a survey of employee parking lots,[i] public and private, located within the nonattainment area that were thought to have more than 100 parking spaces. The results of that survey are presented in Table 5.7-4. It shows that slightly more than 90% of employee parking lot spaces were equipped with electrical outlets in 2001. Employee parking spaces tend to have vehicles parked for longer durations resulting in greater cold start motor vehicle emissions than visiting vehicles which are often parked for short durations.

While many of the Borough parking lots have been upgraded with plug-in infrastructure in the past, the Borough has secured CMAQ funds from the Federal Highway Administration (FHWA) to continue the program of retrofitting public parking lots located in the nonattainment area with electrical outlets. As shown in Table 5.7-5, several projects have been completed, or are scheduled for completion, between 2008 and 2015:

Table 5.7-4
Summary of Employee Parking Spaces Equipped with Plug-Ins in the Fairbanks CO Nonattainment Area

	Spaces	Plug-Ins	% Equipped
Government Summary			
FNSB	2,345*	2,170	93
Federal	1,948	1,928	99
State	971	937	96
City	485**	446	92**
Subtotal	5,749	5,481	95
Schools Not in CO Nonattainment Area (are within $PM_{2.5}$)			
Badger Road Elementary	63	63	100
Pearl Creek Elementary	62	42	68
Ticasuk Brow Elementary	48	48	100
Weller Elementary	40	40	100
Subtotal	213	193	91
CO Nonattainment Area Government Total	5,536	5,288	96
Private Summary			
Lots with >250 plug-ins	2,438	2,318	95
Lots with <250 plug-ins	1,753	1,427	81
Subtotal	4,191	3,745	89

Nonattainment Area Government and Private Total	9,727	9,033	93

* Includes initial retrofit of employer parking of Lathrop High School.
** The City Manager could not provide an estimate of the total spaces. Therefore, an estimate was prepared by assuming that the City fraction equipped was the same as the Borough employee fraction (i.e., 92%).

Table 5.7-5
Fairbanks Nonattainment Area
Additional Parking Lots Equipped with New Plug-Ins
2008-2015

Facility	New Plug-Ins	Comments
West Valley High School	268	Project completed in 2013
North Pole High School	274	Project completed in 2013
Carlson Center	600	Project Timeframe 2015-2019
Big Dipper Ice Arena	300	Project Timeframe 2015-2019
North Pole Library	25	Project Timeframe 2015-2019
Fairbanks Library	50	Project Timeframe 2015-2019
Total	1517	

In addition to the Borough's emphasis on the installation of electrical infrastructure in parking lots, the Assembly passed an ordinance[ii] on April 12, 2001, that requires employers or businesses that have 275 or more parking spaces to provide power to electrical outlets at temperatures of 20 degrees F or lower. This ordinance is included in Appendix III.D.5.7 Key provisions addressed in the ordinance include:

- Parking lot owners are required to supply electricity to outlets between November 1 of each year and March 31 of the subsequent year.
- Power to parking lots may be cycled on and off every other hour during days when temperatures fall below 21º F.
- Employers or businesses subject to the ordinance are required to keep a logbook that documents the days on which power is supplied to electrical outlets. The logbooks are required to note special circumstances that prevented the supply of electricity to outlets. The logbooks need to be maintained and available for inspection for a five-year period.
- Employers and businesses subject to the ordinance must provide outlets for any new parking spaces intended for use by a motorist for longer than two hours.
- Employers or businesses subject to the ordinance must maintain electrical outlets in operable condition and they cannot decrease the number of parking spaces with outlets without prior approval of the Borough.

- The Borough can institute a civil action and obtain penalties not to exceed one thousand dollars for each violation.

To ensure the effectiveness of the ordinance, the Borough developed policies and procedures to govern its implementation, key elements include:

- Maintaining a list of parking lots with plug-ins that are subject to the program.
- Conducting surveys at least twice each winter on days when temperatures are below 20º F to determine whether outlets have power.
- Conducting surveys at least twice each winter to determine the number of vehicles that are plugged in at each of the parking lots subject to the ordinance.
- Maintaining records of the surveys and making that information along with data on the number of parking spaces equipped with plug-ins available to the public.
- Using the results of the surveys to determine the level of plug-in usage and related emissions benefits on an annual basis and making that information available to the public.

Since plug-ins are used extensively in the Borough when temperatures fall below 0º F, the principal benefit of the ordinance is to ensure that power is available at temperatures betweeen 0 and +20º F. The Borough has conducted surveys in the past to determine if outlets have power each winter since the ordinance was implemented. The results, which are available at the Borough Air Quality Management Program Offices, show that employers have a high level of compliance with the ordinance.

Public education is an important part of this control strategy. The Borough encourages residents to plug in their vehicles at temperatures up to 20º above zero. Engine block heaters are considered an essential component of winter driving in Fairbanks. It is estimated that a significant number of vehicles will not start at temperatures of 20º below zero. Since –20º or colder temperatures are a frequent occurrence in winter, it was assumed that by encouraging motor vehicle operators to plug in at warmer temperatures, carbon monoxide and $PM_{2.5}$ emissions would be reduced without creating an onerous burden on residents, as they already have engine block heaters. Subsequent test programs conducted by ADEC and the Borough confirmed the emission benefits of plugging-in at warmer temperatures. Television spots were produced to inform the public of the multiple benefits of plugging in at warmer temperatures. Although not scientific in nature, the messages were that plugging in:

1. Reduces engine wear, thus reducing vehicle maintenance costs;
2. Keeps the air pure and improves air quality;
3. Improves chances of complying with the federal Clean Air Act; and
4. Improves vehicle starting and reduces the idling time needed before driving.

Based on its historical success in implementing the plug-in program, the Borough continues public awareness as part of it implementation of an ordinance that requires owners of parking lots to provide power to electrical outlets for plug-ins at temperatures below 20ºF.

5.7.2.7.2 Mass Transit System

The Borough Transportation Department operates a transit program called the Metropolitan Area Commuter System (MACS). The Borough began operating the MACS fixed route transit service in 1977. The MACS system is comprised of nine fixed routes in the cities of Fairbanks and North Pole, as well as other nearby communities. MACS service operates Monday through Friday from 6:00 AM to 9:45 PM and limited routes on Saturday from 8:45 AM to 7:45 PM. There is no Sunday service.

The Borough also operates a door-to-door paratransit service, VanTran, which began in 1988. The American Disabilities Act of 1990 (ADA) requires all public transit systems that provide fixed route bus and rail service to also provide an alternative transportation service (usually vans and small buses) for people with disabilities who cannot use fixed route bus and train service. This service is usually called “paratransit.” The Van Tran service operates up to five nine-passenger vans and gives priority to ADA-certified disabled passengers within a ¾-mile zone around all MACS fixed routes, although will travel beyond the ¾-mile buffer on occasion. The vanpool system was updated in 2014 with a new approach to make it a successful operation.

Transit program ridership levels are presented in Table 5.7-6:

Table 5.7-6
Annual MACS Transit Ridership
2008 – 2013

Year	MACS Number of Riders
2008	294,142
2009	357,964
2010	383,773
2011	391,799
2012	428,166
2013	475,875

The MACS Transit system has seen increased ridership over the last 6 years, and is projected to continue this trend through 2014, which is expected to exceed 500,000. The ridership information above shows the increase in ridership over that time period. In addition, the MACS Transit system has expanded in the last few years to include improved frequency on high ridership routes, and a new route serving Fort Wainwright. Other notable improvements include better bus stop facilities (bus stop signs and shelters) and a bus tracking system for the public. The FNSB intends to build more shelters with additional funding as it becomes available. The Borough also conducts active public outreach and education to encourage the use of mass transit.

5.7.2.7.3 DOT Anti-Idling and Diesel Emission Reductions

Within the transportation sector, heavy duty diesel activities are a source of $PM_{2.5}$ in the FNSB. Emissions from vehicles are directly related to the amount of fuel used and the rate at which it is used. By reducing the need to have the vehicle engine on, emission reductions are achieved. This is directly related to reduction in fuel use resulting from how often the vehicle is left shut off versus left idling. In cold climates, it is often necessary to leave diesel vehicles idling to avoid performance issues. Anti-idling (idle reduction) technologies provide a means to reduce air pollution from transportation sources.

In July 2011, the Alaska Department of Transportation & Public Facilities began focusing on anti-idling and its potential benefits statewide. DOT&PF's State Equipment Fleet (SEF) and Maintenance & Operations (M&O) staff came together to formulate a long term plan for fleet management and to address on-going budget challenges. Implementation of an anti-idle policy was one of the top picks for optimizing resources and reducing costs. In November 2011, an M&O Directive was put in place to reduce idling to 10 minutes and heavy duty engines were set to turn off automatically at 10 minutes. The focus of the DOT&PF program was on large dump trucks and tractors where idle time was averaging over 30%. During a fleet optimization study, anti-idle was noted to be a way to save thousands of dollars (potentially millions of dollars) on fuel and preventative maintenance and DOT&PF began moving forward with a more visible anti-idling campaign within the department. According to the DOT&PF, reducing idling saves money, conserves fuel, reduces engine wear and maintenance, extends the life of heavy equipment, and helps to preserve the environment. DOT&PF is working to get the message out to every single DOT&PF employee that drives a state provided vehicle through a broad, consistent, and informative internal messaging campaign.

Building off of the DOT&PF's efforts to reduce idling, the ADEC and DOT&PF have developed a Fairbanks specific CMAQ-funded pilot program intended to reduce heavy duty diesel emissions in the nonattainment area through anti-idling, maintenance, and other emission reduction opportunities. The focus of the program is to expand the use of auxiliary heaters to reduce idle time thereby reducing emissions and providing an associated cost saving due to less use of diesel fuel. The program has the following elements:

1. Provide support for the existing DOT&PF anti-idling pilot project currently underway in Fairbanks by assisting with telemetric purchase and installation, installation of additional heaters, and assisting with education and training. With assistance from this program, the DOT&PF pilot program will be fully functional and will be able to provide additional information to assist in expanding anti-idling to others.
2. Expand anti-idling to other heavy duty vehicles within the FNSB nonattainment area; state fleets, local government fleets, private fleets, and commercial fleets. This includes working with the heavy duty fleet owners by providing education materials and training, contracting for installations of auxiliary heaters, and providing incentives for participation including purchasing of heaters and auxiliary equipment.
3. During installation of program auxiliary heaters, conduct an inspection of the vehicle to identify where additional emission reduction possibilities could be implemented – such as maintenance (filter, tune-up), if vehicle is a candidate for retrofit technologies or

repower, and/or candidate for additional emission reduction equipment (particulate matter traps). Partnership and incentive opportunities with vehicle fleet owners will be explored to further emission reduction benefits while a vehicle is in shop.

This pilot program is intended to develop into an on-going program with respect to new installation of heaters and emission reduction equipment on diesel equipment within the nonattainment area. Overall operations and maintenance of the new equipment will be the responsibility of fleet owners. Original startup costs for new fleets (new installation of heaters, initial maintenance, or initial retrofits, additional emission reduction technologies) coming into the program are intended to be covered entirely or in part through the use of CMAQ funds. Once initiated, future installations within a fleet would be limited to actual heater installations and/or telemetrics only.

Project funds would be provided for first time installations only, not for replacement of worn out heaters. The cost of a single auxiliary heater installation is approximately $3500. Conservative estimates indicate auxiliary heaters may save 30% in fuel costs alone along with a 30% reduction in emissions. The cost of the fuel alone, would easily pay for any future replacement of the auxiliary heater and software. The life of the auxiliary heaters is more than ten years, so continued anti-idling use will provide benefits (emission reductions and fuel savings) for the life of the equipment.

5.7.2.7.4 ADEC Diesel Emission Reduction Efforts

ADEC has utilized American Recovery and Reinvestment Act of 2009 (ARRA) and Diesel Emission Reduction Act of 2005 (DERA) funding to reduce emissions in the non-attainment area through several projects.

A 2009 ARRA funded project allowed DOT to replace three 1985 Autocar KM64 trucks with three 2010 International 7600SFA Workstar 8cy dump trucks equipped with snow plows and belly blades. The new vehicles meet the 2010 clean diesel requirements and are equipped with EGR and DPF technology resulting in lowered diesel emissions. The three trucks began service in August of 2010 and the three older engines were rendered inoperable. The 2009 ARRA Locomotive Overhauls with Emissions Upgrades project purchased and installed emissions upgrade kits and automatic engine start-stop technology on two engines operated by the Alaska Railroad Corporation. The upgraded engines meet the Tier 0+ emissions requirements. These engines operate throughout the Alaska Railroad Corporation (ARRC) track system including within the nonattainment area.

In 2013, DEC partnered with DOT using DERA grant funding to retrofit 23 diesel vehicles with anti-idling technology (as described above). The direct-fired heaters allow operators to maintain warm cabin conditions in cold conditions without idling the main engines. Reduction in idle time was estimated to be 4,020 hours per year with a savings of 3,015 to 4,820 gallons of diesel fuel assuming an estimated 0.75-1.2 gallons of fuel consumed per hour of idling. The DERA program was extended through 2016 in 2010 and if funding continues, future projects may also implement clean diesel technology in the nonattainment area.

5.7.2.7.5 Federal Diesel Emission Reduction Programs

The federal government has multiple regulations and initiatives that will help address emissions in the non-attainment area. EPA's National Clean Diesel Campaign works with manufacturers, fleet operators, air quality professionals, environmental and community organizations, and state and local officials to reduce diesel emissions. The National Clean Diesel Campaign offers Diesel Emission Reduction Act funding opportunities through the competitive National Clean Diesel Funding Assistance Program to fund retrofit projects using Smartway verified diesel emission reduction technologies and the non-competitive State Clean Diesel Grant Program that funds grant and loan projects for clean diesel projects. Smartway is a public-private initiative between EPA, large and small trucking companies, rail carriers, logistics companies, commercial manufacturers, retailers, and other federal and state agencies. Its purpose is to improve fuel efficiency and the environmental performance (reduction of both greenhouse gas emissions and air pollution) of the goods movement supply chains. Smartway evaluates emissions control technologies and determines the eligibility of individual technologies for funding under DERA grants. Federal emissions standards for exhaust and evaporative emissions exist for Light-Duty Vehicles, Trucks, and Motorcycles, Heavy-Duty Engines and Vehicles, and Non-road Engines and Vehicles. These emissions standards on manufacturers have incrementally reduced the amount of emissions permitted from each type of regulated engine, resulting in cleaner diesel engines. Phase 3 emissions standards will take effect starting in 2017.

5.7.2.7.6 Federal Motor Vehicle Control Program

The Federal Motor Vehicle Control Program (FMVCP) is the federal certification program that requires all new cars sold in 49 states to meet certain emission standards. (California is excluded because it has its own state-mandated certification program.) These standards vary according to vehicle age, with the newer vehicles required to be considerably cleaner than older models. The result of more stringent emission standards over time from newly manufactured vehicles results in a drop in overall emissions from the vehicle fleet in Fairbanks, as older, dirtier vehicles are replaced with newer, cleaner vehicles. Carbon monoxide cold temperature (down to +20° F) emission standards phased in between 1994 and 1996 for passenger cars and light duty trucks significantly enhanced control system performance for all pollutants at the temperatures associated with cold climate exceedances.

Tier 2 emission standards for passenger cars, light trucks and larger passenger vehicles are focused on reducing emissions most responsible for ozone and particulate matter (i.e., nitrogen oxide or NOx and hydrocarbon or HC emissions). Mandated reductions in the sulfur content of gasoline further enhanced the performance of motor vehicle emission control systems. Starting in 2017, Tier 3 will further reduce both tailpipe and evaporative emissions from passenger cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty vehicles. Additional reductions in gasoline sulfur will make emission control systems more effective for both existing and new vehicles, and enable more stringent vehicle emissions standards. EPA's MOVES model has been used to assess the benefits of the FMCVP and Tier 2 emission standards. Insufficient time has been available to use the recently released MOVES2014 to incorporate the benefits of Tier 3 controls on the motor vehicle emissions in the SIP. Subsequent inventory analysis will be based on MOVES2014 and subsequent available releases of the model.

5.7.2.8 Open Burning

5.7.2.8.1 Winter Season Open Burning Ban

Since the 1970s the Fairbanks North Star Borough had an ordinance to restrict wintertime open burning. In 2013, the Borough Assembly repealed that ordinance in response to a voter initiative that restricted the Borough's authorities to regulate burning. As a result, to ensure that smoke emissions from open burning did not increase in the future, ADEC revised its regulations. ADEC implements open burning regulations found in 18 AAC 50.065. Within the existing regulations (18 AAC 50.065(e)), ADEC can and does prohibit open burning in an area during an air quality advisory (see 18 AAC 50.245).

To further strengthen this requirement inside the nonattainment area by reducing confusion on whether open burning is permitted on a given day and ensuring greater compliance and less smoke emissions in the airshed, ADEC revised 18 AAC 50.065(f) to prohibit open burning during the winter season between November 1 and March 31**.** A copy of the state open burning regulation, 18 AAC 50.065 is included in Appendix III.D.5.7.

In response to public comments on the 2014 regulation revision, the ADEC considered a longer season for open burning restrictions. In analyzing the data available, ADEC found that in the months of October and April conditions have not shown a prevalence for significant air quality deterioration as a result of normal open burning. As a result, ADEC did not lengthen the seasonal restriction on open burning to include those two months. Problem open burns during these “shoulder seasons” can typically be addressed through the use of the department’s other open burning and air pollution regulations. Concerns raised by the public related to the potential for the proposed regulations to prohibit small winter fires for recreational warming and ceremonial purposes were addressed through revisions to the definition of open burning that would exclude these small fires from the prohibition. The department also provided the flexibility for a local air program to institute an open burn permit program in lieu of the seasonal restriction, if approved by the department. It should be noted, that this flexibility does not grant the local air program any authorities not provided to it by its citizens. In recent years, the Borough has not had the authority to establish a program in lieu of the department’s seasonal restriction.

5.7.2.9 ADEC Stationary Source Program

The CAA section 172 (c) requirements for nonattainment areas apply to the $PM_{2.5}$ nonattainment area. Under this attainment plan, the requirements of CAA Part D, New Source Review (NSR) apply for major stationary sources. Section 302 of the CAA (42 U.S. C. 7602) defines a major stationary source as any stationary facility or source of air pollutants that directly emits, or has the potential to emit, 100 tons per year of any pollutant. Permits for construction and operation of new or modified major stationary sources within the nonattainment area must be approved through the NSR program. Within the FNSB, ADEC is responsible for issuing construction and Title V operating permits. ADEC has incorporated the requirements for Prevention of Significant Deterioation (PSD) and nonattainment New Source Review in 18 AAC 50, Article 3.

ADEC actively implements its permit programs. The Air Quality Division issues and amends permits, conducts inspections, reviews reports from industry, provides compliance assistance, and takes enforcement actions when needed.

Each stationary source in the nonattainment area was the subject of a Reasonably Achievable Control Technology (RACT) analysis. The results of that analysis are found in Appendix III.D.5.7. The emission units for which RACT determinations were made include boilers, process heaters, and turbines. The direct $PM_{2.5}$ RACT is a fabric filter system for boilers. Additional $PM_{2.5}$ controls are considered unreasonable for process heaters and turbines. RACT for SO_2 emissions is the use of current fuel for all of the fuel combustion sources. RACT controls were not recommended for NOx because control of NOx is not an efficient or cost effective method for reducing ambient $PM_{2.5}$ in Fairbanks.

All of the emission units that were reviewed are already implementing the emission control techniques identified as RACT. All of the coal-fired units are already equipped with fabric filters, and Alaskan coal has a very low sulfur content. The costs associated with switching from high- to low-sulfur liquid fuels were too high to be deemed to be source specific RACT for those sources currently using liquid fuels.

Stationary source emissions in the nonattainment area have been modeled in the attainment demonstration at "potential to emit" levels from their existing air quality permits. Additionally, historical actual emissions were modeled to determine impacts during the baseline period and were projected to 2015 to provide a potential lower bound on stationary source impacts. This is discussed further in the Modeling and Weight of Evidence Section (III.D.5.8).

5.7.2.10 Calculating the Benefits of Control Measures

Calculation of emission benefits for key control measures are summarized within Section III.D.5.6 and are discussed in detail in Appendix III.D.5.6. Generally speaking, emission benefits were calculated for those measures for which up-to-date, quantitative program activity data were available. Programs/measures for which data were not readily available were excluded from the quantitative emission benefits calculations but were collectively accounted for with credits given to voluntary measures. (Section III.D.5.8 discussed how voluntary measures and their allowed credits were accounted for in the attainment modeling in accordance with EPA guidance.)

Table 5.7-7 summarizes how each of the control measures discussed earlier in this section were accounted for within the SIP. Check marks in the "Voluntary Measure" column identify those measures for which benefits were not individually quantified, but for which collective voluntary program credits were assigned in the attainment modeling. The "Quantified Benefits" column identified those remaining measures for which emission benefits were individually quantified in the emissions inventory. The latter two columns identify the location in inventory where the measure benefits were applied. "Baseline" refers to measures whose benefits were accounted for within the Baseline or Projected Baseline inventory. "Control" indicates those measures for which benefits were applied in the Control inventories, reflecting emission reductions from measures being adopted or expected to occur. (Within the inventory discussion in Section

III.D.5.6, only benefits for the measures under the Control column were explicitly reported. Benefits for those measures accounted for in the Baseline and Projected Baseline inventories, though quantified, were not individually reported in Section III.D.5.6, but were included in the overall estimates of Baseline and Projected Baseline emissions.)

Table 5.7-7
Control Measures for Which Emission Benefits were Quantified

Control Measure/Program	Voluntary Measure	Quantified Benefits	Location in Inventory	
			Baseline	Control
Space Heating and Solid Fuel Heating Controls				
Solid-Fuel Fired Heating Device Upgrades and Emission Standards		✓		✓
Improving Solid-Fuel Device Operations	✓			
Encouraging Reduced Use of Solid Fuel Heating During Air Pollution Episodes	✓			
AHFC Energy Programs		✓	✓	
Expanded Availability and Use of Natural Gas		✓		✓
Transportation Control Strategies				
Expanded Availability of Plug-Ins	✓			
Mass Transit System	✓			
DOT Anti-Idling and Diesel Emission Reductions	✓			
ADEC Diesel Emission Reduction Efforts	✓			
Federal Diesel Emission Reduction Programs		✓	✓	
Federal Motor Vehicle Control Program		✓	✓	
Open Burning				
Winter Season Open Burning Ban		✓	✓	

Regardless of how emission reductions are credited within the planning framework, all measures that reduce $PM_{2.5}$ from local sources are helpful in achieving the overall goal of bringing the area into attainment of the NAAQS.

5.7.2.11 Future Re-Evaluation of Control Strategies

The FNSB and ADEC recognize that in the long term the mix of $PM_{2.5}$ control strategies implemented in Fairbanks could warrant revision. This would be accomplished through a future attainment or maintenance plan revision and subject to approval by EPA. Given the analyses of $PM_{2.5}$ emissions and $PM_{2.5}$ air monitoring data in this attainment plan, the agencies commit to re-evaluating the entire mix of control measures as early as 2016, following the 2015 attainment deadline, to determine whether the measures have succeeded as planned in reducing emissions and improving air quality. This evaluation could result in measures being removed or added to the plan depending on the outcome of the analyses prepared at that time. All changes to the air quality plan must be approved by EPA.

[i] Spreadsheet of Parking Spaces Equipped with Plug-ins, transmitted from Leah Bobick to Bob

Dulla of Sierra Research, dated April 9, 2001.

[ii] Ordinance No. 2001-17, "An Ordinance Mandating a Fairbanks North Star Borough Motor Vehicle Plug-in Program."

5.8. MODELING

5.8.1. OVERVIEW

A variety of modeling studies using different analytical techniques have been performed to provide alternate insights into emission source significance and assess chemical mechanisms influencing particle formation in the atmosphere under conditions associated with exceedances of the 24-hour ambient $PM_{2.5}$ standard. The insight gained from these studies focused attention on the sources that needed to be characterized in the emissions inventory and the chemical mechanisms that needed to be considered in the modeling used to assess the impact on $PM_{2.5}$ concentrations in future years due to control strategies and emission inventory changes over time.

This section provides a review of initial modeling studies used to characterize source apportionment, including (1) a statistical evaluation (using positive matrix factorization or PMF) of the variance in speciated measurements of $PM_{2.5}$ collected on filters at the Federal Reference Monitor (FRM) located at the state office building in downtown Fairbanks, to attribute source significance; (2) another statistical evaluation using Chemical Mass Balance (CMB) modeling to compare the mix of chemical compounds collected at multiple Fairbanks monitoring sites to the mix of chemical compounds emitted from each emission source, to prioritize source significance; (3) Carbon-14 (^{14}C) assessment of the age distribution of carbon molecules found at each site, to provide insight into the distribution of emissions from wood burning versus fossil fuels; and (4) analysis of an organic chemical compound known as levoglucosan, which is a unique byproduct of wood burning, to assess its significance. In addition to the statistical analyses, a dispersion modeling study using CALPUFF was used to assess the impact of pollutants emitted from the six power plants located in Fairbanks on the State Office Building monitor. That study provided insight into how pollutants emitted above the mixed (i.e., inversion) layer were dispersed during the 2008 Jan/Feb modeling episode.

Recognizing that sulfate particles collected on the monitoring filters are a mix of primary (i.e., directly emitted) and secondary particles formed from gases emitted into the atmosphere, an analysis of the chemical mechanisms governing sulfate formation was conducted. The results were used to assess how well secondary particulate formation could be simulated in photochemical modeling. An analysis of the organic chemical composition of $PM_{2.5}$ from Fairbanks was also prepared to identify and quantify the chemical species emitted from fossil fuel combustion.

As discussed earlier, baseline emission inventory estimates were prepared for 2015 and 2019. Control measures were then applied to these inventories to quantify their effect on emissions in these years. The inventory estimates—baseline and with controls (discussed in Section 5.06)—were combined with meteorological inputs developed for the selected episodes (discussed in Section 5.3) and available chemistry mechanisms in the Community Multiscale Air Quality (CMAQ) Modeling System to assess the ability of Fairbanks to demonstrate attainment in 2015 and assess the potential for attainment in 2019. A detailed summary of the CMAQ modeling results is presented in this section.

5.8.2. Sources of $PM_{2.5}$ Emissions In and Around Fairbanks:

Winters in Fairbanks, Alaska present unique meteorological conditions; cold air is trapped close to the ground, causing minimal vertical mixing within the stable boundary layer. These conditions lead to elevated concentrations of air pollutants from local emissions of $PM_{2.5}$ and its precursors, especially sulfur dioxide (SO_2). To further understand these elevated concentrations, Sierra Research conducted an initial source contribution analysis based on monitoring data from a site in downtown Fairbanks. The study used a statistical analysis approach called positive matrix factorization (PMF)[1] to analyze the co-variance[2] in air quality measurements in Fairbanks in an attempt to understand the number and types of sources that are contributing to the elevated $PM_{2.5}$ concentration. Figure 5.8-1 summarizes the source contributions to total $PM_{2.5}$ concentrations in Fairbanks from March 2005 through April 2008. As shown, the principal factors responsible for the elevated concentrations were secondary aerosols (sulfate and nitrate), wood burning, and an unidentified zinc-related source, with smaller contributions from sea salt, motor vehicles, and soil.

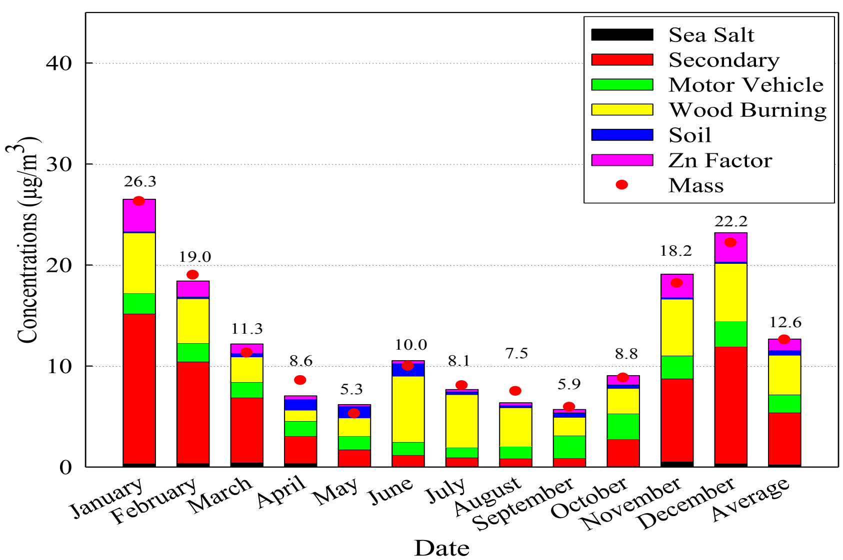


Figure 5.8-1. PMF Source Contributions to Total $PM_{2.5}$ Mass in Fairbanks, Alaska (03/17/2005-4/12/2008)

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[1] Eberly, S.,(2005), "EPA PMF 1.1 User's Guide", June 30, 2005. USEPA, National Exposure Research Laboratory, http://www.epa.gov/heasd/products/pmf/pmf.htm.

[2] "Co-variance" quantifies the correlation between measured values, reflecting how changes in one variable are associated with changes in a second variable. *http://mathworld.wolfram.com/Covariance.htm*l

The study found that, in winter months, secondary aerosols—such as sulfate and nitrate—make up about 40 to 55 percent of the monthly average mass concentrations of $PM_{2.5}$. The concentrations are highest in January, the coldest month.

The source of the zinc factor was unknown and viewed as an anomaly. Possible sources may be the burning of waste lubricating oil for space heating, burning of lubricating oil by motor vehicles, other local trace sources, or distant sources of zinc mining and ore handling. A study done by Cahill[3] indicated that very fine, ultra fine, and nano-particles of zinc were from burned lubricating oil. If this is true, the motor vehicle contribution to $PM_{2.5}$ shown in the graph would be much greater than shown from the PMF analysis.

The monthly average PMF analysis did not reflect the worst-case scenarios—emissions from space heating, including both the burning of wood and sulfur-bearing fuel oil, would be expected to be significantly higher on the coldest days compared to the average winter days. Atmospheric conditions on the coldest days may be quite different from average winter days, resulting in stagnant air that contributes to elevated air pollutants.

During the same time period as the PMF analysis, speciation concentrations from November 2005 to February 2008 were correlated, $PM_{2.5}$ concentrations in Fairbanks in winter are correlated inversely with temperature, as shown in Figure 5.8-2[4]. The correlation is weak due to several confounding factors.

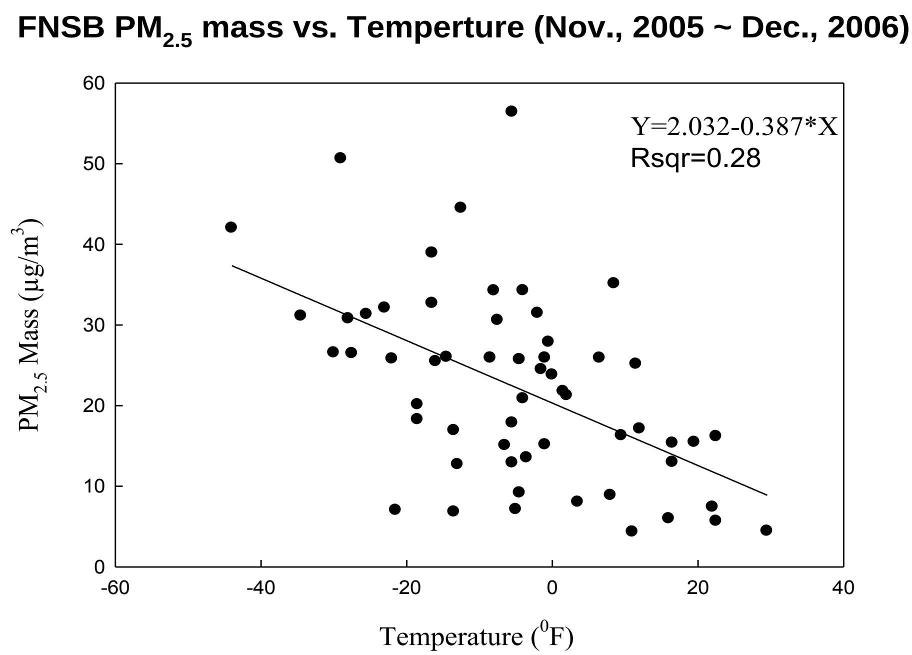

Figure 5.8-2. $PM_{2.5}$ vs. Temperature

[3] T. Cahill, "Persistence of Very-fine, Ultra-fine, and Nano-particles in the Ambient Atmospheric Environment," University of California, Davis; http://www.cce.umn.edu/pdfs/cpe/conferences/nano/Thomas_Cahill.pdf

[4] Appendix III.D.5.8, Updated Speciation Analysis for Fairbanks, 2008

These include (1) the increase in emissions as the temperature decreases; and (2) the decrease in atmospheric dispersion with decreased temperature due to lower wind speeds, lower mixing depths, and more extreme lapse rates, which retards vertical mixing.

The PMF analysis was able to resolve profiles for six possible sources of $PM_{2.5}$ concentrations in Fairbanks: wood burning, secondary aerosols, motor vehicles, zinc, soil, and sea salt. These profiles and their contributions are described below.

- Wood burning is characterized by organic carbon (OC), elemental carbon, (EC) and potassium (K). The sources are from home heating (e.g., wood stoves, fireplaces, inserts and wood boilers, etc.) and transport from occasional wildfires. Smoke from wild fires is a significant contributor to particulates in summer months and home heating is in winter months.

- Secondary particulates occur from sulfate, nitrate, ammonium, and OC, with the contribution of secondary particulate being lower in the summer months than in the winter. This seasonal variation is thought to be caused by the higher emissions of precursor gases (SO_2, oxides of nitrogen [NO_X], and OC) from increased fossil fuel consumption during the winter, as well as the seasonal change in the inversion height.

- Zinc profiles include zinc (Zn), lead (Pb), EC, and OC, and are thought to represent the municipal incinerators and smelters that are burning waste oil or possibly the lubricating oil in automobiles. Sources may be from local incinerator use, burning of waste oil, or some other activity that is unknown. There are no smelters in the local area. Contributions are significantly higher in the winter than in the summer and spring months.

- Emission profiles for motor vehicles, soil, and aged sea salt were also resolved. All three sources contribute very little to the $PM_{2.5}$ concentrations during the winter months.

Figure 5.8-1 and Figure 5.8-2 represent the average values for all measurements recorded and do not distinguish between speciation values collected on violation days and those from non-violation days. Figure 5.8-3 displays the PMF-estimated source contributions on each of the 12 violation days on which values recorded at the speciation monitor exceeded the 24-hour ambient $PM_{2.5}$ standard. The graph shows uniformly high concentrations of $PM_{2.5}$, but no clear trends. Comparing the source contributions in Figure 5.8-3 to those in Figure 5.8-1 for the winter months (November to February)

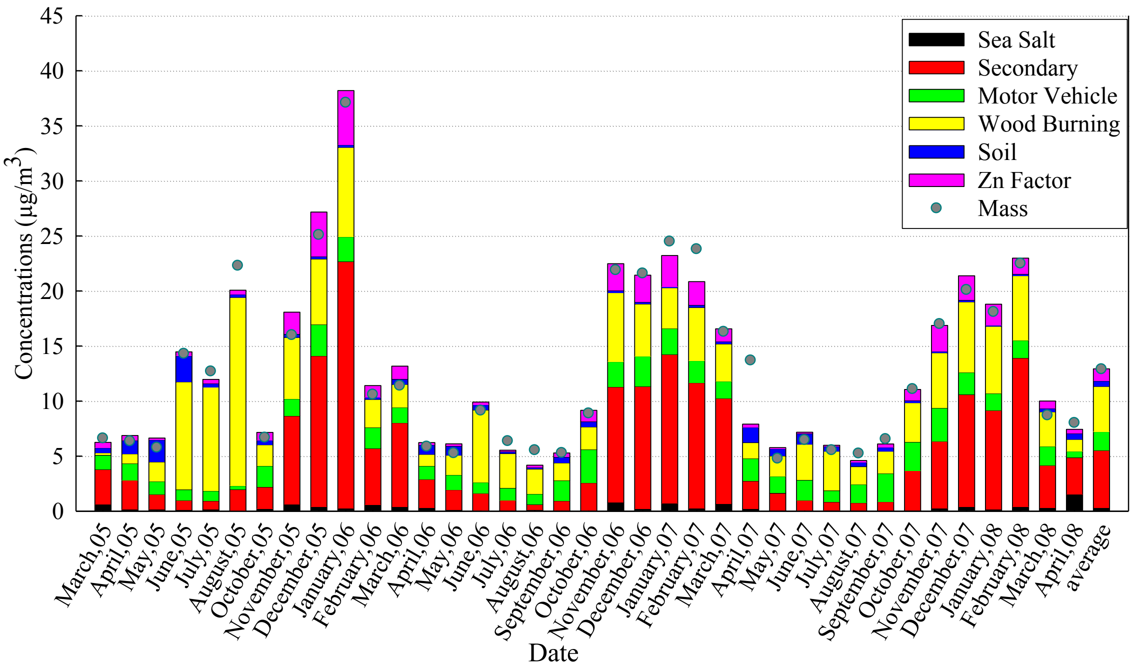

Figure 5.8-3. PMF Assessment of Source Contributions to Total $PM_{2.5}$ Mass in Fairbanks, Alaska (3/17/2005-4/12/2008)

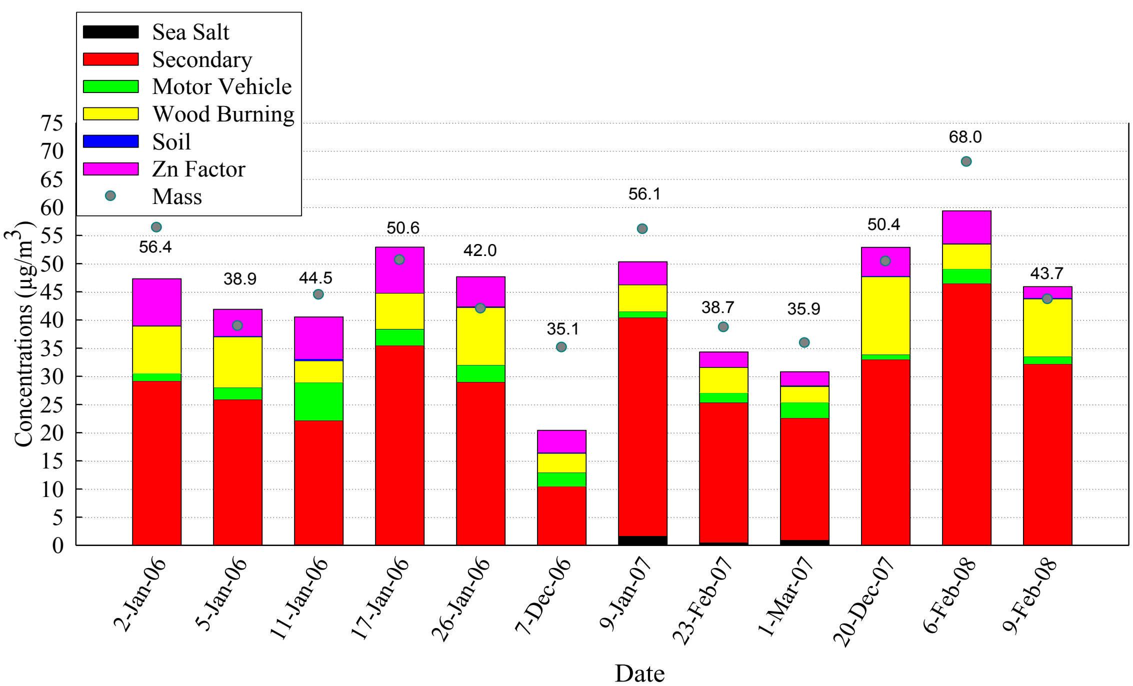

Figure 5.8-4. PMF Source Contributions ($PM_{2.5} > 35$ µg/m^3) to Total $PM_{2.5}$ Mass During Winter Time at FNSB, Violation Days Only (3/17/2005-4/12/2008)

shows that secondary aerosols (sulfate+nitrate), wood burning, and the zinc factor are still the major sources. On average, the absolute source contributions increased for the violation days.

The results of this preliminary study led to a number of questions regarding the sources of the $PM_{2.5}$ in Fairbanks. To address these questions, further studies such as chemical mass balance (CMB) modeling were conducted to estimate future $PM_{2.5}$ concentrations. This initial emissions study led to Alaska-specific WRF modeling by Penn State. Subsequently, data collected from these meteorological studies were used for regional air quality modeling with CMAQ.

5.8.3. Fairbanks $PM_{2.5}$ Source Apportionment Estimates Study

To understand the sources of $PM_{2.5}$ in the Fairbanks airshed, the University of Montana, Center for Environmental Health Sciences, conducted a source apportionment study based on monitoring data collected during the winters of 2008/2009, 2009/2010, and 2010/2011. This information was critical to the Borough's efforts to identify which sources need to be controlled in order to reduce wintertime $PM_{2.5}$ concentrations in Fairbanks.

Up until the winter of 2008/2009, chemical speciation $PM_{2.5}$ monitoring data were available only from the State Office Building in downtown Fairbanks. To have a better understanding of the particulate problem, three additional monitoring sites were added in the winter of 2008/2009: North Pole Elementary School, Peger Road at the Borough Transportation Center, and a field located to the northwest of the intersection between Geist Road and the Parks Highway (Reindeer site). A map depicting the location of each site is shown in Figure 5.8-5.

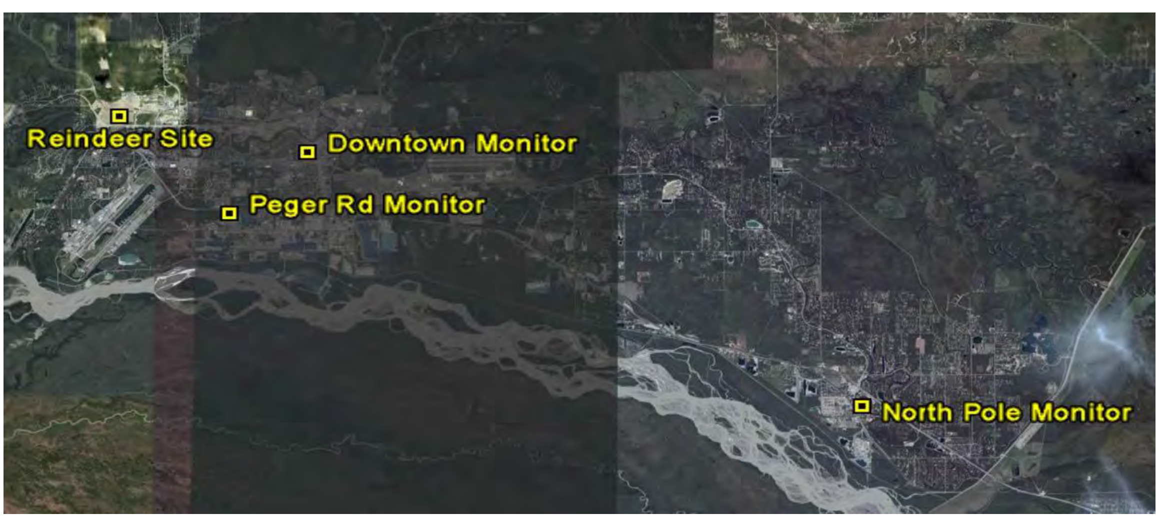

Figure 5.8-5. Location of the $PM_{2.5}$ Monitors in Fairbanks, Alaska

The University of Montana employed several source apportionment techniques to analyze the data collected—Chemical Mass Balance (CMB) modeling, Carbon-14 (^{14}C) analysis, and a chemical analysis focusing on wood burning. Because of the uncertainty in each method, use of several methods provided a broader range of insight into emission source contributions.

CMB modeling[5][6], which is a U.S. Environmental Protection Agency (EPA) approved statistical analysis procedure, was used to compare the chemical compounds collected at each site to chemical compounds emitted from each emission source. Based on source profiles developed by EPA, the CMB modeling found that wood smoke was the major source of $PM_{2.5}$ throughout the three winter months study in Fairbanks, contributing between 60% and nearly 80% of the measured $PM_{2.5}$ at the four sites. The other sources of $PM_{2.5}$ identified by the CMB model were secondary sulfate (8-20%), ammonium nitrate (3-11%), diesel exhaust (not detected-10%), and automobiles (not detected-7%). Approximately 1% of the $PM_{2.5}$ was unexplained by the CMB model. The EPA source profile CMB modeling results from the winter of 2008/2009 for all four sites are displayed in Figure 5.8-6.

[5] Friedlander, S.K., 1973. Chemical element balances and identification of air pollution sources. *Environ. Sci. Technol.*, 7, 235-240.
[6] Watson, J.G., Robinson, N.F., Chow, J.C., Henry, R.C., Kim, B.M., Pace, T.G., Meyer, E.L., Nguyen, Q., 1990. The USEPA/DRI chemical mass balance receptor model, CMB 7.0. *Environ. Software,* 5, 38-49.

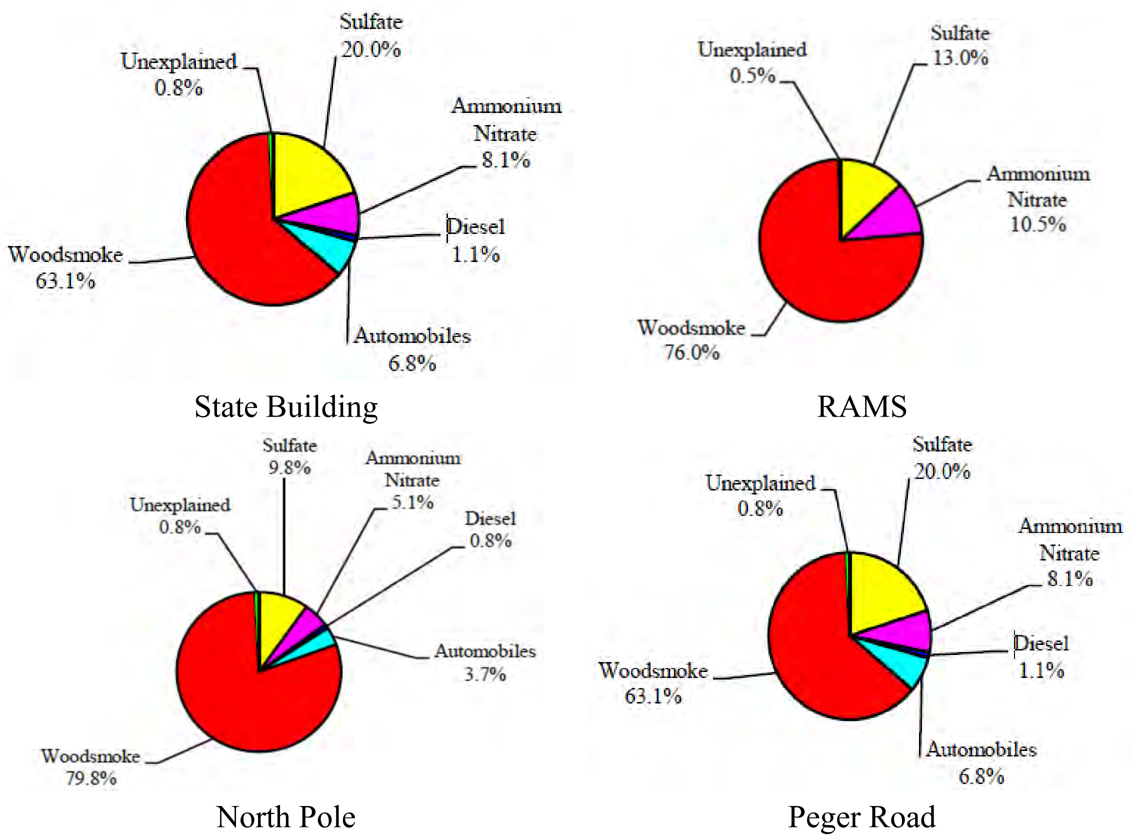

Figure 5.8-6. Emission Source Contribution Estimated from CMB Analysis

To address Fairbanks-specific home heating fuel types and meteorological conditions, CMB modeling was also conducted for winter 2008/2009 using source profiles developed by OMNI Environmental Services and the results were compared to those from the EPA-developed source profiles. The results were consistent with the EPA modeling in identifying wood smoke as being the largest source of $PM_{2.5}$ at all four site OMNI source profiles did not include automobile and diesel exhaust; instead, No. 2 fuel oil combustion was identified as contributing 11.1% to 27.2% of the ambient $PM_{2.5}$ at each of the four sites. Figure 5.8-7shows the results from one of the sites using OMNI profiles in CMB modeling.

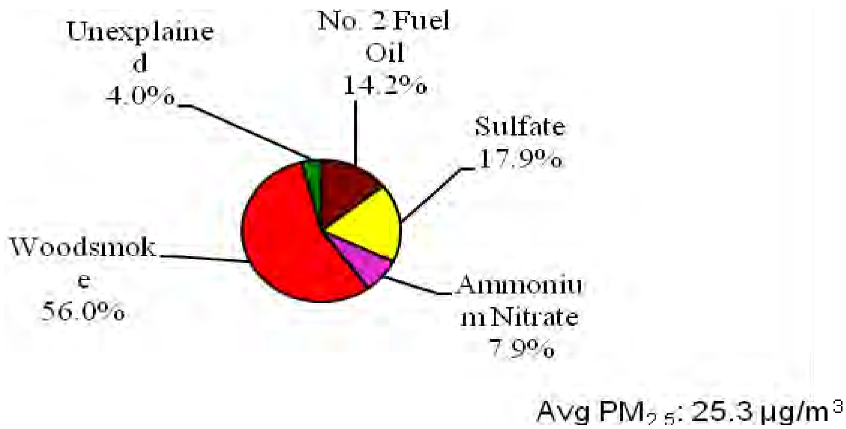

Figure 5.8-7. State Office Building CMB Results Using OMNI Profiles (November 8, 2008 – April 7, 2009)

The second approach used in identifying the main source of $PM_{2.5}$ was Carbon-14 (^{14}C) analysis, which looks at the age distribution of carbon molecules found at each site—the newer carbon is generally associated with wood burning, while the older carbon is associated with petrochemicals or fossil fuels. The third approach was to measure the organic chemical compound known as levoglucosan (an organic compound), which is a unique byproduct of wood burning.

The Carbon isotope ^{14}C and levoglucosan results, analyzed from a subset of filters collected from each of the four monitoring sites, also showed that approximately 50% to 80% of the measured ambient $PM_{2.5}$ came from a new-carbon source (i.e., a wood smoke source). The CMB modeling coupled with the ^{14}C and Levoglucosan results support that wood smoke is the largest contributor to the ambient $PM_{2.5}$ in the Fairbanks airshed during the winter months.

5.8.3.1 Using the CALPUFF Dispersion Model to Characterize the Fairbanks Power Plant Plumes

EPA Region 10 suggested running a dispersion model to assess the plumes from the point sources located at the Non-Attainment Area. ADEC and EPA agreed that CALPUFF would be an appropriate model to run to characterize the plumes from the power plants located within the vicinity of the nonattainment area.

CALPUFF is a non-steady-state meteorological and air quality modeling system used by the EPA for studies that include long-range transport of pollutants. The model was configured with WRF inputs using Mesoscale Model InterFace (MMIF) program and was modified to handle 38 vertical layers representing Fairbanks, with the lowest layer being 4 meters above ground level on a 1.33 x 1.33 km grid cell. Listed below are the six point sources in the Fairbanks $PM_{2.5}$ nonattainment area that were modeled for the design episode January 23- February 10, 2008.

1. Fort Wainwright (Facility ID 1121) – Coal is the fuel source; hourly emissions provided.

2. University of Alaska Fairbanks (Facility ID 315) – Coal is the base fuel and distillate fuel oil is the secondary fuel used to satisfy increased loads; hourly emissions were provided.

3. GVEA Zehnder – One of GVEA's two facilities, the Zehnder peaking facility (Facility ID 109) is north of downtown and burns high sulfur distillate fuel oil on an intermittent basis; hourly emissions provided.

4. GVEA North Pole – The second of GVEA's facilities, North Pole (Facility ID 110) is a larger facility and burns a mixture of high sulfur distillate fuel oil and naptha (very low sulfur); hourly emissions provided.

5. Aurora Energy (Facility ID 315) – This power plant, located in downtown Fairbanks, is owned by the coal company and burns a mixture of coal and distillate fuel oil. It sells power to GVEA, and hot water and steam to office buildings and a limited number of homes in the downtown area. Only constant yearly emissions were provided.

6. Flint Hills Refinery (Facility ID 71) – Located in North Pole, this is a distillation refinery, no cracking; all heavy ends go back into the pipeline. Hourly emissions were provided.

Figure 5.8-8 represents the modeling domain 201 x 201 in the X and Y direction with a grid cell size of 1.33 x 1.33 km. In addition to the gridded receptors, the model used discretely placed receptors at specific locations with vertical resolution of the WRF data's first 12 layers to obtain the average surface concentration of the entire domain. Summary of the six major point sources average surface concentration of $PM_{2.5}$and SO_2 is tabulated below in Table 5.8-1.

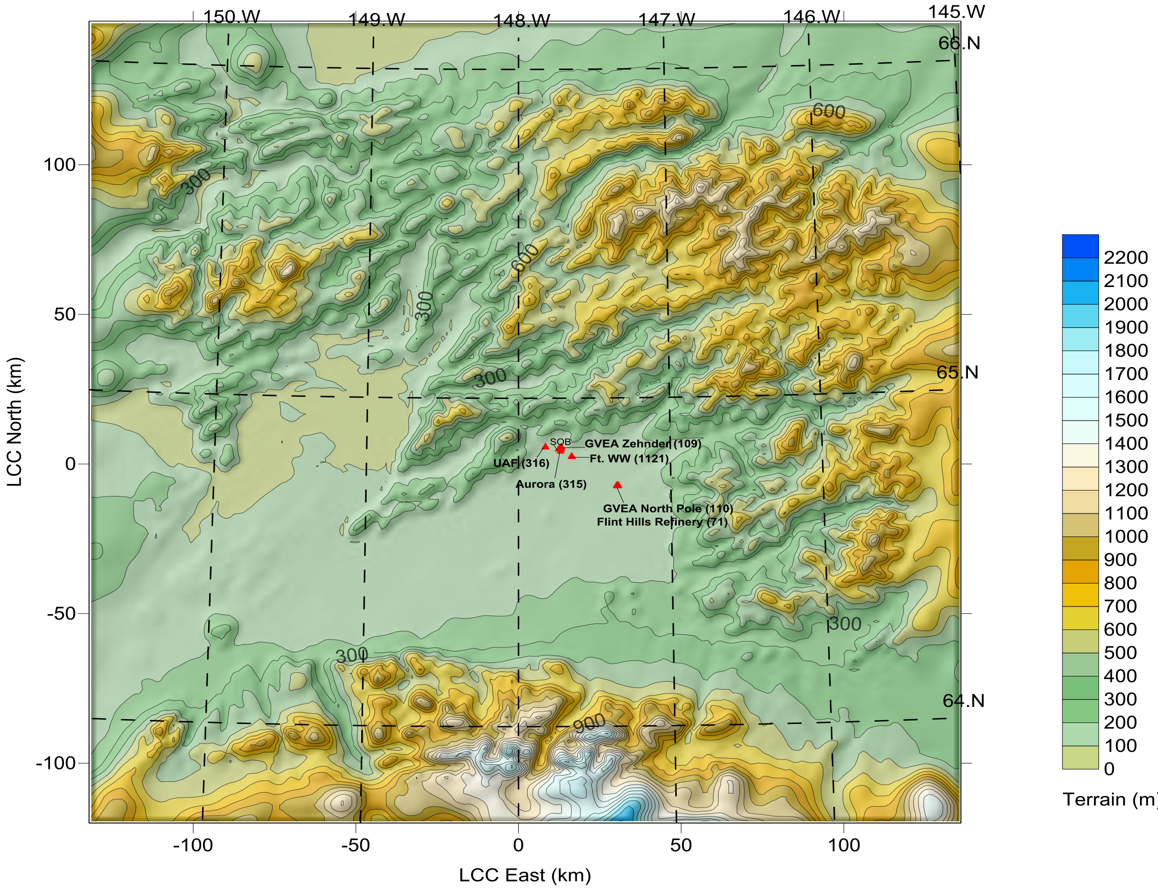

Figure 5.8-8. Fairbanks point source locations are represented by red triangles and are labeled by facility ID number and abbreviated name. The SOB (State Office Building) that houses the FRM (Federal Reference Method) monitor is labeled with a red triangle. The domain represented is 201 x 201, 1.33 km grid cells.

Table 5.8-1. Summary of Six Major Fairbanks Point Source Plumes from CALPUFF for the Episode (Jan. 23rd to Feb. 9th, 2008) Average Surface Concentrations at the State Office Building of $PM_{2.5}$ and SO_2 in µg/m³

Power Plant	Episode average SO_2 (µg/m³)	Episode average $PM_{2.5}$ (µg/m³)
UAF- 316	2.75	0.16
Aurora- 315	0.75	0.02
Zehnder-109	0.48	0.19
Flint Hills-071	0.016	0.38
GVEA NP-110	3.8	1.45
Ft. WW- 1121	14	1.6
Total surface concentration	21.8	3.8

CALPUFF modeling showed that the two largest sources that influence $PM_{2.5}$ concentrations at the downtown State Office Building site were the GVEA North Pole and Ft. Wainwright power plants. Monitoring data from the State Office Building was selected for comparison because it was the only location for which January 2008 episode data were available. The average SO_2 concentration from all sites for the entire episode was 4.4 μg/m^3 and the highest were from the aforementioned two sources.

5.8.4. Sulfur Formation in Fairbanks

According to observations for the highest concentration winter days between 2006 and 2010, the second largest component of $PM_{2.5}$ is sulfur-containing particles amounting to 18% of the $PM_{2.5}$ composition. Sulfur is emitted to the atmosphere through biogenic or anthropogenic sources; anthropogenic sources are quite extensive, resulting from the combustion of petro-fuel such as heating oil, diesel, and coal.

Due to the significance and complexity of sulfate formation, Dr. Richard Peltier drafted a comprehensive review of the heterogeneous and homogenous reactions that control the conversion of SO_2 to sulfate. In Fairbanks, the specific sources of sulfur are thought to be from coal-fired power plants, on-road diesel fuel, and home heating oil; however, the mechanisms of formation of sulfate are not fully understood. SO_2 gas phase reactions from point sources are not likely a major source of sulfate. According to several studies, heterogeneous process is most likely the mechanism involved in formation of sulfur bound particles; the mediating factors needed for the formation are oxidants such as metal catalysis, hydroxyl radical, ozone, organic peroxides, etc.

The aerosol acidity profiles of the $PM_{2.5}$ data collected by FNSB differed for winter and non-winter months. There was an excess of positively charged ammonium ions during the winter season, which suggests that sulfur conversion reactions were not highly favored; however, sulfur compounds are the second highest contributor of $PM_{2.5}$ in Fairbanks. Measurements of elemental sulfur and particulate sulfate examined in Fairbanks show significant wintertime spikes in sulfate.
The understanding of aerosol chemistry related to sulfur is quite poor in Fairbanks. Additional studies pertaining to the formation of ice fog, air quality model calibration, and source apportionment are needed to better understand the elevated $PM_{2.5}$ levels and develop strategies to reach attainment.

Source contributions and possible chemical mechanisms have not been fully resolved in the case of particulate sulfate in Fairbanks. These analyses provide context to understanding the model performance for secondary sulfate as a component of $PM_{2.5}$.

5.8.5. Organics Analysis for Residential Oil Burner Emissions

Several studies conducted for possible sources of $PM_{2.5}$ in Fairbanks Alaska determined that residential heating, transportation, and coal combustion are a few of the major sources attributing to the elevated concentrations of particulate matter. ADEC contracted with the University of Montana to characterize the organic chemical composition of $PM_{2.5}$ from Fairbanks with the goal of identifying and quantifying chemical species that can be used to indicate and monitor $PM_{2.5}$ emissions from fossil fuel combustion.

Selected samples representing typical or high $PM_{2.5}$ days from the winter of 2009-2010 in Fairbanks were analyzed for organic compounds: hopanes, steranes, and polynuclear aromatic hydrocarbons (PAHs). Emphasis was placed on sulfur-containing compounds such as dibenzothiophene known emission of diesel fuels and residential oil burners. The PAH picene was also looked at in determining the emissions from coal combustion.

The study found high concentrations of hopanes, steranes, picene and thiophenes in the air and $PM_{2.5}$ composition, indicating that coal combustion may account for a significant level of the sulfur/sulfate fraction of $PM_{2.5}$. Overall, the results indicated that fossil fuel and coal combustion significantly add to the $PM_{2.5}$ problem seen in Fairbanks.

These sources potentially contribute to the total sulfur and carbon measured in particles in Fairbanks. This study provides some insight into the importance of oil burning and coal burning sources that can be useful comparison points for air quality modeling outputs.

5.8.6. Rationale for Model Selections

Air quality attainment modeling is divided into three different modeling tasks: (1) meteorological modeling/processing, (2) emissions modeling/processing, and (3) photochemical transport modeling. There are a number of available computer models for each of these tasks. The models chosen for the meteorological and photochemical transport tasks are explained below. A rationale is not required in the selection of the emissions modeling system.

5.8.6.1. Meteorology

The Weather Research Forecasting Model (WRF) Advanced Research WRF (WRF-ARW) model was chosen as the meteorological model. Typically either the Mesoscale Meteorological Model Version 5 (MM5) or the WRF model are considered for generating gridded, regional meteorological data as inputs for a photochemical transport model. For Fairbanks, the meteorological model must be able to accurately represent a subarctic environment with extreme atmospheric inversions, cold ambient temperatures, and low wind speeds over long periods.

Based on past research at the University of Alaska Fairbanks (UAF)[7]and Penn State University,[8] the WRF model was ultimately selected as the meteorological model for this

[7] Mölders, N. and G. Kramm, 2010: A case study on wintertime inversions in interior Alaska with WRF. Atmos. Res., 95, 314-332
[8] Gaudet, B., D. Stauffer, N. Seaman, A. Deng, K. Schere, R. Gilliam, J. Pleim, and R. Elleman, 2009:

SIP. Researchers at UAF have had success adapting WRF to the unique winter surface conditions of the subarctic region around Fairbanks. As part of an EPA-funded Regional Applied Research Effort (RARE), project researchers at Penn State tested WRF model sensitivity when optimized to represent a low wind speed under extreme cold conditions.[9]

5.8.6.2. Air Quality

The Community Multiscale Air Quality (CMAQ) Modeling System was chosen as the model for the $PM_{2.5}$ attainment test in Fairbanks for the SIP. Generally, EPA defines an air quality attainment model as one that accurately represents the observed ambient particulate matter concentrations across a geographic region. Model considerations include the following:

1. Are the model's functions and their implementation well documented and tested?
2. Does the model support the relevant atmospheric physical and chemical functions?
3. Are experienced personnel available to deploy the model?
4. Would implementation of the model produce a prohibitive cost in time or effort?
5. Is use of the model consistent with the efforts in neighboring regions (U.S. EPA 2007)?[10]

The CMAQ model has a long track record of use in the study of regional air quality and $PM_{2.5}$ attainment modeling.[11] The model is well documented,[12] peer reviewed,[13] and

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Modeling extremely cold stable boundary layers over interior Alaska using a WRF FDDA system. 13th Conference on Mesoscale Processes, 17 ‑ 20 Aug, Salt Lake City, UT, American Meteorological Society.

[9] Gaudet, B.J., and D.R. Stauffer, 2010: Stable boundary layer representation in meteorological models in extremely cold wintertime conditions. Final Report, Purchase Order EP08D000663, Environmental Protection Agency.

[10] U.S. EPA, 2007, Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze, EPA-454/B07-002.

[11] San Joaquin Valley 2008 and 2012 SIPs http://www.arb.ca.gov/planning/sip/sjvpm25/24hrsjvpm25.htm

[12] Community Modeling & Analysis System provides a detailed user's guide and technical documentation https://www.cmascenter.org/cmaq/documentation/5.0.2/users_guide.cfm

[13] Aiyyer, A., Cohan, D., Russell, A., Stockwell, W., Tanrikulu, S., Vizuete, W., and Wilczak, J., 2007, Final Report: Third Peer Review of the CMAQ Model, submitted to

supported actively by EPA and a broader academic community.[14,15,16] The CMAQ model is a 3-D Eulerian photochemical transport model that can simulate atmospheric aerosols, gaseous compounds, acidity and visibility. Contractors with photochemical modeling experience were hired by ADEC to support the use of the model for the SIP. Prior to the SIP limited past efforts had been made to adapt photochemical models to the Fairbanks region; however, the broader support of CMAQ was deemed favorable in reducing the cost and effort required. Neighboring regional modeling efforts were not considered due to the spatially isolated nature of the Fairbanks air quality exceedances.

At the time of the original SIP development CMAQv4.7.1[17] (Foley et al., 2010) was the most current version of the model and used throughout the modeling process. Versions 5.0[18] (September 2011) and 5.0.1[19] (July 2012) were released during the SIP development process, but these versions were not used due to the effort already invested in adapting version 4.7.1 for Fairbanks.

5.8.7. Model Setup

Several computer models are used in the process of attainment modeling. The configuration of the meteorological, emissions, and photochemical-transport models is described below.

5.8.7.1. Meteorology

WRF model version 3.1 using data assimilation was used to complete the meteorology modeling for both episodes. For the SIP m[20]odeling WRF version 3.1 was used with CMAQ because Penn State conducted the metrology study under the EPA RARE project. The newer versions of WRF since that study were not used due to the considerable

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the Community Modeling and Analysis System Center, University of North Carolina, Chapel Hill

[14] Chemel, C., et al. "Application of chemical transport model CMAQ to policy decisions regarding PM2. 5 in the UK." Atmospheric Environment 82 (2014): 410-417.

[15] Shimadera, Hikari, et al. "Sensitivity analyses of factors influencing CMAQ performance for fine particulate nitrate." Journal of the Air & Waste Management Association 64.4 (2014): 374-387

[16] Zhang, Y., Liu, P., Liu, X., Pun, B., Seigneur, C., Jacobson, M.Z., and Wang, W., 2010, Fine scale modeling of wintertime aerosol mass, number, and size distributions in Central California, Journal of Geophysical Research, 115, D15207, doi:10.1029/2009JD012950..

[17] http://www.epa.gov/AMD/Research/CMAQ/release4_7_1.html

[18] http://www.airqualitymodeling.org/cmaqwiki/index.php?title=CMAQ_version_5.0_ %28February_2012_ release%29_Technical_Documentation

[19] http://www.airqualitymodeling.org/cmaqwiki/index.php?title=CMAQ_version_5.0.1_ %28July_2012_ release%29_Technical_Documentation

[20] Byun,D.W. and J.K.S Ching (1999), "Science Algorithms of the EPA Models-3 Community Multiscale Air Quality (CMAQ) Modeling System" Office of Research and Development, USEPA, EPA/600/R-99/030

resources invested in adapting WRF to Fairbanks.[21] The model configurations are shown in Table 5.8-2 through Table 5.8-4. A nested gridding configuration was used to simulate three grids: Grid 1 a 401x301 cell area with 12km horizontal resolution, Grid 2 a 202x202 cell area with 4km horizontal resolution, and Grid 3 a 202x202 cell area with 1.33km horizontal resolution. The nesting configuration is shown in Table 5.8-3. Vertical gridding was held constant between the cells at 39 layers with heights described in Table 5.8-2. Further details of the meteorology modeling are available in Appendix III.D.5.8.

Table 5.8-2. Grid-Independent Features of WRF Simulations

WRF Feature	Value
nesting procedure	one-way concurrent
model top (hPa)	50
Number of vertical layers	39
eta value of full levels	1.0, 0.9995, 0.999, 0.9984, 0.99705, 0.99415, 0.99155, 0.986, 0.78, 0.966, 0.95, 0.034, 0.918, 0.902, 0.886, 0.866, 0.842, 0.814, 0.78, 0.74, 0.694, 0.648, 0.602, 0.556, 0.51, 0.464, 0.418, 0.372, 0.326, 0.282, 0.24, 0.2, 0.163, 0.128, 0.096, 0.066, 0.04, 0.018, 0
Approximate height above ground level of half levels (m)	2.0, 6.0, 10.5, 18.4, 35.5, 57.8, 90.9, 146.2, 228.3, 344.5, 478.7, 614.8, 752.7, 892.5, 1052.3, 1251.1, 1491.2, 1785.4, 2148.4, 2587.7, 3079.8, 3598.2, 4146.0, 4727.3, 5346.7, 6010.4, 6725.8, 7502.6, 8333.4, 9208.6, 10135.5, 11190.6, 12139.8, 13234.2, 14408.4, 15652.1, 16921.7, 18193.7
Exclude nudging from the boundary layer	No
G for analysis nudging, when used (s^{-1})	0.0003
G for obs nudging, when used (s^{-1})	0.0004
obs nudging half-time window (hr)	2
Specified, relaxed zone width	1, 9

[21] Appendix III.D.5.8 – EPA RARE project

Table 5.8-3. Grid-Dependent Features of Baseline WRF-Model Configuration

	Grid 1	Grid 2	Grid 3
Horizontal extent	401 x 301	202 x 202	202 x 202
Horizontal Δx (km)	12	4	1.33
i parent start	-	156	103
j parent start	-	106	106
Time step (s)	24	8	4
Sound step ratio	8	8	4
Dampcoef	0.0	0.0	0.0
Analysis nudging	yes	no	no
obs nudging	yes	yes	yes
Surface obs nudging xy radius (km)	100	100	75
Topographic dataset	USGS 10 m	USGS 2 m	USGS 30 s

Table 5.8-4. Grid-Independent WRF Preprocessor System (WPS) Features

Feature	Value
Projection	Lambert conformal
Reference latitude, longitude	64.8, -148.0
True latitudes	50.0, 70.0
Standard longitude	-148.0
Initial conditions	0.5 degree GFS analyses
Analysis interval (hr)	6

The high-resolution Grid 3 outputs were used in the processing of the emissions and air quality modeling. All grids used a Lambert conformal projection with reference latitude and longitude of 64.8, -148.0. Meteorology fields were processed through the Meteorology-Chemistry Input Processor (MCIP) version 3.6. Minor changes were made to MCIP due to bugs during the execution of the air quality model.[22]

[22] "Fairbanks North Star Borough $PM_{2.5}$ Non-Attainment Area CMAQ Modeling: Final Report Phase I," Project: 398831 CMAQ-DEC, Mölders, N., Leelasakultum, K. University of Alaska Fairbanks, Geophysical Institute, College of Natural Science and Mathematics, Department of Atmospheric Sciences, December 1, 2011

5.8.7.2. Emissions Processing

Emission inventories are prepared for the air quality model using the Sparse Matrix Operator Kernal Emissions (SMOKE) model. SMOKE will convert inventories to the needed spatial, temporal, and speciation formats for the air quality model. Inventories for the SMOKE model cover the following source categories: home heating, industrial point sources, onroad mobile, nonroad, air travel, and area sources (excluding home heating). Raw inventory summaries are provided in the emissions inventory overview section (SIP Section 5.6). SMOKE version 2.7.5b was used to create 3-D photochemical transport model ready inputs for CMAQ. Modifications to SMOKE were made to allow for importing of hourly home heating gridded area source inventories. Modifications have been outlined in Appendix III.D.5.8 along with bug fixes to the model in the areas of the inventory importing (SMKINVEN), gridding (GRDMAT), temporal (TEMPORAL) and merging (SMKMRG) processes of the source code. Bugs were also addressed in the MOVESMRG source code used for importing and processing of MOVES mobile source emission rates.

MOVES version 2010a was used to generate mobile source emission rates lookup tables by hour using modeled temperature data generated by WRF and processed through MCIP.

5.8.7.3. Air Quality

Computer simulations of the two model episodes were performed with the Community Multiscale Air Quality (CMAQ) model version 4.7.1. CMAQ was compiled on a Linux custom-built computer (Intel i7 950 4 core/8 thread, 8 GB system memory, 1 TB hard disk drive) running Ubuntu 10.04 OS using the Portland Group Fortran compiler version 11.4.

The CMAQ model was configured with the modules shown in Table 5.8-5. The module selection followed the default options for CMAQ-4.7.1 with the exceptions of vertical diffusivity and photolysis modules. These modules were chosen based on a review of the CMAQ-model conducted by Mölders and Leelasakultum at UAF.[23]

The model was compiled with version 11.4 of the PGI Fortran compiler with the Message Passing Interface Library (MPICH 2 version 1.3.2). The CMAQ source code was modified to incorporate changes from a UAF study of the CMAQ-model usage in the Fairbanks North Star Borough $PM_{2.5}$ non-attainment area.[24]

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[23] Ibid.

[24] "Fairbanks North Star Borough $PM_{2.5}$ Non-Attainment Area CMAQ Modeling: Final Report Phase I," Project: 398831 CMAQ-DEC, Mölders, N., Leelasakultum, K. University of Alaska Fairbanks, Geophysical Institute, College of Natural Science and Mathematics, Department of Atmospheric Sciences, December 1, 2011 *http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/CMAQ_final_report_December_1_2011_Molders_Leelasakultum.pdf*

Table 5.8-5. CMAQ Model Module Configuration Options

CMAQ Module	Selected Option[25]	Description[26]
Horizontal Advection	*hyamo*	"Global mass-conserving scheme"
Vertical Advection	*vyamo*	"Global mass-conserving scheme"
Horizontal Diffusivity	*multiscale*	"Use diffusion coefficient based on local wind deformation"
Vertical Diffusivity	*eddy*	"eddy diffusivity theory"
Photolysis	*photo_inline*	inline photolysis rate calculations
Gas-phase Chemistry Solver	*ebi_cb05cl_ae5*	"Euler Backward Iterative solver optimized for Carbon Bond-05 mechanism with chlorine and extended aerosols"
Aerosol	*aero5*	"fifth-generation model CMAQ aerosol model with extensions for sea salt emissions and thermodynamics and anew formulation for secondary organic aerosol"
Deposition	*aero_depv2*	"second-generation CMAQ aerosol deposition velocity routine"
Cloud Chemistry	*cloud_acm_ae5*	"ACM cloud processor that uses the ACM"
Mechanism	*cb05cl_ae5_aq*	"CB05 gas-phase mechanism, fifth-generation CMAQ aerosol mechanism with sea salt, aqueous/cloud chemistry, and active chlorine"

5.8.8. Model Performance

A model performance evaluations serves to provide confidence in the final attainment demonstration. Outputs from the meteorological and air quality models are compared against measurements for the modeling episodes. A number of statistical techniques are employed to ensure that the models are behaving within stated criteria.

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[25] Ibid.
[26] Descriptions are reproduced from Operational Guidance for the "Community Multiscale Air Quality (CMAQ) Modeling System Version 4.7.1 (June 2010)" accessed from *https://www.cmascenter.org/cmaq/documentation/4.7.1/Operational_Guidance_ Document.pdf*

5.8.8.1. Weather Research and Forecasting Model (WRF)

Observed meteorology data from METAR stations are compared against the final configuration of the WRF model (dubbed TWIND2X30 in Appendix III.D.5.8). The met statistics presented here are comparable to the met statistics suggested in EPA $PM_{2.5}$ modeling guidance.[27] The statistics presented are for root-mean-square error (RMSE), mean absolute error (MAE), and bias. A comparison of the observed meteorology statistics between the final WRF model outputs of the Nov 2008 and Jan-Feb 2008 episodes (Table 5.8-6) shows that the modeled version of the Jan-Feb 2008 episode arguably has better statistics than the Nov 2008 episode, despite the more extreme cold present in the former. However, the more negative temperature bias in the Nov 2008 versus the Jan-Feb 2008 episode is consistent with the relative absence of extreme cold periods in Nov 2008 and the configurations general tendency to have a negative temperature bias in milder winter conditions for the Fairbanks region. While the model tends to be too warm during the periods of the coldest temperatures, the coldest temperature periods also tend to be of short duration.

Table 5.8-6. Comparison of Statistics for Nov 2008 and Jan-Feb 2008 Episodes for the WRF Model Outputs

	Nov 2008 RMSE (MAE for wind direction)	Nov 2008 Bias	Jan-Feb 2008 RMSE (MAE for wind direction)	Jan-Feb 2008 Bias
Temperature (°C)				
Fairbanks	2.75	-1.16	2.22	-0.12
Eielson AFB	2.03	-0.47	2.05	-0.23
Ft. Wainwright	2.38	-0.97	1.83	0.51
Three Stations	2.43	-0.86	2.07	0.00
Relative Humidity (%)				
Fairbanks	5.43	0.71	8.15	2.55
Eielson AFB	5.93	3.35	12.45	-2.49
Ft. Wainwright	12.48	-10.39	17.09	-13.67
Three Stations	7.14	0.05	12.44	-3.32
Wind Speed (m s-1)				
Fairbanks	1.27	0.91	1.51	0.86
Eielson AFB	1.63	1.28	1.18	0.69
Ft. Wainwright	0.95	0.45	1.21	0.25
Three Stations	1.41	1.00	1.34	0.68

[27] Tesche, T.W.and D.E.McNally, and C.Tremback, (2002), "Operational evaluation of the MM5 meteorological model over the continental United States: Protocol for annual and episodic evaluation."

	Nov 2008 RMSE (MAE for wind direction)	Nov 2008 Bias	Jan-Feb 2008 RMSE (MAE for wind direction)	Jan-Feb 2008 Bias
Wind Direction (degrees)				
Fairbanks	32.8	6.1	21.6	-5.6
Eielson AFB	38.6	18.2	26.0	-10.3
Ft. Wainwright	50.8	17.9	40.3	3.4
Three Stations	41.3	13.6	29.2	-3.6

5.8.8.2. Photochemical Transport Modeling (CMAQ)

Baseline air quality model performance was evaluated for daily 24-hour average $PM_{2.5}$ over both 2008 episodes. Modeled results were compared at the State Office Building grid cell in the model using speciated $PM_{2.5}$ FRM measurement data and BAM corrected total $PM_{2.5}$ concentrations at the State Office Building monitor. Figure 5.8-9 shows the trends over the modeling episode days for observed concentrations at the State Office Building (blue line) and the modeled concentrations (green line). The modeled and observed days for episode 1 show good agreement on both high and low concentration days. In episode 2 the model does not reproduce the maximum and minimums as accurately as in episode 1, but the periods of the high and low concentrations do generally match.

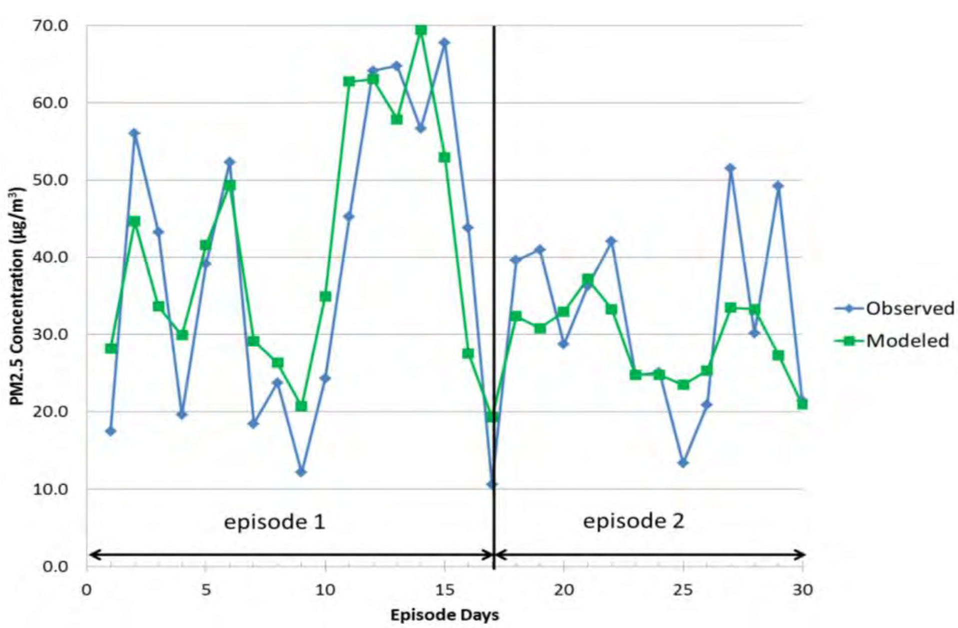

Figure 5.8-9. Modeled and Observed 24-hour Averaged $PM_{2.5}$ at the State Office Building Monitor for Both Winter Episodes

On a day-to-day basis the observed and modeled concentrations during the episodes generally track a 1:1 line seen in the scatter plot below (Figure 5.8-10). For episode days with observations on the low end of the range of measured $PM_{2.5}$ concentrations, the model tends to overestimate the $PM_{2.5}$ concentrations. Days with higher observed concentrations tend to show the model under-predicts total $PM_{2.5}$.

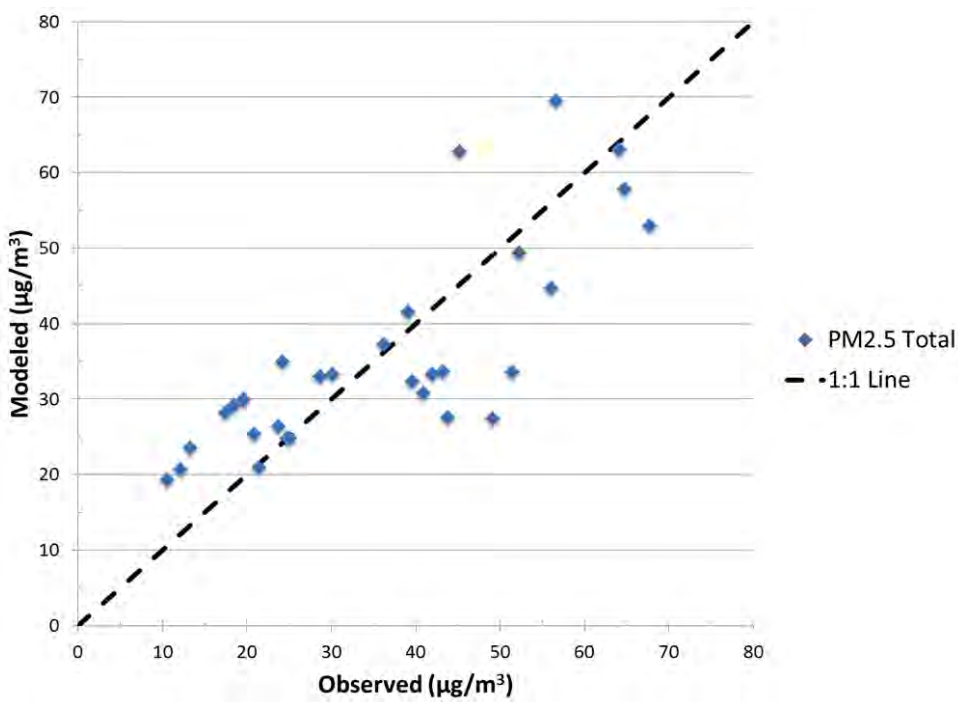

Figure 5.8-10. Scatter Plot of Observed and Modeled State Office Building Daily Episodic 24-hr $PM_{2.5}$ Concentrations

The breakdown of total particulate concentrations during the modeling episodes by percent contribution for each species is given in Figure 5.8-11 for the modeled and observed $PM_{2.5}$ at the State Office Building monitor. Observations show the $PM_{2.5}$ during the two modeling episodes is largely composed of the following in order of their contribution: organic carbon (OC), sulfate (SO_4), other primary particulates (OTH), ammonium (NH_4), elemental carbon (EC), and nitrate (NO_3). The modeled concentrations similarly reflect OC as the primary contributing species to total $PM_{2.5}$; however, the model tends to over-predict the contribution of OC and EC while under predicting the contributions of SO_4, OTH, and NH_4. The CMAQ model's low estimates of sulfate and ammonium are likely due to underperforming chemistry limiting the production of sulfate from SOx precursor gases. This under-prediction of sulfate and ammonium increases the apparent share of OC and EC in the modeled $PM_{2.5}$. The under-prediction of $PM_{2.5}$ OTH is most likely caused at the level of the emissions inventory, as OTH is not formed in the atmosphere but contributed solely by direct emissions.

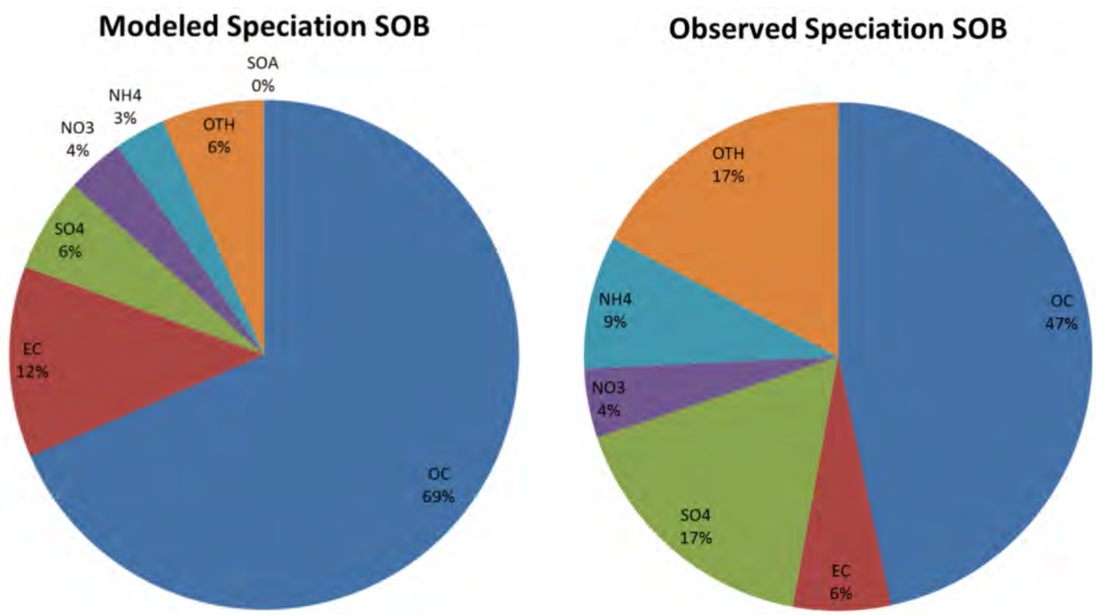

Figure 5.8-11. Baseline 24-hour Averaged Modeled and Observed $PM_{2.5}$ Speciation Over all Episode FRM Days

Speciation profiles of the PM emissions may be the cause considering that the direct emitted OC and EC are over-predicted.

Table 5.8-7 shows the average modeled and observed concentrations in micrograms per cubic meter for the winter episodes. The total $PM_{2.5}$ for the modeled and observed match to within 0.4 $\mu g/m^3$; however, the species show the over-prediction of carbon-containing compounds (OC and EC) and under-prediction of SO_4, NH_4, and OTH.

Table 5.8-7. Comparison of Modeled and Observed Particulate Matter Components

Species	Observed ($\mu g/m^3$)	Modeled ($\mu g/m^3$)
$PM_{2.5}$	36.1	35.7
OC	17.0	24.5
EC	2.3	4.3
SO_4	6.2	2.1
NO_3	1.6	1.3
NH_4	3.1	1.2
OTH	6.3	2.3
SOA	N/A	0.01

Field plots of the 2008 baseline $PM_{2.5}$ throughout the nonattainment area are shown in Figure 5.8-12 through Figure 5.8-18. The plots show the 24-hour average $PM_{2.5}$ over all episode days for $PM_{2.5}$ total, OC, EC, SO_4, NO_3, NH_4, and Other. Most of the emissions activity is contained within the nonattainment area as are the highest particulate concentrations. The model shows the highest concentrations within the downtown Fairbanks area and in grid cells to the west of town, with values in the 35 to 45+ µg/m^3 range. The model shows the next-highest $PM_{2.5}$ concentrations in the area of North Pole with values in the 25 to 30 µg/m^3. During the modeling episode, the only monitor available for $PM_{2.5}$ comparisons against the model is the State Office Building site. Assessment of model performance outside of that location is not possible. Generally, the highest concentration areas match those same areas with the highest emissions density.

The spatial extent of gaseous SO_2 concentrations is shown in Figure 5.8-19. Sulfur dioxide is an important precursor gas leading to the formation of particulate sulfate in Fairbanks, as seen in the observed PM speciation. Considering the model's under prediction of sulfate, it is useful to highlight the areas most likely to form sulfate in the atmosphere.

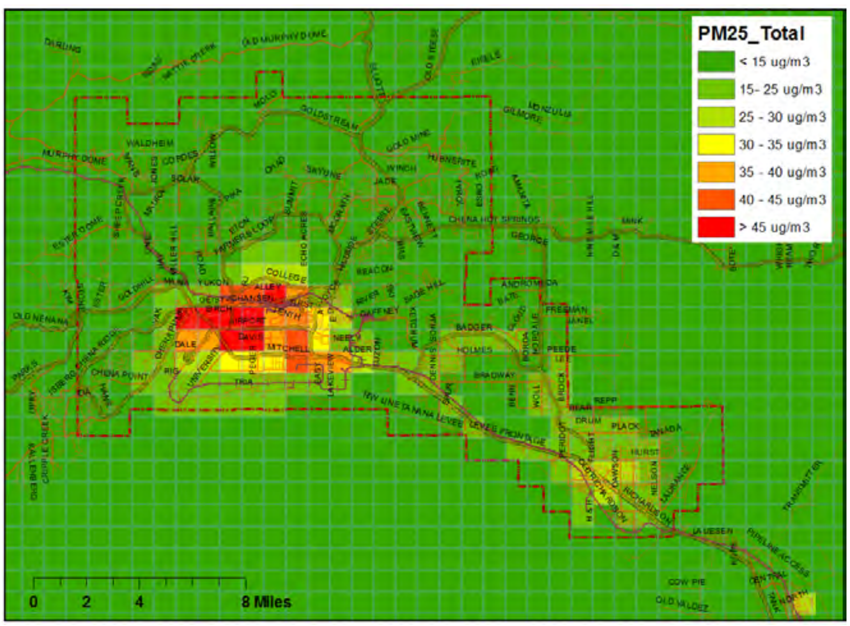

Figure 5.8-12. Baseline 24-hour Averaged Model Total $PM_{2.5}$ Concentrations for the Nonattainment Area over All Episode Days (January 23 to February 10 and November 2 to 17, 2008)

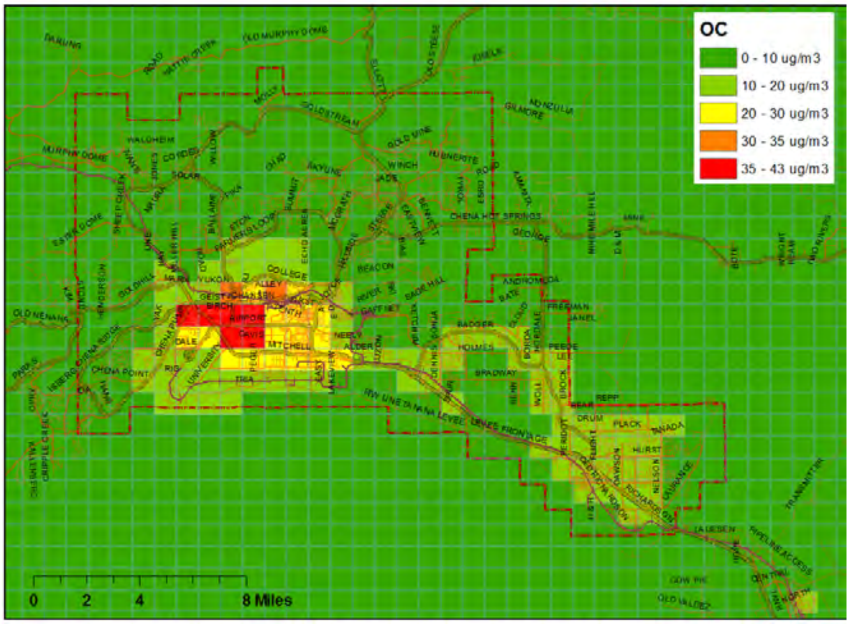

Figure 5.8-13. Baseline 24-hour Averaged Model OC $PM_{2.5}$ Concentrations for the Nonattainment Area over All Episode Days (January 23 to February 10 and November 2 to 17, 2008)

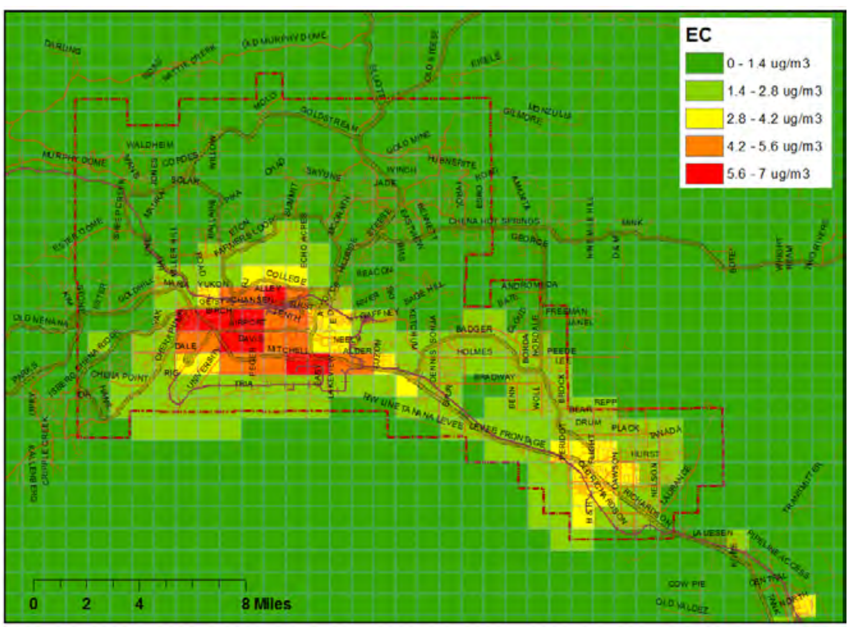

Figure 5.8-14. Baseline 24-hour Averaged Model EC $PM_{2.5}$ Concentrations for the Nonattainment Area over All Episode Days (January 23rd to February 10 and November 2 to 17, 2008)

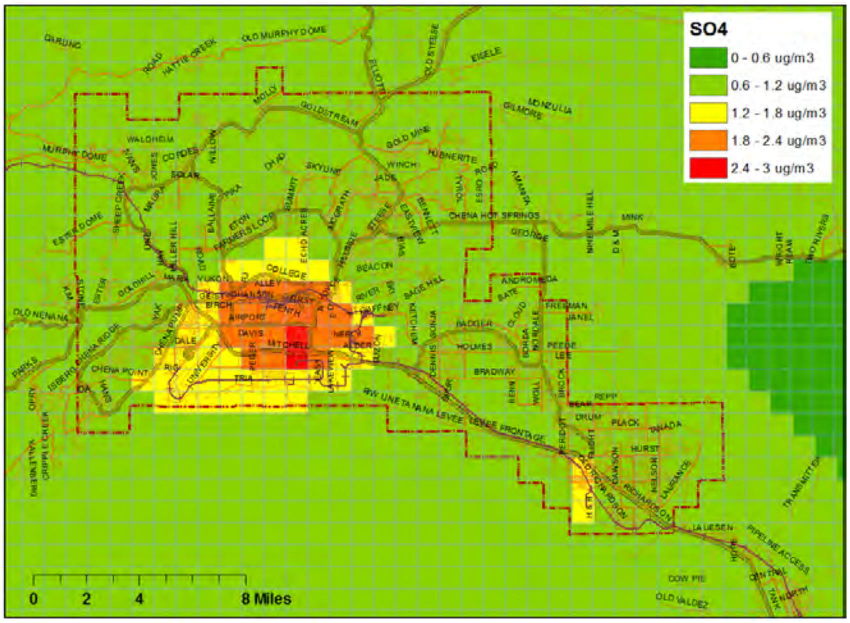

Figure 5.8-15. Baseline 24-hour Averaged Model SO_4 $PM_{2.5}$ Concentrations for the Nonattainment Area over All Episode Days (January 23 to February 10 and November 2 to 17, 2008)

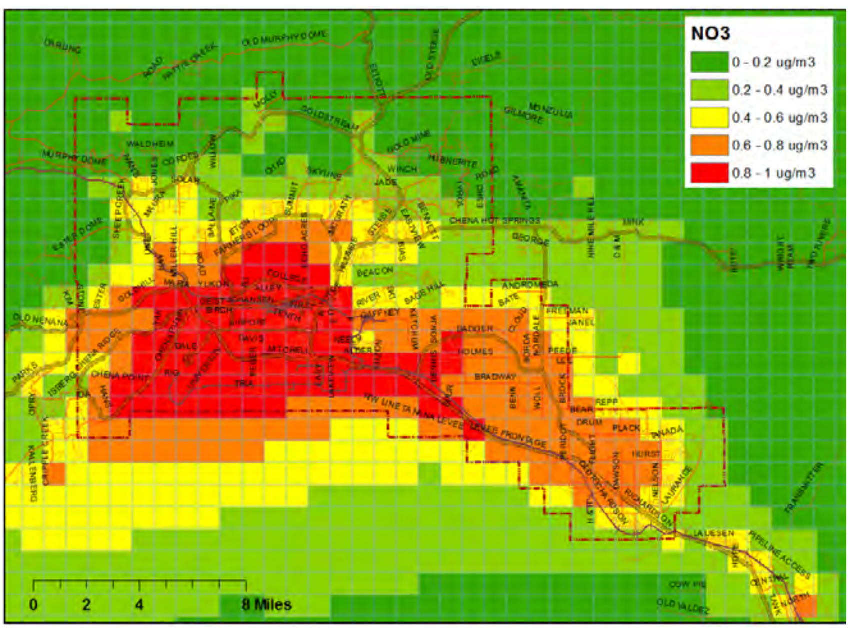

Figure 5.8-16. Baseline 24-hour Averaged Model NO_3 $PM_{2.5}$ Concentrations for the Nonattainment Area over All Episode Days (January 23 to February 10 and November 2 to 17, 2008)

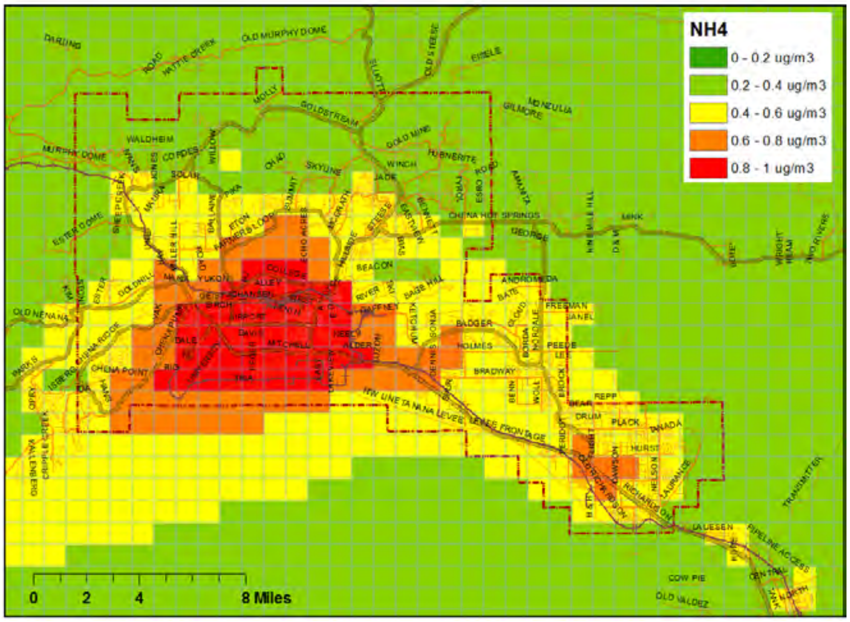

Figure 5.8-17. Baseline 24-hour Averaged Model NH4 PM2.5 Concentrations for the Nonattainment Area over All Episode Days (January 23 to February 10 and November 2 to 17, 2008)

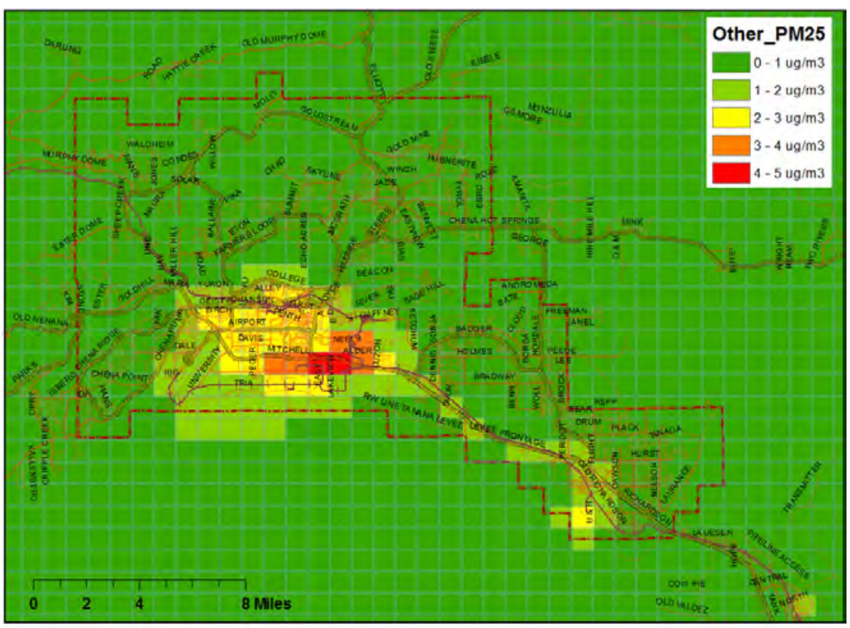

Figure 5.8-18. Baseline 24-hour Averaged Model Other $PM_{2.5}$ Concentrations for the Nonattainment Area over All Episode Days (January 23 to February 10 and November 2 to 17, 2008)

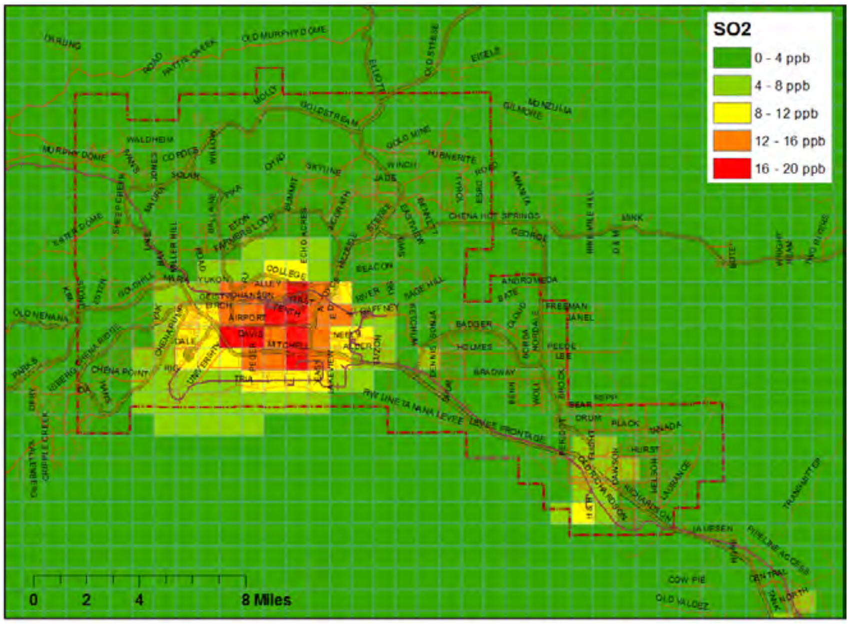

Figure 5.8-19. Baseline 24-hour Averaged Model Gaseous SO_2 Concentrations for the Nonattainment Area over All Episode Days (January 23 to February 10 and November 2 to 17, 2008)

Model performance is quantified using the mean fractional error and mean fractional bias metrics per EPA's guidance. Mean fractional error is calculated using the following formula:

$$MFE = \frac{2}{N}\sum_{1}^{N}\left(\frac{|Model - Obs|}{Model + Obs}\right) \times 100\%$$

This formula states that the error is the sum of the absolute value of the difference between Model and Observed concentrations (Model – Obs) divided by the sum of the Model and Observed concentrations (Model + Obs) over all observation days (N) multiplied by 2, divided by the number of observation days and multiplied by 100%. The error is always a positive value with a target goal of 50% or better and a criterion of 75% or better. Values can range above the criterion depending on the modeling location and the ambient concentrations to up to 125%.[28,29,30,31]

[28] Boylan, J., VISTAS, "PM Model Performance Goal and Criteria", National RPO Modeling Meeting, Denver, CO, 2005a..

[29] Morris, R., et al., "Application of Multiple Models to Simulation Fine Particulate in the Southeastern US", National RPO Modeling Meeting, Denver, CO, 2005a

Mean fractional bias is calculated in a similar fashion, except the absolute value of the Model and Observation difference is not used. MFB can be either a positive or negative value and gives an indication of whether the model is over- or under-predicting a given species.

$$MFB = \frac{2}{N}\sum_{1}^{N}\left(\frac{Model - Obs}{Model + Obs}\right) \times 100\%$$

Goal and criteria values for MFB are stated as ±30% and ±60%. [32] The range of MFB can also vary by region and pollutant with values shown up to 180% variation.

The MFE and MFB values for the baseline model are shown in Table 5.8-8. The values for MFE range from 30.2% to 88.5%. $PM_{2.5}$, OC, EC, and NO_3 are within EPA's stated criteria for MFE (<75%) with $PM_{2.5}$ and OC within the goal range (<50%). SO_4, NH_4, and OTH are outside of the criteria but within an error range comparable to other studies. MFB is shown to be within criteria ranges (<±60%) for $PM_{2.5}$, OC, EC, and NO_3 with $PM_{2.5}$ within the goal range (<±30%). SO_4, NH_4, and OTH are outside of the criteria but within a bias range comparable to other studies. Overall the total $PM_{2.5}$ response at the

Table 5.8-8. Mean Fractional Error and Mean Fractional Bias

Species	MFE (%)	MFB (%)
$PM_{2.5}$	30.2%	8.0%
OC	37.3%	34.2%
EC	52.8%	52.8%
SO_4	88.5%	-88.5%
NO_3	57.9%	-35.2%
NH_4	79.9%	-79.9%
OTH	87.3%	-87.3%

State Office Building monitor site is very good even though some components perform less well. Since there were no other monitors operating within the nonattainment area collecting speciated $PM_{2.5}$ during the episodes the performance metrics are only calculated for the State Office Building site.

[30] Tonnesen, G., et al., "Regional Haze Modeling: Recent Modeling Results for VISTAS and WRAP", CMAS Annual workshop, RTP, NC, 2003.
[31] Morris, R., et al., "Model and Chemistry Inter-comparison: CMAQ with CB4, CB4-2002, SAPRC99", National RPO Modeling Meeting, Denver, CO, 2005b
[32] [32] Boylan, J., VISTAS, "PM Model Performance Goal and Criteria", National RPO Modeling Meeting, Denver, CO, 2005a..

The performance metrics stated above can also be visualized as a soccer plot of the values. The soccer plot (Figure 5.8-20) shows the same trends as stated in the tables above. These metrics can fail to reflect that typically less stringent goals and criteria are used for less abundant species such as NO_3 and EC.[33]

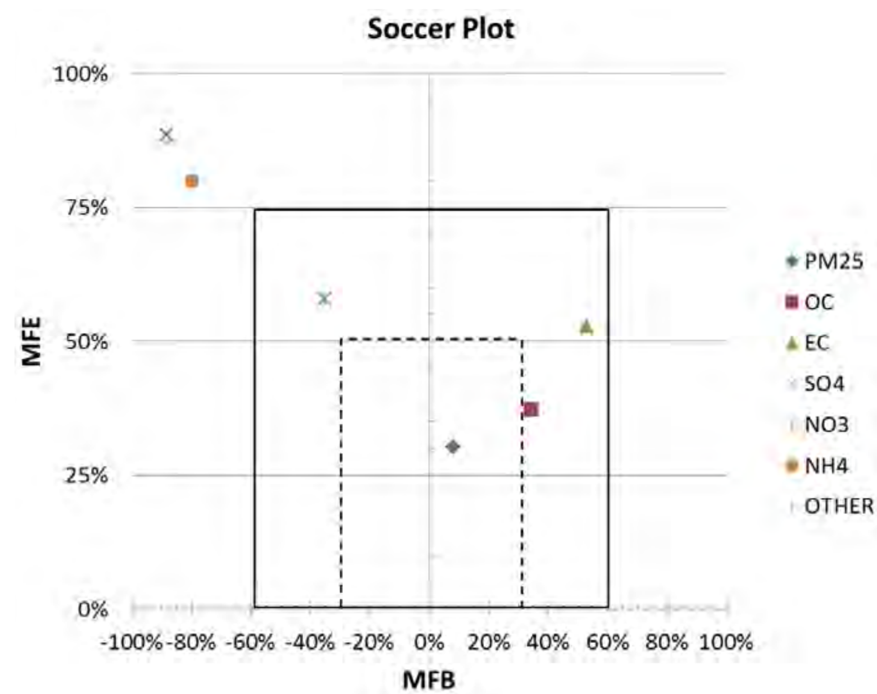

Figure 5.8-20. Soccer Plot of Mean Fractional Error and Bias at the State Office Building Monitor for Fairbanks 2008 $PM_{2.5}$ Winter Modeling Episodes

Figure 5.8-21 and Figure 5.8-22 show the MFB and MFE metrics with a higher tolerance for observations below 2.5 μg/m^3. Both EC and NO_3 are closer to the goal lines for MFE and MFB on these figures, with the NO_3 MFB falling into the goal range.

[33] Boylan, J., VISTAS, "PM Model Performance Goal and Criteria", National RPO Modeling Meeting, Denver, CO, 2005a.

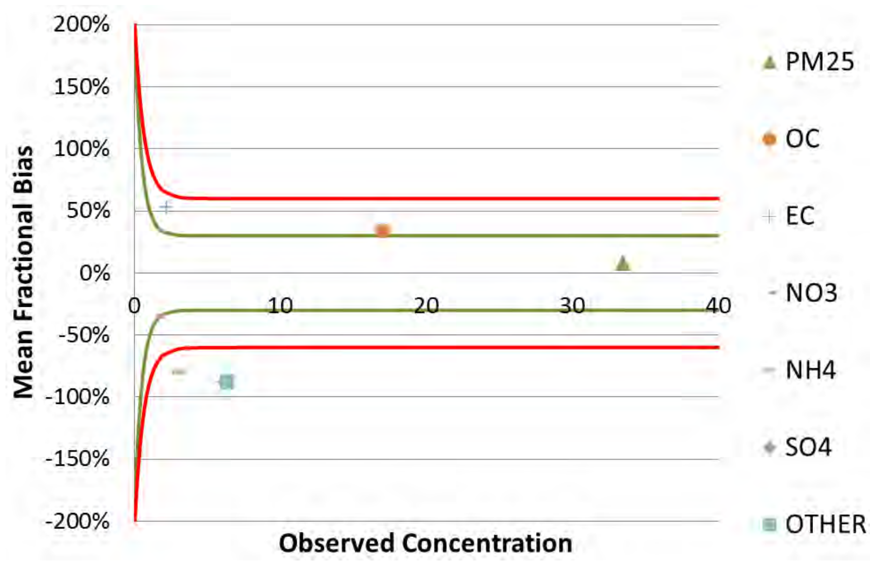

Figure 5.8-21. Mean Fractional Bias with Less Stringent Goals at Low Concentrations

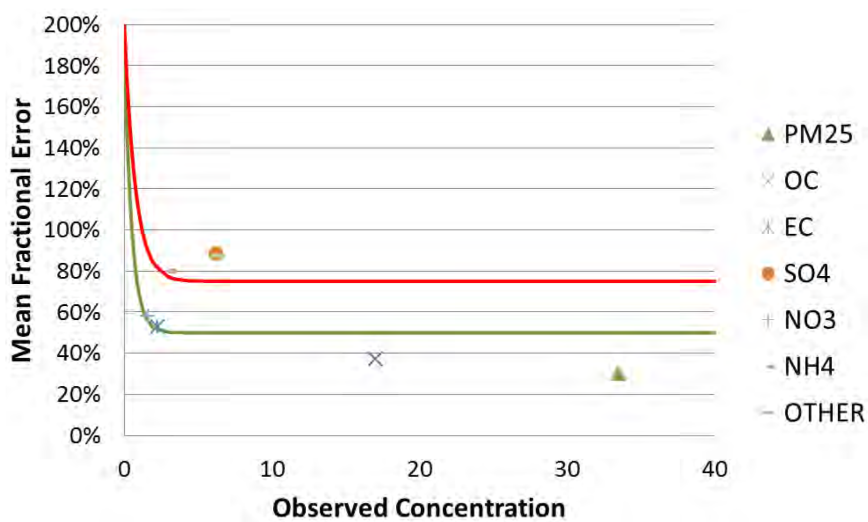

Figure 5.8-22. Mean Fractional Error with Less Stringent Goals at Low Concentrations

Overall, the model performance shows that the model does provide confidence in the prediction of total $PM_{2.5}$ at the State Office Building monitor site. Some components will receive extra scrutiny such as sulfate, ammonium, and other primary particulates as the control scenarios are evaluated due to their performance.

5.8.9. ATTAINMENT

5.8.9.1. Requirements

The modeling of attainment requires the calculation of future design values using the Species Modeled Attainment Test (SMAT) method discussed below. Modeling must be completed for the year 2015 with projected growth and control scenarios in place prior to December 31, 2014. If the projected control scenario shows attainment at the monitoring cites, then an unmonitored area analysis (UMAA) must be performed to demonstrate attainment in other grid cells.[34]

5.8.9.2. Modeling Ambient Air Quality Data using Sandwich_SMAT Methods

40 CFR part 58 requires states to monitor $PM_{2.5}$ mass concentrations using Federal Reference Method (FRM) devices to determine compliance with the NAAQS. Following 2007 EPA Modeling Guidance and Attachment B (Fox, 2011), ADEC produced the Species Modeled Attainment Test (SMAT) for the 24-hour $PM_{2.5}$ NAAQS. The method uses quarterly average FRM-derived species concentrations from the STN (speciation trend network) monitor.

The FRM monitor uses a gravimetric weight-based analysis compared to the nylon filter and denuder set up on the STN monitor. The methodology for the recommended treatment of the species data references Section 5.1.4 of the EPA (2007) guidance incorporating the Frank (2006) paper and several others. The SMAT technique uses the design value site at the Fairbanks, Alaska State Office Building (SOB) to calculate the quarterly average species mass fractions. Collocated at this site are the FRM monitor used in designation of Fairbanks as a non-attainment area and an STN monitor. The data used in the quarterly calculations are 2006-2010 for the following seven major components of $PM_{2.5}$ as recommended (USEPA, 2007):

- Measured sulfate [SO_{4STN}];
- Adjusted nitrate [NO_{3FRM}] (retained on the FRM filter);
- Adjusted ammonium [NH_{4FRM}] (retained on the FRM filter);
- Measured elemental carbon [EC_{STN}] (corrected IMPROVE to NIOSH analysis);
- Organic carbonaceous mass estimated from a mass balance [OCMmb];
- Estimated particle bound water [PBW]; and
- Estimated other primary $PM_{2.5}$ components [OPP].

[34] Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 , and Regional Haze U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Air Quality Analysis Division Air Quality Modeling Group Research Triangle Park, North Carolina - EPA -454/B-07-002 April 2007

Details on how each of the major components were calculated are provided in Appendix III.D.5.8.

Quarterly average FRM-derived species mass fractions for the wintertime quarters 1 and 4 for 2006-2010 are represented in species mass fraction percentages in Table 5.8-9. The top 25% of total number of days for quarter 1 and 4 were used for the baseline concentrations for 2006-2010.

Table 5.8-9. Quarterly average percentage of SANDWICH'ed $PM_{2.5}$ Calculated from the Top 25% of $PM_{2.5}$ Days for Years 2006-2010

	SO_{4STN}	NO_{3FRM}	NH_{4FRM}	PBW	$EC_{IM>NI}$	OPP	OCMm $b_{IM>NI}$	Non blank FRM
Q4	17.40	3.64	7.57	5.82	6.89	1.25	57.43	100
Q1	19.15	5.03	8.54	6.27	6.19	1.01	53.82	100

The FRM-derived mass species fractions are used to estimate the species contributions to the design value concentration of 44.7 µg/m^3 calculated from the EPA (2007) updated attachment B guidance document. Relative response factors (RRFs) determined below are multiplied into the individual species to determine the future design value (FDV) as calculated following the method specified by SMAT test steps 4-9 of EPA (2007) attachment B. The attainment demonstration is based on the calculated FDV following this methodology.

That guidance recommends using the average of the three design value periods centered on the year of the base year emissions. Since 2008 is the base year for planning, design values for 2006-2008, 2007-2009, and 2008-2010 were used to calculate the design value for use in attainment modeling. A description of that calculation is presented in Appendix III.D.5.8.

5.8.9.3. 2015 Attainment Modeling

Discussed below is the photochemical transport modeling of the 2015 emissions scenarios with projected activity levels and control packages. The 2015 control scenario includes benefits from the Alaska Resource Agency (ARA) Outdoor Hydronic Heater (OHH) retrofits, Wood Stove Change Out (WSCO) program, and State standards for heating devices in new homes. In addition to those programs, the 2015 baseline shows some benefits from the natural turnover of vehicles and home heating devices. Voluntary measure benefits of 0.5 µg/m^3 are also included in all calculations.[35]

[35] Calculated based on a weighted average of 6% benefit from area sources and a 3% benefit for mobile sources. Calculations are shown in the Appendix III.D.5.8. and follow

For the attainment modeling, the baseline projections were modeled for all source sectors with point sources operating at potential to emit levels (PTE). For the control package analysis for 2015, two scenarios were modeled for point source emissions: one with PTE levels and one with actual levels (Actual). The relative response factors (RRF) are calculated over the average of all episode days (minus two episode days at the start of each episode allowed for model spin up) for each of the species of $PM_{2.5}$, with three exceptions: sulfate, ammonium, and particle-bound water (PBW). Due to the model performance for sulfate, the RRF of sulfate is held at 1.00 to avoid a bias in the final control calculations. Sensitivity to this assumption is discussed in a subsequent section. The ammonium and PBW RRFs are calculated based on the RRFs for nitrate and sulfate based on EPA's guidance in "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM 2.5 , and Regional Haze."[36] Details for how these adjustments are calculated can be found in Appendix III.D.5.8.

For all other species, the RRF is calculated as the ratio of the 2015 episode 24-hour averaged concentration of a species by the 2008 episode 24-hour averaged concentration:

$$RRF_i = \frac{[i_{2015}]}{[i_{2008}]}$$

where *RRF* is the relative response factor of species *i* and [*i*] is the concentration of *i* for 24-hours averaged over all episode days in 2008 and 2015.

Table 5.8-10 summarizes the RRFs for the 2015 projected baseline with PTE-level point sources, 2015 control package with PTE-level point sources, and 2015 control package with Actual-level point sources.

The calculated RRFs for 2015 show values < 1.00 except in the case of SO_4 and other primary particulate (OTH). Generally the OTH values are biased by the presence of PTE-level point source emissions, and sulfate is held constant. Values of RRFs less than 1.00 represent a reduction in particulate concentrations for a given species. Each species' RRF has a different impact on the overall future design value (FDV) $PM_{2.5}$ concentration based on that species contribution to total $PM_{2.5}$. The FDV as described in the SMAT

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guidance from *INCORPORATING EMERGING AND VOLUNTARY MEASURES IN A STATE IMPLEMENTATION PLAN (SIP)* - Air Quality Strategies and Standards Division Office of Air Quality Planning and Standards U.S. Environmental Protection Agency Research Triangle Park, North Carolina 27711
http://www.epa.gov/ttn/oarpg/t1/memoranda/evm_ievm_g.pdf

[36] *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM 2.5 , and Regional Haze* U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Air Quality Analysis Division Air Quality Modeling Group Research Triangle Park, North Carolina - EPA -454/B-07-002 April 2007

section is the estimate of the concentration at the State Office Building monitor in the projected year 2015. The FDV is compared to the 24-hour $PM_{2.5}$ NAAQS of 35 µg/m^3.

Table 5.8-10. 2015 RRF Values for Projected Baseline and Control Scenario (PTE and Actuals)

Scenario Name	Organic Carbon (OC)	Elemental Carbon (EC)	SO_4	NO_3	Other Primary Particulate (OTH)
Baseline PTE	0.96	0.90	1.00	0.97	1.80
Control Package with PTE	0.85	0.82	1.00	0.92	1.80
Control Package with Actual	0.85	0.80	1.00	0.91	0.92

For Fairbanks the RRF of OC has the most impact on the total $PM_{2.5}$ FDV concentration, which is also reflected by OC making up the largest share of the total aerosol mass. The OTH or other component of PM has the weakest impact on the FDV. The FDV calculated from the RRF values are shown in Table 5.8-11.

Table 5.8-11. 2015 FDV for Projected Baseline and Control Scenario (PTE and Actuals)

Scenario	Description	Future Design Value (µg/m^3)
Baseline PTE	Projected 2015 baseline with point sources at PTE levels	43.2
Control Package with PTE	2015 projection with all control scenarios applied, voluntary measures, and point sources at PTE levels	40.1
Control Package with Actual	2015 projection with all control scenarios applied, voluntary measures, and point sources at actual levels	39.6

The 2015 control package with actual point source levels reaches an FDV of 39.6 µg/m^3. This value is still well above the 24-hour $PM_{2.5}$ NAAQS of 35 µg/m^3 with a further 4.6 µg/m^3 reduction in $PM_{2.5}$ required. The breakdown of individual program contributions is shown in Table 5.8-12 below. The control contributions are the same for both the PTE and Actual scenarios. Using Actual emissions for point sources reduces concentrations by 0.5 µg/m^3. Of the available controls the Fairbanks North Star Borough's Wood Stove

Change Out program provides the largest benefit with 3.0 μg/m^3 (60%) of the total PM reduction modeled for 2015.

Voluntary programs operating in the Borough include public education programs and a curtailment program. The educational component of the voluntary programs increases public awareness of air quality problems and encourages home heating practices that reduce particulate emissions. Voluntary curtailment can also reduce $PM_{2.5}$ emissions through reduced use of solid-fuel combustion on high concentration days. Voluntary measures are calculated as the maximum possible contributions of 3% of the total needed reductions for mobile source contributions and 6% of the total

Table 5.8-12. 2015 Control Benefits

Control Program	Individual Contributions to Control Scenario Reductions	Concentration Reduction (μg/m^3)
Voluntary Measures	10.5%	0.54
Natural Turnover	29.2%	1.50
Outdoor Hydronic Heater Retrofits	0.7%	0.04
Wood Stove Change Out	59.6%	3.06

needed reductions from all other sectors. Discussion of these benefits is in RACM in the Appendix III.D.5.7 and calculations are provided in Appendix III.D.5.8.

5.8.9.4. 2015 Weight of Evidence/Sensitivity

The FDV of 39.6 μg/m^3 for the 2015 control scenario reflects a best case for the adopted controls. The impacts of PTE emissions and sulfate assumptions can affect the outcome of the FDV calculations. When using PTE emissions for point sources, the increased emissions drive the FDV up to a range of 40.1 – 43.5 μg/m^3. The range of values also depends on assumptions about the source of PM2.5 sulfate. The attainment calculations above depend on the sulfate being held constant. When sulfate RRFs vary, the range of FDVs can vary for actual emissions of point sources by 39.6 to 40.1 μg/m^3. If secondary sulfates are estimated from changes in SOx emissions, the actuals final FDV would be adjusted to 40.1 μg/m^3. Calculations for these ranges are shown in Appendix III.D.5.8.

CMB, C-14, and PMF analyses suggest that wood burning's share of the inventory is on the higher end of the winter averages based on those techniques, but not outside of their range of estimates. Each of these techniques can provide some insight into the local sources that contribute to higher concentrations, but they are not perfect estimates and show disagreements as to the importance of secondary pollutants. If the modeled contributions from home heating are overestimated, the control impacts may also be overestimated; the FDV would thus be higher than the value provided.

Modeled concentrations show overestimates of direct (OC and EC) PM and underestimates of secondary (sulfate and ammonium) PM. Since the SANDWICH methodology anchors the species to actual measurements and all control impacts are calculated on a relative basis the impacts of over/underpredicting a species is somewhat mitigated.

In total, the considerations above point towards a higher FDV than 39.6 $\mu g/m^3$. A best estimate of the adjusted FDV would be over 40.1 $\mu g/m^3$. Due to the relative nature of the RRF calculations, over/underestimating a species does not appear to have a significant impact on FDV estimates. Inventory assumptions could also impact the FDV; however, the contribution of CMAQ-modeled home heating sources is within the range of other modeling technics such as CMB. This agreement provides confidence in the modeled control effectiveness.

5.8.9.5. 2015 Unmonitored Area Analysis

Given the state of modeled FDVs at the State Office Building in 2015, the need to show attainment in other grid cells is eliminated. However, the UMAA has been performed for 2015 to show the range of estimated concentrations in the nonattainment area following the application of the control package. As shown in Figure 5.8-23, surface impacts of $PM_{2.5}$ appear highest in the western portions of downtown Fairbanks and to the southeast of the State Office Building monitor cell. North Pole area concentrations also show exceedances, but do not reflect concentrations as high as those in the downtown Fairbanks area.

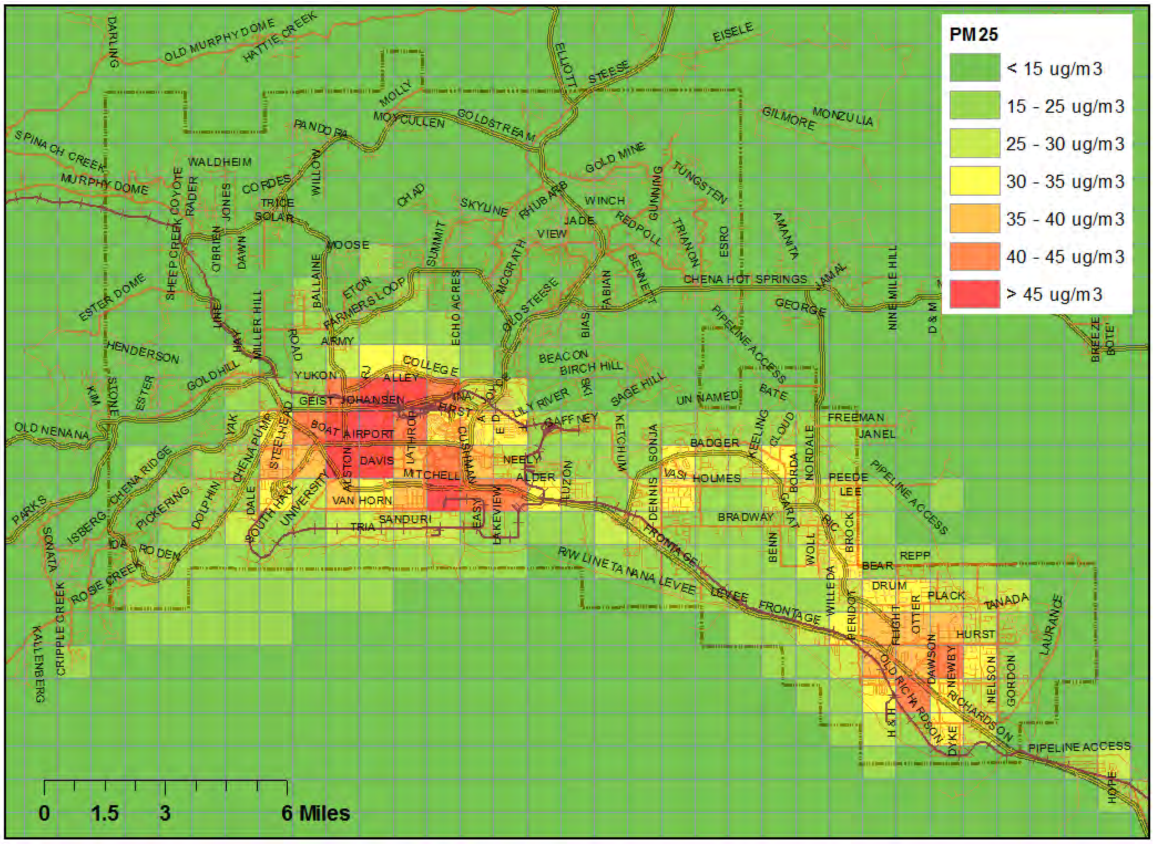

Figure 5.8-23. Unmonitored Area Analysis of 24-hour $PM_{2.5}$ for the 2015 Control Scenario

5.8.9.6. 2019 Attainment Modeling

The following modeling results are included to show the effectiveness of control programs when projected to 2019. There is no requirement to demonstrate attainment for the year 2019. Based on projections for the current control programs for 2015 to 2019 along with the addition of new control programs, a FDV was calculated for a 2019 control package. This control package contains the ARA OHH, WSCO, State standards, natural gas expansion, dry wood, natural turnover, and voluntary measures. The RRFs by species are shown in Table 5.8-13 for the baseline projected inventory and the control packages for 2019 with PTE. As with the 2015 RRF calculations, the RRFs are relative to 2008 and sulfate is held constant. Ammonium and PBW are derived from the nitrate and sulfate concentrations.

Table 5.8-13. 2019 RRF Values for Projected Baseline and Control Scenario (PTE)

Scenario Name	Organic Carbon (OC)	Elemental Carbon (EC)	SO_4	NO_3	Other Primary Particulate (OTH)
Baseline PTE	0.97	0.87	1.00	0.97	1.79
Control Package with PTE	0.60	0.59	1.00	0.99	1.79

Using the RRFs presented in Table 5.8-13, the FDV for the 2019 control package reduces concentrations to 33.5 μg/m^3 at the State Office Building site (Table 5.8-14). The projected control scenario reduces concentrations to below the 35 μg/m^3 24-hour average $PM_{2.5}$ NAAQS.

Table 5.8-14. 2019 FDV for Projected Baseline and Control Scenario (PTE and Actuals)

Scenario	Description	Future Design Value (μg/m^3)
Baseline PTE	Projected 2019 baseline with point sources at PTE levels	43.4
Control Package with PTE	2019 projection with all control scenarios applied and point sources at PTE levels	33.5

5.8.9.7. 2019 Weight of Evidence/Sensitivity

The above control scenario does not include the adoption of energy logs in the Fairbanks region by wood-burning households. A modeling analysis has shown that energy logs can contribute to a reduction in wood burning particulate emissions by up to 2.5 μg/m^3 during the modeling episodes. These estimates conservatively assume a supply of 3,700 tons of energy logs available by 2019, far below state expansion capacity.

5.8.9.8. 2019 Unmonitored Area Analysis

Figure 5.8-24 depict the results of the unmonitored area analysis for 2019, showing that high concentrations do persist away from the monitor in the 2019 control package. It is unclear how much these concentrations persist as a result of noise in the high resolution (1.33 x 1.33 km) modeling or reflect actual hot spots in the region. Additionally, some of these grid cells may show higher concentrations due to PTE-level point source emissions.

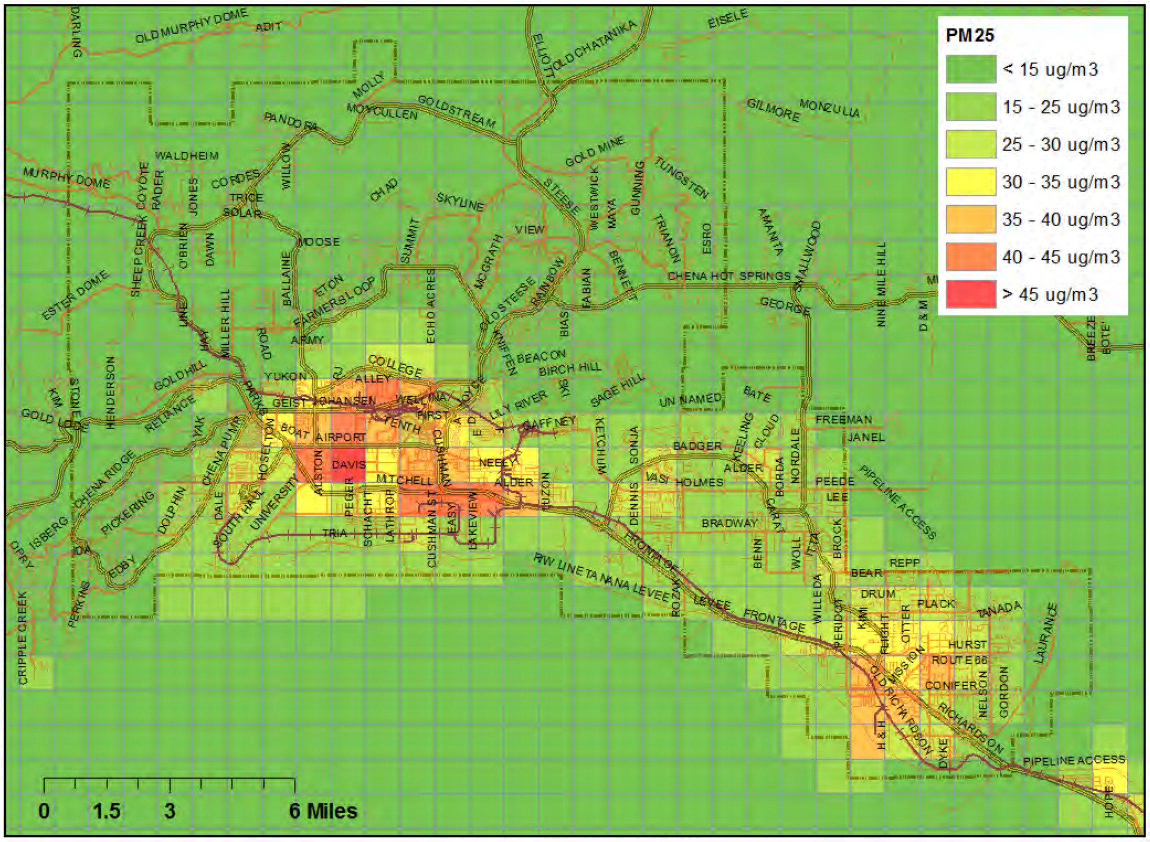

Figure 5.8-24. Unmonitored Area Analysis of 24-hour $PM_{2.5}$ for the 2019 Control Scenario

5.9 ATTAINMENT DEMONSTRATION

Section 189 of the Clean Air Act[1] requires states with a Moderate nonattainment area to prepare an implementation plan which satisfies the following requirements:

> *(A) For the purpose of meeting the requirements of section* 7502 (c)(5) *of this title, a permit program providing that permits meeting the requirements of section* 7503 *of this title are required for the construction and operation of new and modified major stationary sources of PM-10.*
>
> *(B) Either*
>
> > *(i) a demonstration (including air quality modeling) that the plan will provide for attainment by the applicable attainment date; or*
> >
> > *(ii) a demonstration that attainment by such date is impracticable.*
>
> *(C) Provisions to assure that reasonably available control measures for the control of PM–10 shall be implemented no later than December 10, 1993, or 4 years after designation in the case of an area classified as moderate after November 15, 1990.*

Information demonstrating compliance with the subsection A permit program requirements for $PM_{2.5}$ is presented in Section III.D.5.7. Compliance with subsection C requirements is documented in the summary of the reasonably available control measure (RACM) analysis findings, including RACT (reasonably available control technologies) presented in Section III.D.5.7; it shows:

- The State of Alaska and FNSB evaluated all emission units with emissions greater than 5 tons per year of $PM_{2.5}$ or its precursors (NOx and SO_2) and concluded that the current level of controls meets RACT for all of the pollutants (VOCs, NH3, NOx, SO_2) from all of the emission units.

- The State of Alaska and FNSB also determined that the control measures listed below are RACM.
  - Education and Outreach programs for residential wood combustion
  - Voluntary curtailment of wood burning on episode days
  - Require new wood combustion units to be EPA-certified
  - Provide subsidies to encourage retirement/replacement of old, noncertified wood-burning equipment
  - Reinstate open-burning bans on episode days
  - Prohibit the use of burn barrels
  - Subsidize heating upgrades and weatherization

[1] CAA Part D, subpart 4, Section 189(a)(1)(B)

Many of these measures were implemented between 2008 and 2013 to encourage changes in behavior that produce emission reductions. The Borough and State continue to operate these programs and plan to do so in the future. Since many of these programs are voluntary and it is difficult to quantify their impact on behavior, the total credit taken was limited to the EPA Guidance for voluntary measures in a SIP at 6%.

The remainder of this section presents information addressing the subsection B demonstration requirements. The deadline for demonstrating attainment for a Moderate $PM_{2.5}$ is December 31, 2015.[2] Section III.D.5.6 quantified the emission benefits of the control measures selected in Section III.D.5.7, including the following:

- ARA (catalyst retrofit of OHHs);
- Wood stove change out program; and
- Natural turnover (vehicles, wood burning appliances, etc.).

As shown in Table 5.6-22, these measures are estimated to reduce directly emitted $PM_{2.5}$ within the nonattainment area by 10.4% between the 2008 Baseline Year and the 2015 Attainment Year; impacts on precursor emissions varied by pollutant.

Section III.D.5.8 documents the use of the resulting emission inventory estimates in combination with meteorological inputs developed for the selected episodes to quantify their impact on modeled concentrations. The 2008 Baseline Year and the 2015 Attainment Year concentrations were input to the required EPA nine-step process for SMAT[3] (Speciated Modeled Attainment Test) to produce a final future design value for 2015.

The nine steps involved in the SMAT process are included below with further details available in Appendix III.D.5.8.

1. Identify the highest observed daily $PM_{2.5}$ concentrations at the State Office Building monitor between 2006 and 2010.

2. Quarterly $PM_{2.5}$ concentrations were calculated for OC, EC, SO_4, NO_3, NH_4, OPP (other primary particulate), PBW (particle bound water), salt, and blank mass at the State Office Building monitor for observed top 25% concentration days. The average of winter quarters 1 & 4 were used in step 5 for the purpose of projecting future air quality.

3. High ambient daily $PM_{2.5}$ species concentrations are calculated based on the component concentrations in step 2 and the high ambient observed days in step 1.

[2] FRN / Vol. 79, No. 105 / Monday, June 2, 2014
[3] USEPA (2011): Attachment A and B. http://www.epa.gov/ttn/scram/guidance/guide/Update_to_the_24-hour_PM25_Modeled_Attainment_Test.pdf

4. Air quality modeling results for 2008 baseline and 2015 control scenario were used to derive modeled RRF (relative response factor) values averaged over the modeling episode days for the species-specific components of $PM_{2.5}$.

5. The model-derived RRFs (step 4 are multiplied into the quarterly component concentrations (step 2) to calculate the future quarterly $PM_{2.5}$ component concentrations with the exception of ammonium and PBW.

6. Calculate the ammonium and PBW future year $PM_{2.5}$ concentrations based on the nitrate and sulfate concentrations determined in step 5.

7. Components of $PM_{2.5}$ are summed for each day in each year to calculate the total future 24-hr $PM_{2.5}$ concentrations at the State Office Building site.

8. The future year 98th percentile concentrations are determined for each year.

9. A 5-year weighted average of the future year 98th percentile values is then calculated by averaging future year 98th percentile averages in three-year intervals.

The results of that process produced a 2015 concentration of 40.1 $\mu g/m^3$, which was adjusted to 39.6 $\mu g/m^3$ to reflect the 0.5 $\mu g/m^3$ benefit of the voluntary control measures. While this value represents a substantial reduction from the 44.7 $\mu g/m^3$ design value, it falls far short of the 35 $\mu g/m^3$ standard. The weight of evidence discussion presented in Section III.D.5.8 indicates that calculated 2015 design value represents a best estimate and that if PTE levels for major point sources are included in the modeling, the design value would be increased by more than 0.5 $\mu g/m^3$ (i.e., in the wrong direction relative to the standard). The proposed state control measures that were outlined in Section III.D.5.7 are not included in the modeled demonstration for 2015 because they will not be adopted until October 1, 2015. Under EPA modeling guidance, control measures need to be in place by the beginning of the year preceding the attainment date[4]. The control programs consisting of wood stove change outs, natural turner over of newer stoves, catalysts retrofits, and including a reduction for voluntary measures are not enough to reach attainment by 2015. For these reasons, the demonstration of attainment by the December 31, 2015 deadline is impracticable.

5.9.1. 2019 Attainment Demonstration and UMAA

The 2015 impracticability demonstration, above, satisfies the requirements of the CAA Part D, Subpart 4 (sections 188-190), but also demonstrates that additional emission reductions are needed to bring the area into attainment of the 35 $\mu g/m^3$ standard. This section, while not required, has been added to illustrate that there is a potential longer term path to demonstrate attainment by 2019. Since this section is not required and is for illustration only, the level of supporting documentation provided is not as detailed as that provided for the required 2015 demonstration.

[4] EPA Modeling Guidance page 34-35

As discussed in Section III.D.5.7, additional control measures will be implemented after 2015; those measures include the following:

- State standards for wood burning appliances;
- Dry wood program; and
- Natural gas expansion.

Section III.D.5.6 shows that when the benefits of these programs are combined with the benefits of controls addressed in 2015, directly emitted $PM_{2.5}$ is estimated to decline by 27.7% within the nonattainment area by 2019 relative to 2008. Table 5.6-26 also shows the estimated reductions in precursor pollutants. The modeled 2019 concentrations using the controlled emission inventory followed the nine-step SMAT process and produced a future design value of 34.0 $\mu g/m^3$, which becomes 33.5 $\mu g/m^3$ after accounting for the 0.5 $\mu g/m^3$ benefit of voluntary measures. The weight of evidence discussion indicates that compressed wood "energy logs" may offer a new opportunity to further reduce that 2019 design value.

The future design values calculated for both 2015 and 2019 represent concentrations for the grid cell encompassing the State Office Building, which houses the monitor recording measurements used to set the baseline design value. A successful attainment demonstration, however, must show that attainment is achieved not only in that grid cell but also in all 202 x 202 grid cells that comprise the nonattainment area. In modeling, this is called the Unmonitored Area Analysis (UMAA) and every grid cell in the model represents an area of the Fairbanks NAA (details on the UMAA analysis are found the technical modeling Section III.D.5.8, section 7). Figure 5.9-1 displays the results of the UMAA calculations for each grid cell in the nonattainment area for 2019.

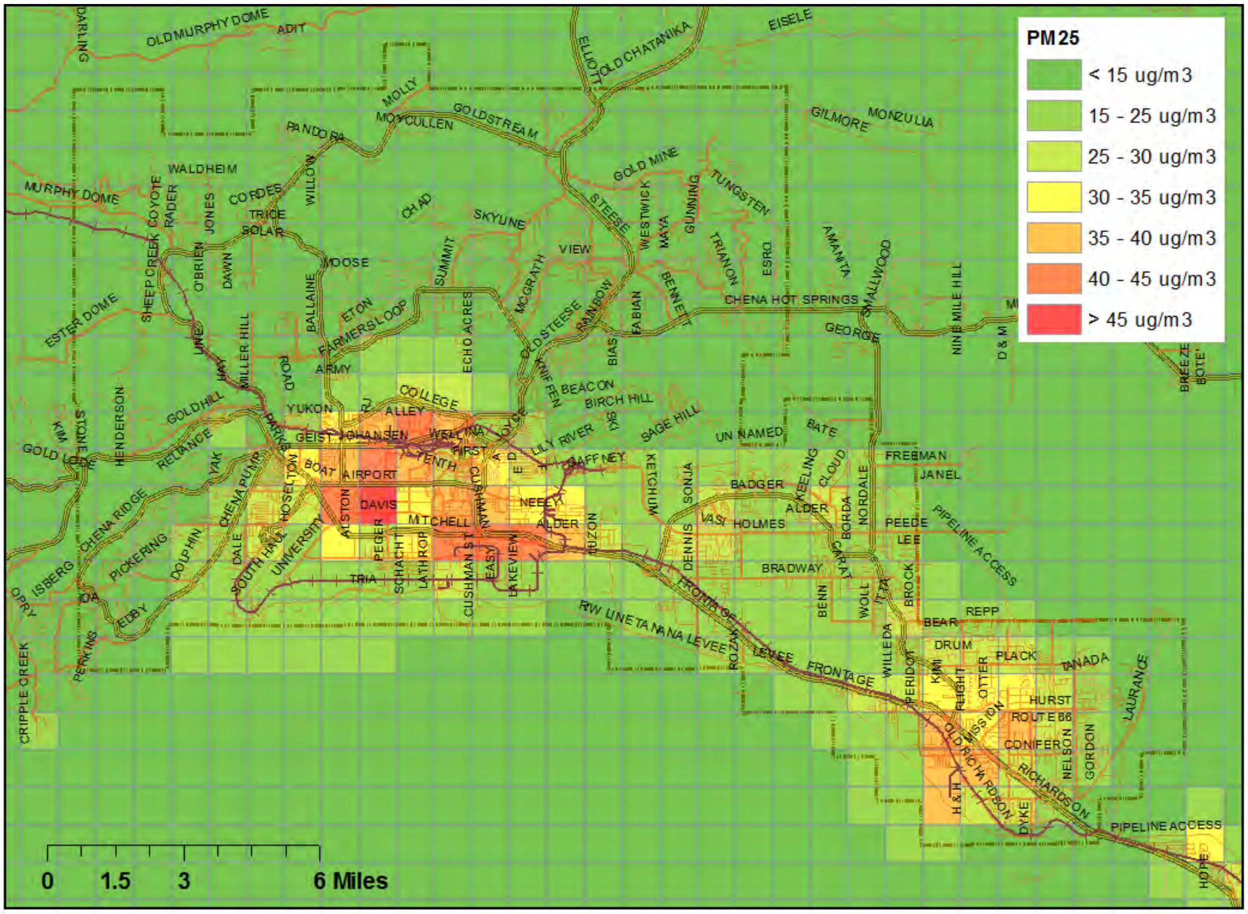

Figure 5.9-1. 2019 UMAA Concentrations for Fairbanks $PM_{2.5}$ Nonattainment Area Grid Cells

While many grid cells including the one encompassing the State Office Building in downtown Fairbanks show compliance with the NAAQS in 2019, the remaining grid cells that do not show modeled attainment will be updated and revised in the coming years as additional controls become available and are implemented. Although air quality modeling is not required for 2019 in this 2015 impracticability SIP, the inclusion of the 2019 modeling forecast shows that a path to attainment has been identified.

Under the plan provisions for impracticability in a Moderate area, the NAA area will then be reclassified as a Serious area for failing to attain the standard if the 3-year monitored design value for 2015 is greater than 35 $\mu g/m^3$ as the modeled demonstration has predicted; with that reclassification to “Serious”, more restrictive requirements will apply (CAA Part D, Subpart 4 (Sections 189).

5.10. Contingency Measures

Section 172(c)(9) of the CAA requires nonattainment plans to "provide for the implementation of specific measures to be undertaken if the area fails to make reasonable further progress, or to attain the national primary ambient air quality standard by the (applicable) attainment date . . . ." It further states that such contingency measures shall be structured to take effect, if triggered, without any further action by the State or EPA.

The fully adopted rules or control measures discussed in this section are ready to be implemented, without significant additional action (or only minimal action) by the State, as expeditiously as practicable upon a determination by U.S. EPA that the area has failed to achieve, or maintain reasonable further progress, or attain the NAAQS by the applicable statutory attainment date. This moderate nonattainment area SIP for the FNSB $PM_{2.5}$ nonattainment area shows that it is impracticable for the area to demonstrate attainment by the moderate area attainment deadline of 2015, but identifies a path to attainment of the 24-hour $PM_{2.5}$ NAAQS by 2019.

The FNSB and ADEC are actively working on implementing additional measures and a number of the contingency measures identified in this section are already either underway or being put in place. These measures will result in further emission reductions in the 2016-2019 time period. As discussed in Section III.D.5.7, two of the primary measures that will assist in bringing the area into attainment are the continuation of the FNSB heating device change out program and the expanded availability and use of natural gas within the nonattainment area. The identified contingency measures can provide SIP creditable emissions reductions that will provide generally linear progress towards achieving the overall level of reductions needed to demonstrate attainment by 2019 as described in Sections III.D.5.6 and III.D.5.9.

5.10.1. Continuation of the FNSB Solid-fuel Fired Heating Device Repair, Replacement and Removal Program

The FNSB has an on-going program to replace solid-fuel burning devices with less polluting heating appliances. During the period 2015-2019, this program would be continued as a contingency measure to provide additional $PM_{2.5}$ emission reductions.

Starting in June of 2010, the FNSB established an incentive program to encourage homeowners to replace their old, uncertified solid-fuel heaters with new EPA certified heaters. Upgrade or removal of solid-fuel heaters provides for immediate and long term emission reductions in $PM_{2.5}$. As heating fuel costs increased during the past 5 years, a large number of outdoor wood and coal boilers were installed by residents seeking to reduce their heating costs. These large units have proven problematic in some neighborhoods creating significant localized smoke impacts. The volume of solid fuel heaters, whether large or small, have combined to increase $PM_{2.5}$ levels significantly and the Borough has identified a number of "hot spot" neighborhoods. In its implementation of the change out program, the Borough has sought to prioritize their funds for upgrading units in areas with high $PM_{2.5}$ concentrations.

The change-out program has been popular with local residents and has evolved between 2010 and 2014 as the Borough adapted and improved the program to create additional incentives for participation. From inception through August 2014, the Borough has repaired, replaced, or removed significant numbers of solid-fuel heaters. Between 2008 and 2019, the Borough plans to incentivize the replacement of nearly all the uncertified wood heating devices in the nonattainment area. An estimated 4,640 of heater replacements or removals will be completed by 2019 (2,760 from the Borough's program and 1,880 from natural turnover).

5.10.2. Expanded Availability and Use of Natural Gas

As discussed in Section III.D.5.7, the State of Alaska is actively engaged in expanding the availability and use of natural gas in the nonattainment area through the implementation of the Interior Energy Project. A key to reducing fine particulate matter air pollution in the FNSB nonattainment area in the long term is expanding the availability of affordable, cleaner burning fuel options within the nonattainment area. The Interior Energy Project provides the financial tools needed to bring natural gas to the Fairbanks and North Pole area. The project was established through Senate Bill 23 which passed the Alaska Legislature unanimously in April 2013. The legislation authorizes the Alaska Industrial Development and Export Authority (AIDEA) to provide the financing package to partner with the private sector to build a liquefied natural gas (LNG) plant on the North Slope and natural gas distribution system in Fairbanks and North Pole. The current projections indicate that the earliest this project will provide additional natural gas into the community is 2016. This project will result in meaningful emission reductions between 2016 and 2019.

According to a 2014 Cardno-Entrix report prepared for AIDEA that forecasted both natural gas penetration and conversion, a penetration rate (reflecting availability of natural gas) of 36% was estimated across the non-attainment area by the end of 2018. Cardno's economic analysis projected a 77% conversion rate for existing oil and wood-burning homes with natural gas availability based on an expected retail gas price that is rougly half the current cost of heating oil. The combined penetration/conversion rate of 28% (36% × 77%) translates to an estimate of just under 10,000 homes expected to convert to natural gas heating by the end of 2018.

North Slope natural gas will be liquefied and trucked to Fairbanks using the Dalton Highway. The Dalton Highway, also known as the "Haul Road" was built to support North Slope oil and gas activities and to handle an estimated 10,000 trips per day. At full production, the initial North Slope LNG plant is anticipated to require 48 trips (30 trucks) daily. The Interior Energy Project will have the capability to expand and produce more LNG as demand grows. The initial North Slope LNG plant is anticipated to produce 6 to 9 billion cubic feet (Bcf) of gas per year. Depending on initial demand, the LNG plant could serve half to three-quarters of estimated residential and commercial heating needs for customers in Interior Alaska.

The Interior Energy Project is anticipated to reduce monthly heating bills by 40 to 50 percent, resulting in up to $3,000 of annual savings to residential ratepayers. Clean-burning natural gas will help substantially improve Fairbanks and North Pole air quality by providing an affordable substitute to wood-, coal-, and oil-burning heating systems.

The initial cost for the North Slope LNG facility is anticipated to be approximately $208 million. By 2015 it is expected that $101 million will be spent on regasification, storage and distribution to the medium-and high-density areas within the Fairbanks North Star Borough, with costs at full build out to be in the range of $258 million. The Project includes a financial package to act as a catalyst for Alaska Industrial Development Export Authority (AIDEA) and private-sector partners to finance and develop the supply and delivery of natural gas to Interior Alaska. The financing package includes a $57.5 million appropriation from the Sustainable Energy Transmission Supply and Development Fund (SETS) to serve as the State's equity stake in the project, low-interest SETS loans, coupled with State-backed AIDEA bonds. The project also leverages previous legislation that provides up to $15 million in natural gas storage credits for each qualifying LNG storage tank. The components of the state financing project include:

Sustainable Energy Transmission & Supply Development Program (SETS)

- $57.5 million appropriation to directly reduce LNG cost
- $125 million SETS capitalization to provide optimal commercial structure at 3 percent interest

AIDEA Bonds

- Authorized for $150 million to provide low-cost capital for the distribution system build out at an anticipated 3 to 4.5 percent interest rate

Existing Natural Gas Storage Credits

- $15 million per qualifying storage tank to directly reduce the customer utility price

5.10.3. Expanding Motor Vehicle Plug-In Infrastructure

As described in detail in Section III.D.5.7, engine preheaters are used extensively throughout Fairbanks when ambient temperatures drop below 0° F to ensure that motor vehicles exposed to these temperatures can be easily started. Local testing programs have confirmed that preheating vehicles, a practice commonly referred to as "plugging-in," provides a substantial reduction in motor vehicle cold start emissions. Recognizing the many benefits of plugging-in (e.g., reduced emissions, lower need for maintenance, fuel economy, startability, etc.), the Borough has a long-standing practice of expanding the number of parking spaces equipped with electrical outlets. This has been achieved by securing funds for retrofitting existing facilities (e.g., school renovations) and including outlets in new public facilities (e.g., the construction of new schools). It has also been achieved by encouraging the private sector to retrofit existing facilities (e.g., hospital expansions) and including outlets in new private facilities (e.g., Home Depot). This strategy was made more viable with Congress' passage of the Transportation Equity Act for the 21st Century that removed the restriction on the use of CMAQ funds for the Section 108(f) transportation control measure (xii) that reduces motor vehicle emissions under extreme cold start conditions. While many of the Borough parking lots have been upgraded with plug-in infrastructure in the past, the Borough will continue to work to secure CMAQ funds from the Federal Highway Administration (FHWA) to continue the program of retrofitting additional public parking lots located in the nonattainment area with electrical outlets.

5.10.4. Continuation of AHFC Energy Programs

As described in Section III.D.5.7, the Alaska Housing Finance Corporation (AHFC) implements several energy programs that are designed to make homes more energy efficient. As homeowners make energy efficiency improvements they reduce the amount of fuel and electricity needed for power and heat leading to corresponding air quality benefits due to the reduced fuels being burned for space heating and power generation. Information on AHFC energy programs is available on the internet at: www.ahfc.us/efficiency/energy-programs/. It is anticipated that AHFC energy programs will continue in the future, assuming continued funding, and, as a result, additional emission benefits will be realized in the 2016-2019 period

5.10.5. State Regulatory Contingency Measures

In addition to these important efforts that are underway, ADEC has included in its regulations additional measures that will act as contingency measures for the moderate area plan. The triggers for these measures are proposed to occur in part upon an EPA re-classification of the nonattainment area to the serious category which will occur, at the latest, when EPA notifies the state of the area's failure to monitor attainment with the NAAQS by the applicable deadline.

5.10.5.1. Reducing Woodburning Emissions through Enhanced Dry Wood Compliance

In order to enhance resident's ability to comply with the state's regulatory requirement to only burn dry wood during the winter season, the ADEC has established a contingency measure in 18 AAC 50.076(c) that requires commercial wood sellers to register with ADEC and provide moisture content information to consumers at the time of wood sale and delivery. The disclosure of wood moisture content to consumers that buy wood provides them with the information needed to make appropriate decisions about seasoning their wood and planning ahead for when it will be ready for use in their wood heater. This additional information will be useful in improving compliance with the state's regulatory dry wood requirement, which results in significant $PM_{2.5}$ emission reductions in the area.

5.10.5.2. Requiring Replacement of Older Wood Heating Devices When Properties Are Sold

As described previously, replacing old wood heating devices with new, cleaner units is an important strategy in reducing $PM_{2.5}$ air pollution in the community. In order to ensure that older wood heating devices are turned over at a substantial rate, ADEC has established a future contingency measure in 18 AAC 50.077 that requires older wood fired heating devices to be replaced upon the sale of a property. The contingency measure also provides the ability for a local air quality program to substitute a local program in lieu of the state requirement.

5.10.6. Process for Identifying Additional Contingency Measures

Beyond the solid fuel-fired heating device change out program, enhanced availability and use of natural gas, and state regulatory contingency measures, the FNSB and ADEC continue to seek additional measures that may be developed and considered for implementation in the coming years. Working with the local community and elected officials, the agencies will evaluate programs that may serve as contingency measures or that can be included in any needed updates to the local air quality control plan.

In October 2014, the residents of the FNSB voted on a ballot initiative that would have retained restrictions on the Borough's authority to address home heaters and fuels. That ballot initiative failed. As a result, the FNSB has a renewed ability to consider additional measures to reduce air pollution resulting from local sources. Should the Borough determine to implement additional local measures, those programs may serve as additional contingency measures and can be included in revisions to the local air quality plan.

In the event monitoring data indicate that violations of the NAAQS continue to occur beyond the moderate attainment deadline of 2015, the FNSB and ADEC would use monitoring data to assess the spatial extent (i.e., hot spot versus region) and severity of violations as well as trends over time. Based on this information, Borough staff in consultation with ADEC would determine additional measures that may be added to the suite of measures currently in place or already identified as contingencies for this plan. Additional measures can be integrated into the air quality planning process and included in future revisions to the area's air quality State Implementation Plan. Once measures are implemented, the Borough will track monitoring data and determine in consultation with ADEC whether additional controls are needed.

Two emerging opportunites for additional $PM_{2.5}$ emission reductions are described below:

- *Enhancing the Use of Manufactured Compressed Wood Logs*

An emerging opportunity for additional emission reductions is the use of manufactured, compressed wood logs. Over the past year, locally manufactured logs (also known as pellet logs or energy logs) have been introduced into the Fairbanks firewood market. The FNSB and ADEC have been researching and evaluating this product for its potential use in the local air quality programs. A review of the literature found 1990 vintage test measurements of compressed wood "energy" logs produced in Idaho showed substantial reductions in wood burning particulate (PM) emissions (i.e., 60% for certified stoves and 90% for uncertified stoves) relative to cordwood. Since the cordwood and the manufactured logs used in these tests do not represent the mix of wood products available in Fairbanks, are not of the same dimensions as the locally manufactured logs and may not have equivalent moisture content levels, the FNSB issued a procurement to measure emissions of (1) dry Fairbanks birch cordwood (20% moisture content), (2)manufactured logs (7.5% moisture content) and (3) a 50/50 mix of cordwood and manufactured logs in both an EPA certified stove and an uncertified stove. Representative samples of the cordwood and manufactured logs were shipped to Dirigo Laboratories in Portland, Oregon for PM emission testing at both low-medium and high burn rates. Test results at low-medium burn rates, which are typical of wood stove operations in Fairbanks and used to quantify emissions in this plan's emission inventory showed:

- reductions in PM emissions for both the manufactured logs and the 50/50 mix relative to dry cordwood, ranged from 18% - 54%, and
- reductions in PM emissions for the 50/50 mix were roughly twice those found when using manufactured logs alone, ranging from 40% - 54%.

ADEC expanded on the initial testing effort by FNSB by commissioning tests of (1) wet Fairbanks birch cordwood (~40% moisture content) and (2) a 50/50 mix of wet cordwood and manufactured logs. Test results at low-medium burn rates showed the 50/50 mix produced:

- 64% reduction in PM emissions for both uncertified and certified stoves relative to wet cordwood.

While the test results are based on limited samples, they indicate substantial emission reduction potential when the manufactured logs are burned in combination with cord wood (wet or dry). Discussions with the vendor producing the manufactured logs indicates that current production capacity is 3,000 tons/year and that engineering plans are being developed to increase that capacity to 15,000 tons per year.

A program targeting manufactuted log/cordwood mix use on unhealthy days (defined as days forecasted above 35 ug/m^3), which averaged 24 days/winter 2010 – 2013 at the State Office Building, was considered based on current and forecasted manufactured log production capacity.

- Assuming a 60% compliance rate with such a targeted program by 2019, a 50/50 mix program would produce an additional 21.8% reduction in space heating PM emissions using 3,700 tons per/year, which is well below potential production capacity in 2019.

Fairbanks currently provides a $300 voucher for homeowners participating in the wood stove change out program for the purchase of either pellets or manufactured logs. Additional programs could be targeted to encourage the use of manufactured logs in combination with cordwood. The vendor is tracking sales and will make a decision in the spring of 2015 on whether to expand production capacity.

- *Expansion of Diesel Anti-idling Program*

As discussed in detail in Section III.D.5.7, ADEC and DOT&PF have developed a Fairbanks specific CMAQ-funded pilot program intended to reduce heavy duty diesel emissions in the nonattainment area through anti-idling, maintenance, and other emission reduction opportunities. The focus of the program is to expand the use of auxiliary heaters to reduce idle time thereby reducing emissions and providing an associated cost saving due to less use of diesel fuel. The program has the following elements:

1. Provide support for the existing DOT&PF anti-idling pilot project currently underway in Fairbanks by assisting with telemetric purchase and installation, installation of additional heaters, and assisting with education and training. With assistance from this program, the DOT&PF pilot program will be fully functional and will be able to provide additional information to assist in expanding anti-idling to others.

2. Expand anti-idling to other heavy duty vehicles within the FNSB nonattainment area; state fleets, local government fleets, private fleets, and commercial fleets. This includes working with the heavy duty fleet owners by providing education materials and training, contracting for installations of auxiliary heaters, and providing incentives for participation including purchasing of heaters and auxiliary equipment.

3. During installation of program auxiliary heaters, conduct an inspection of the vehicle to identify where additional emission reduction possibilities could be implemented – such as maintenance (filter, tune-up), if vehicle is a candidate for retrofit technologies or repower, and/or candidate for additional emission reduction equipment (particulate matter traps). Partnership and incentive opportunities with vehicle fleet owners will be explored to further emission reduction benefits while a vehicle is in shop.

This pilot program is intended to develop into an on-going program with respect to new installation of heaters and emission reduction equipment on diesel equipment within the nonattainment area. Should this pilot program prove successful, an on-going measure will be considered for implementation as a future strategy for the local air quality plan. Overall operations and maintenance of the new equipment will be the responsibility of fleet owners. Original startup costs for new fleets (new installation of heaters, initial maintenance, or initial retrofits, additional emission reduction technologies) coming into the program are intended to be covered entirely or in part through the use of CMAQ funds. Once initiated, future installations within a fleet would be limited to actual heater installations and/or telemetrics only.

As envisioned, project funds would be provided for first time installations only, not for replacement of worn out heaters. The cost of a single auxiliary heater installation is approximately $3500. Conservative estimates indicate auxiliary heaters may save 30% in fuel costs alone along with a 30% reduction in emissions. The cost of the fuel alone, would easily pay for any future replacement of the auxiliary heater and software. The life of the auxiliary heaters is more than ten years, so continued anti-idling use will provide benefits (emission reductions and fuel savings) for the life of the equipment.

5.11. Fairbanks Emergency Episode Plan

Section 127(a) of the 1990 Clean Air Act Amendments (CAAA) requires all SIPs to include measures providing public notification of instances or areas in which any NAAQS is exceeded, and of the health hazards associated with such pollution. EPA previously issued guidance on the adoption of emergency episode plans designed to keep air pollution concentrations below those levels considered to have adverse consequences on human health.

5.11.1. Forecasting $PM_{2.5}$ Air Quality Episodes

The Fairbanks North Star Borough (FNSB) monitors $PM_{2.5}$ air quality in the nonattainment area and provides daily air quality forecasts using EPA's Air Quality Index (AQI) on its web site at http://co.fairbanks.ak.us/airquality/. The Borough posts separate AQI forecasts for Fairbanks and North Pole. The forecasts are based on $PM_{2.5}$ data collected from the Borough's ambient monitoring/meteorological reporting network and supplemented by a predictive model developed specifically for the purpose of forecasting $PM_{2.5}$ events in the community.

The AQI is an index for reporting daily air quality. It provides information on how clean or polluted the air is, what associated health effects may be of concern, and actions to take to reduce exposure and health impacts. The AQI provides six categories that correspond to a different level of health concern:

- Good – Air quality is satisfactory and poses little or no health risk.
- Moderate – Air quality is acceptable; however, pollution may pose a moderate healtth concern for a very small number of individuals.
- Unhealthy to Sensitive Groups – Members of sensitive groups (like elderly, children, those with heart or lung disease) may experience health effects, but the general public is unlikely to be affected.
- Unhealthy – Everyone may begin to experience health effects. Members of sensitive groups may experience more serious health effects.
- Very Unhealthy – Everyone may experience more serious health effects.
- Hazardous – The entire population is even more likely to be affected by serious health effects.

To support this function, FNSB uses an air quality forecasting tool called the AQ Alert Model that projects $PM_{2.5}$ concentrations over a four day window (the remainder of today, tomorrow, and the following two days). The model outputs include the predicted values for $PM_{2.5}$ concentrations (rolling 8-hour averages and 24-hour daily averages) at each monitor site over the next four days along with the weather conditions forecast by NWS as context for understanding the $PM_{2.5}$ predictions. To accomplish this, the model accesses in near-real time a wide range of data on recent $PM_{2.5}$ concentrations and meteorological conditions at the monitor sites, surface observations and upper air soundings taken at the Fairbanks airport, and forecasts of surface and upper air conditions from the Global Forecast System (GFS) weather prediction model operated by the National Weather Service. These data are combined within the model to drive a statistical representation of the relationship between meteorological conditions and ambient $PM_{2.5}$ concentrations. The statistical model is based on a detailed analysis of data from the FNSB area and is updated annually to account for changes in consumer behavior that influence $PM_{2.5}$ concentrations. FNSB recently completed an assessment of the model's performance in the 2013-2014 winter and found that 88 percent of the time it correctly predicted whether an exceedance would occur on the following day.

Air quality specialists at FNSB use the model during the day to monitor changing air quality conditions at the monitors. Forecasts of future $PM_{2.5}$ levels can be generated at any time but are normally prepared in the hour preceding 5 pm local time. Air quality specialists use themodeled forecasts as one input to the decision-making process for issuing an air quality advisory. Other inputs are the afternoon forecast of dispersion conditions issued by the NWS forecasting office in Fairbanks and the assessment by FNSB personnel of many factors based on their long-standing experience in observing air quality in Fairbanks, including the rate of change in concentrations at the monitors and the location and movement of weather fronts seen in satellite photos.

5.11.2. Borough Episode Program

In June 2010, the FNSB Assembly adopted revisions to the Borough's Code to establish the local $PM_{2.5}$ Air Quality Control Program in Chapter 8.21.[i] A copy of this ordinance, 2010-28, is included in Appendix III.D.5.12. In Section 8.21.040, the code requires the Borough to issue daily weekday $PM_{2.5}$ forecasts during the months of October through March (i.e., the period of potential wintertime $PM_{2.5}$ episodes).

The code requires an air quality alert to be declared whenever the Borough determines that concentrations have reached the onset level for an air quality episode and concentrations are expected to remain at that level for 12 hours. Alerts are called when the Borough's Air Quality Division determines, using available data, that $PM_{2.5}$ concentrations are expected to exceed 35 ug/m3, the level of the 24-hour $PM_{2.5}$ NAAQS. When a local air quality alert is declared, the Borough Air Quality Program notifies local media to ensure that the declared alert is broadcast to the public. This notification includes the $PM_{2.5}$ forecast and additional information on how the public can further reduce $PM_{2.5}$ emissions. Declaration of an local air quality alert results in the implementation of voluntary restrictions for the duration of the air pollution episode. Residents shall be requested to voluntarily stop operation of solid fuel burning appliances, pellet stoves, and masonry heaters within the nonattainment area during the episode.

In 2014, the Fairbanks North Star Borough established a program to further encourage, incentivize, and facilitate the voluntary cessation of the use of wood burning appliances (i.e., wood stoves, wood-fired hydronic heaters, wood-fired furnaces, fireplaces, fireplace inserts, masonry heaters or pellet fuel burning appliances) in the nonattainment area during air quality episodes. The Borough recognized that it will be difficult or impossible for some households to participate in this program (e.g., those that heat solely with wood or for which wood is a necessary supplement during periods of cold weather). Therefore, this program is designed and intended for households that are able to use space heating alternatives with significantly lower PM2.5 emissions, including those fueled by gas, oil, electricity, propane or district heat, but not wood or pellet stoves or other wood burning appliances.

The Voluntary Burn Cessation Program (VBCP) consists of five separate components; an Alert System, Social Media, Public Awareness, Marketing, and Incentive program.

- **Alert System:** Alert Media selected as the notification platform. Alert messages during episodes are sent out through email, text messaging and social media.
- **Social Media:** Alerts, daily forecast, and program signup are available via Facebook.
- **Public Awareness:** 4 updateable reader-boards and 10 static sandwich board signs placed alongside roads in Fairbanks and North Pole displaying VBCP activity.
- **Marketing:** Radio, TV, and Newspaper advertising to create awareness of the VBCP and current air quality.
- **Incentives:** The Borough will recognize all participants of the program at the end of the year through a Fairbanks Daily Newsminer advertisement.

5.11.3. State Episode Program

In addition to the Borough AQI forecast and local episode actions, ADEC has also been implementing actions to address high concentration episodes. ADEC's statewide $PM_{2.5}$ air episode and air advisory requirements are framed in regulation at 18 AAC 50.246. The regulations split the overall emergency episode response approachces into two categories: air episodes and air advisories. $PM_{2.5}$ air episodes rely on air monitoring data and are called when concentrations reach specific thresholds defined in the regulation. Air advisories are not strictly reliant on air monitoring data and may be called when the department finds that, in its judgment, that air quality conditions exist that might threaten public health; the advisory regulation allows for ADEC response to poor air quality in areas where no air monitors may exist. These two categories have differing response features and trigger different supporting requirements within the state regulations. In both cases, like the Borough, ADEC publicizes the air quality episode or advisory and any actions to be taken to protect public health. However, 18 AAC 50.246 also allows ADEC to take action upon a Borough air quality episode or advisory. To avoid duplication of effort, ADEC and the Borough may clarify their respective roles under 18 AAC 50.246 through the Air Quality Memorandum of Understanding (MOU). In the absence of a revised MOU, ADEC will continue addressing high concentration episodes as described in this section.

Air episodes for $PM_{2.5}$ are defined in 18 AAC 50.246. Formal episodes may be triggered if the concentration of an air pollutant in the ambient air has reached, or is likely in the immediate future to reach, any of the concentrations established in Table 6a of the regulation. For $PM_{2.5}$ the formal episode concentrations adopted in 2014 are as follows:

Table 5.11-1. State $PM_{2.5}$ Episode Levels

Episode Type	24-hour Average $PM_{2.5}$ Concentration (micrograms per cubic meter)
Air Alert	35
Air Warning	251
Air Emergency	351

During a formal air episode, in addition to providing information on protecting an individual's health, ADEC will provide information on how an individual may assist in reducing emissions. In some instances, ADEC may prescribe and publicize opacity limits for solid fuel-fired heating devices as described further below.. ADEC tailors its response and curtailment actions to address the specific conditions surrounding a specific air pollution event. The following state regulations are also triggered by the declaration of an air episode (in addition to any regulations triggered by the declaration of an air quality advisory as described below):

- 18 AAC 50.075(d)

  A person may operate a wood-fired or solid fuel-fired heating device in an area for which the department has declared a PM-2.5 air quality episode under 18 AAC 50.246, only if: visible emissions or opacity from the wood-fired or solid fuel-fired heating device are below the opacity levels identified in the episode announcement for that area as defined in the *State Air Quality Control Plan* adopted by reference in 18 AAC 50.030.

Air advisories are established under 18 AAC 50.246(b), which sets forth that "the department will declare an air quality advisory if, in its judgment, air quality or atmospheric dispersion conditions exist that might threaten public health". If the department declares an air quality advisory it may request voluntary emission curtailment actions. For $PM_{2.5}$, the department declares air advisories when pollutant concentrations have reached, or are expected to reach, 35 ug/m^3, the level of the NAAQS. The following specific state regulations are triggered by the declaration of an air quality advisory:

- 18 AAC 50.065(e)

  "Open burning is prohibited in an area if the department declares an air quality advisory under 18 AAC 50.245, stating that burning is not permitted in that area for that day. This advisory will be based on a determination that there is or is likely to be inadequate air ventilation to maintain the standards set by 18 AAC 50.010. The department will make reasonable efforts to ensure that the advisory is broadcast on local radio or television."

- 18 AAC 50.075(a)(2)

  "A person may not operate a wood-fired heating device in a manner that causes
  (1) black smoke; or
  (2) visible emissions that exceed 50 percent opacity for more than 6 minutes in any one hour, except during the first 20 minutes after initial firing of the unit, in an area for

which an air quality advisory is in effect under 18 AAC 50.245 or 18 AAC 50.246. Visible emissions are measured following opacity reading procedures as required by Vol. 3., sec. IV-3, Appendix IV-3, of the state air quality control plan, adopted by reference in 18 AAC 50.030;

Given the history of significant wintertime air quality episodes within the FNSB $PM_{2.5}$ nonattainment area and concerns of local residents related to the implementation of wood heating curtailment during air quality episodes, and concern about emissions from solid-fuel fired devices that use coal, ADEC is defining its approach for allowing solid-fuel fired devices to operate during an episode provided they meet an opacity level during formal air quality episodes inside the nonattainment area under 18 AAC 50.075(d).

Solid-fuel Fired Device Opacity Levels during Air Quality Episodes Under 18 AAC 50.075(d)

Given community concerns about the reasonableness of requiring residents to cease use of solid fuel-fired heating devices during periods of poor air quality coupled with extreme cold temperatures, ADEC adopted state regulations that would allow continued use of solid fuel-fired heating devices during air quality episodes, but only if they are operated in a clean and efficient manner. When operated properly, solid-fuel fired heating devices emit little or no smoke.

The visible emission regulations in 18 AAC 50.075(d) would apply specific opacity levels during formal air quality episodes. Properly operated, efficient solid-fueled heating devices using the proper fuels should be able to meet the stated opacity limits during an episode. Efficient operations not only reduce air pollution but allow for the burning of less wood, an economic or time savings to residents who buy or cut wood.

For the FNSB nonattainment area, ADEC is setting specific visible emission or opacity limits that must be met at specific $PM_{2.5}$ concentration thresholds. Should ADEC determine that the specific conditions surrounding a specific air pollution event within the FNSB nonattainment area warrant an announcement for opacity restrictions for solid fuel-fired heating devices, ADEC will issue an episode alert and within the alert identify the specific opacity limit that is in effect. The opacity limits for the FNSB non-attainment area during air episodes are as follows:

Table III.D.5.11-2
FNSB Opacity Limits during Air Episodes

Opacity Limit	$PM_{2.5}$ Concentration in micrograms per cubic meeter
40%	> 35 (24-hour average)
30%	> 56 (24-hour average)
20%	> 150 (24-hour average)

For compliance and enforcement purposes, opacity is measured using EPA method 9, as modified by following opacity reading procedures as required by Vol. 3., sec. IV-3, Appendix

IV-3, of the state air quality control plan, adopted by reference in 18 AAC 50.030; by a person who has passed and is current in their Method 9 certification.

Upon observing an opacity limit exceedance during a declared episode the department will attempt to provide education on the correct maintenance and operation of the solid fuel-fired device. Education could also include the use of proper fuels. If education does not provide a remedy to the opacity exceedances, the department may issue a Notice of Violation, Abatement Order, or may pursue other administrative enforcement remedies.

ADEC will use the following approaches to notify the public of requirements and address any compliance issues. The public will be notified of an air quality episode that has specific opacity limits utilizing several outreach methods. All episode announcements are emailed to ADEC's up-to-date distribution list. This distribution list contains all local media outlets (radio, TV), the FNSB Air Quality Program staff, elected officials, and anyone who signs up for electronic notices. ADEC has online sign-up capabilities for various electronic notices and alerts through its *Air Online Services* accessible through the Division of Air Quality's home page at: http://dec.alaska.gov/air . In addition to these electronic emailed announcements, all advisories (alert and episode) are posted to the Division's Air Quality Advisories web page at: http://dec.alaska.gov/Applications/Air/airtoolsweb/Advisories/, which includes the actual advisory, the start and end dates, the area, and status (expired, active) of the advisory. ADEC will also post advisories on its Burn Wise Alaska face book page as well as the department's Twitter account.

In addition to providing notification when the opacity limits are in effect, the department plans to provide on-going public information on the opacity limits and ways that residents can comply. Difficulty meeting opacity limits could be due to wet wood. Residents will be encouraged to find dry wood or purchase manufactured wood logs (e.g. energy logs) to mix with their wet wood to assist in bringing down emissions. Residents will be directed to those wood sellers participating in the voluntary *Moisture Disclosure Program* where wood sellers either disclose the moisture content of purchased wood or agree to provide dry wood. Brochures on proper maintenance and operation of a solid-fuel fired device will also be available. To the extent that ADEC resources allow, staff can assist residents who request help in determining in advance of episode conditions whether their typical burning operations meet the opacity limits outlined in this plan.

If a resident is found to be out of compliance with the opacity limits identified for a specific episode, ADEC is responsible for taking actions to enforce the requirement. The department's compliance activities are conducted using the tools and authorities provided under the state statutes. The Division of Air Quality does not have statutory authority to issue administrative penalties for violations of Alaska environmental law. This means that ADEC staff cannot simply write "tickets" to individuals that are found to be violating the opacity limits. All compliance and enforcement activities are case specific, however, ADEC generally initiates compliance activities in response to complaints received that indicate the potential for violations of a state regulation. ADEC staff investigate complaints to verify or corroborate a problem or violation of a state requirement. In most cases, the department finds that compliance can be achieved through assistance to businesses and individuals in understanding the regulatory requirements and how they can comply. In the case of problem burners failing to meet these opacity levels during air quality episodes, it is important to bring a unit into compliance quickly to reduce smoke and assist in bringing levels of $PM_{2.5}$ into compliance in the local area. As a result, if a resident working with or without the assistance of ADEC does not come into compliance, ADEC staff would request that the resident stop burning for the duration of the air quality episode if they have another heating source available. In the event that compliance assistance is not successful in resolving a recurring smoke concern at a specific residence or business, the department staff may use additional administrative enforcement tools, such as nuisance abatement orders, to address the concern.

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[i] Fairbanks North Star Borough Assembly Ordinance No. 2010-28, June 10, 2010.

5.12. Assurance of Adequacy

Under Section 110(a)(2)(E) of the CAA, each SIP must provide the necessary assurances that the State or the general-purpose local government designated by the State (e.g., the FNSB) for such purposes will have "adequate personnel, funding, and authority" under State or (as appropriate) local law to carry out the SIP. The CAA also states that the SIP must provide necessary assurances that, where the State has relied on a local government for the implementation of any plan provision, the State has responsibility for ensuring adequate implementation of such plan provisions.

5.12.1. Local Legal Authority

As described previously (Section III.D.5.7 Control Strategies), the local control measures contained in this SIP for FNSB consists of the solid-fuel fired heating device replacement program, motor vehicle plug-in program, and a number of voluntary measures including public education, mass transit, and a voluntary burn cessation program. ADEC has delegated authority for local air pollution control to the FNSB under AS 46.14.400 (formerly AS 46.03.210). AS 46.03.210 allowed local municipalities to establish air pollution control programs within their jurisdictions by August 5, 1974. The FNSB Assembly adopted that authority by ordinance. Included in Appendix III.D.5.12 are copies of the FNSB Code of Ordinances related to the air pollution control program as follows:

- Chapter 8.04 Air Pollution
- Chapter 8.20 Vehicle Plug-In Program
- Chapter 8.21 $PM_{2.5}$ Air Quality Control Program

In 2010, ADEC and the FNSB updated the agencies Memorandum of Understanding for Air Quality to include the roles and responsibilities for air pollution control in the $PM_{2.5}$ non-attainment area that continues FNSB's lead role in developing the local air pollution control plan for $PM_{2.5}$.

5.12.1.1 Adequate Local Personnel and Funding

The overall budget and staffing level of the Borough air program is reviewed annually by the FNSB Administration and Assembly during the adoption of the FNSB's annual operating budget. Upon justification by the program manager, the Assembly provides the Administration with authorization for adequate personnel to carry out the $PM_{2.5}$ air program. This annual process ensures that program staffing levels can be upgraded on a timely basis if required, while also providing the fiscal control required by FNSB statute.

5.12.2 State Commitment to Implement Plan

While ADEC has delegated authority for local air pollution control to the FNSB as described above, the state is responsible for implementing some aspects of this $PM_{2.5}$ air pollution control plan. ADEC understands its responsibility under the Clean Air Act and is committed to implementing the state programs contained in this $PM_{2.5}$ air quality plan and, should the FNSB fail to do so, the Borough programs. ADEC's legal authorities are described in Volume II of the Air Quality Control Plan. ADEC's Air Quality budget and staffing levels are reviewed annually by the Alaska Legislature as part of the state's annual operating budget. This annual process ensures that adequate personnel and resources are available to implement the state's Air Quality Control Plan.

5.13. AIR QUALITY CONFORMITY AND MOTOR VEHICLE EMISSION BUDGET

5.13.1. REGULATORY OVERVIEW

Transportation conformity is required under Clean Air Act section 176(c) (42 U.S.C. 7506(c)) to ensure that federally supported highway and transit project activities are consistent with the purpose of the state air quality implementation plan (SIP). The requirements for transportation conformity are found in State regulation at 18 AAC 50 Article 7, Conformity, and in Volume II Section III.I in the State Air Quality Control Plan.

Conformity for the purpose of the SIP means that transportation activities will not cause new air quality violations, worsen existing violations, or delay timely attainment of the relevant national ambient air quality standards (NAAQS or "standards") or any required interim emissions reductions or other milestones. The U.S. Environmental Protection Agency's (EPA) transportation conformity rule (40 CFR 51.390 and Part 93) establishes the criteria and procedures for determining whether transportation activities conform to the SIP. Conformity helps protect public health through early consideration of the air quality impacts of transportation decisions in places where air quality does not currently meet federal standards.

In March, 2010, the EPA finalized changes to the transportation conformity rule that primarily affected $PM_{2.5}$ and PM_{10} non-attainment and maintenance areas. The final rule provides clear guidance on how to implement transportation conformity under the 2006 $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS) to ensure transportation planning and air quality planning are coordinated and air quality is protected.

On October 7, 2014 EPA approved the release of the MOVES2014[1] emissions model for SIPs and transportation conformity analyses in states other than California.[2] This approval also started a two-year transportation conformity grace period that ends on October 7, 2016, after which MOVES2014 is required to be used for new transportation conformity analyses outside of California.

Specific guidance on $PM_{2.5}$ conformity requirements is also contained in the Final Fine Particulate Implementation Rule.[3] A court decision[4] in January 2013 remanded the $PM_{2.5}$ rule back to EPA to be re-promulgated to be consistent with Subpart 4. EPA withdrew the Subpart 1-based guidance document and new Subpart 4 based guidance has not been issued.

[1] Vehicle emissions in the SIP were developed based on MOVES2010a, which was released in August 2010 and was the latest version of MOVES at the time SIP inventory development work began. In April 2012, EPA released an updated version, MOVES2010b. For criteria pollutants addressed under this SIP both versions of MOVES produce essentially identical results.
[2] Federal Register, Vol. 79, No. 194, Tuesday, October 7, 2014.
[3] Federal Register, Vol. 72, No. 79, Wednesday, April 25, 2007.
[4] Natural Resources Defense Council (NRDC) v. EPA, No. 08-1250 (D.C. Cir., Jan. 4, 2013).

Until EPA re-promulgates the implementation rule to meet Subpart 4 requirements, the 1992 general preamble[5] to the Clean Air Act and its addendum are the only available guidance documents.

5.13.2. Regional Conformity and Motor Vehicle Emission Budget

EPA requires that all non-attainment areas develop a motor vehicle emissions budget for use in determining regional transportation conformity. The process used to calculate the motor vehicle emission budget is described in Chapter 5.6.5. Relevant portions of that description are presented below to ensure consistency in the information presented and to avoid the need for readers to shift between sections of this document.

Need for MVEBs – Generally, motor vehicle emission budgets (MVEBs) must be established within a SIP for use in subsequent regional transportation conformity analysis that is tied to the SIP's attainment demonstration and the on-road vehicle emissions share of the overall attainment inventory. However as discussed in Chapter 5.9, the central finding of this Moderate Area SIP is that attainment of the $PM_{2.5}$ NAAQS by the required 2015 deadline will be impracticable in Fairbanks due to the magnitude of required reductions and the difficulty and the cost of implementing measures that achieve these reductions in the near term (i.e., by 2015).

A control strategy implementation plan revision and MVEB is defined under 40 CFR §93.101 as follows:

> *Motor vehicle emissions budget is that portion of the total allowable emissions defined in the submitted or approved control strategy implementation plan revision or maintenance plan for a certain date for the purpose of meeting reasonable further progress milestones or demonstrating attainment or maintenance of the NAAQS, for any criteria pollutant or its precursors, allocated to highway and transit vehicle use and emissions.*

EPA's Office of Transportation and Air Quality (OTAQ) and Office of Air Quality Planning and Standards (OAQPS) through EPA Region 10 were consulted to assess the need for MVEBs within this SIP. EPA confirmed the need for MVEBs within this "impracticability" SIP, citing language in the 1992 General Preamble[5] for Title I implementation of the CAA. Under the Reasonable Further Progress (RFP)/Quantitative Milestone (QM) Requirements portion of the Particulate Matter, Statutory Background section [III.C(1)(f)], the Preamble contains the following language:

> *The PM-10 non-attainment area SIP's must include quantitative emissions reductions milestones which are to be achieved every 3 years and which demonstrate RFP, as defined in section 171(1) until the area is redesignated attainment [section 189(c)].*

and

> *There is a gap in the law that the text of section 189(c) does not articulate the starting point for counting the 3-year period. The EPA believes it is reasonable to begin counting*

[5] Federal Register, Vol. 57, No. 74, April 16, 1992.

the 3-year milestone deadline from the due date for applicable implementation plan revisions containing the control measures for the area. The EPA believes it is reasonable to key the milestone clock to the SIP revision containing control measures which will give rise to emission reductions.

Although this Preamble was written prior to development and implementation of separate ambient standards for $PM_{2.5}$, EPA has confirmed that the language above for PM_{10} also applies to $PM_{2.5}$ SIPs. Thus, EPA guidance was that MVEBs must be developed under this SIP pursuant to the RFP/QM requirements of Section III.C(1)(f) of the Preamble.

<u>MVEB Calendar Year and Pollutants</u> – EPA has interpreted the three-year milestone deadline for Fairbanks as the 2014 due date for this Moderate Area SIP. Thus, MVEBs were established for calendar year 2017. Separate budgets of on-road motor vehicle emissions occurring within the non-attainment area were set for both directly-emitted $PM_{2.5}$ and NOx, the latter based on EPA's interpretation of applicable precursor requirements under 40 CFR §93.102(b)(1) and §93.102(b)(2)(iv).

<u>Summary of MVEB Methodology</u> – The MVEBs were calculated using the same approach applied in modeling motor vehicle emissions within the SIP emission inventories. The MVEB modeling is summarized below.

- *Emissions Model* – Emissions were calculated using the MOVES2010a vehicle emissions model, executed in county-wide "Inventory" mode. The model was run to generate emissions over the six-month non-attainment season (October through March).

- *Activity Inputs* – Vehicle activity inputs (VMT by vehicle type, speed distributions, road type VMT distributions) for calendar year 2017 were developed by interpolating activity between the 2010 and 2035 calendar years for which regional travel demand model outputs supporting FMATS.

- 2012-2015 TIP modeling were available. The same locally developed seasonal, weekly, and diurnal travel activity profiles used in the SIP inventories were also used to generate the MVEBs. Default MOVES activity was assumed for heavy-duty trucks (with no explicitly input extended idling).

- *Fleet Characteristics Inputs* – 2017 vehicle populations were extrapolated from actual 2010 registrations using the same growth rate assumptions used to generate the 2015 and 2019 Projected Baseline inventories. Vehicle age distribution and Alternative Vehicle and Fuel Technology (AVFT) inputs were based on the calendar year 2010 registration data, with an exception for light-duty vehicle age distributions explained as follows. Age distribution inputs for light-duty vehicles were based on wintertime parking lot survey data collected by ADEC, rather than registration data. Multiple parking lot surveys have consistently found that older vehicles are operated less during winter due to drivability concerns. In developing winter non-attainment season inputs, motorcycles were assumed to not operate during harsh winter conditions. Thus their populations were zeroed out.

- *Meteorology Inputs* – Based on interagency consultation guidance from EPA and FWHA, single hourly ambient temperature and relative humidity profiles were developed from hourly temperatures (and humidity data) averaged across the 35 modeling episode days and used as the meteorology inputs to the MVEB modeling. The average ambient temperature across all hours of the 35 modeling episode days was -11.8°F. This was consistent with episodic modeling inventory development in the SIP although the average meteorology profile across the 35 episode days was used for the MVEB while individual day meteorology (for each of the 35 days) was used to establish the MVEB and was agreed upon in consultation with EPA and FHWA.

- *Plug-In Adjustments to $PM_{2.5}$ Emissions* – Finally, starting exhaust $PM_{2.5}$ emissions for light-duty gasoline vehicles were adjusted to account for the effects of wintertime vehicle plug-in block heater use in Fairbanks. These adjustments were applied using an EPA-accepted approach that consisted of modifying the MOVES soak time distribution inputs for light-duty vehicles contained in *OpModeDistribution* table in the model's default database. Appendix III.D.5.6 provides further details on these plug-in adjustments. Note that EPA's approval of the methodology for modeling the adjustments only extends to analyses conducted using MOVES2010; additional interagency consultation will be needed to identify a methodology for use with MOVES2014.

Motor Vehicle Emission Budgets – Using the modeling methodology outlined above, MOVES2010a was executed with locally developed inputs representative of wintertime calendar year 2017 conditions. Table 5.13-1 summarizes the resulting regional average winter day on-road vehicle $PM_{2.5}$ and NOx emissions, which represent the applicable MVEBs under the SIP.

Table 5.13-1
Fairbanks Non-Attainment Area Motor Vehicle Emission Budgets

	Motor Vehicle Emission Budgets (tons/day)	
Calendar Year	**$PM_{2.5}$**	**NOx**
2017 and later	**0.33**	**2.13**

The $PM_{2.5}$ MVEB shown in Table 5.13-1 includes the plug-in adjustment effects. (As noted earlier, the plug-in adjustments are applied only to starting exhaust emissions for light-duty gasoline vehicles. Plug-ins reduced vehicle fleet-wide $PM_{2.5}$ emissions by 5.4%.) The $PM_{2.5}$ MVEB assumed zero contribution from fugitive road dust, consistent with the SIP inventory assumption that road dust emissions do not occur during winter in Fairbanks when road surfaces are snow- and ice-covered. The emissions budget also does not include construction dust for the same reason.

Budget Adequacy Requirements - For an emissions budget to be found adequate by EPA, the revisions to the air quality control plan that establishes the budget must fulfill a series of requirements per 40 CFR 93.118(e)(4). Each of these requirements are listed in *italics* below, along with specific actions that satisfy each requirement.

- *Be endorsed by the Governor (or a designee)* - Prior to submittal to EPA, this plan will be filed by the Lieutenant Governor as per state regulation.

- *Be subject to a public hearing* - Prior to submittal to EPA, these plan revisions will be the subject of a public hearing held in Fairbanks on <Insert Date>. The affidavit of oral hearing will be included in Appendix III.D.5.13.

- *Be developed through consultation among federal, State and local agencies* - Federal, state, and local agencies were consulted on the motor vehicle emissions budget. Specifically, the state has held monthly status calls related to the regulatory requirements and the appropriate technical methodologies for development of the motor vehicle emissions budget. These calls have involved appropriate DEC, FMATS, Borough, EPA, FHWA and FTA personnel. The most recent call was held on October 3, 2014 and focused on ensuring consistency between budgets established in the SIP and estimation of vehicle emissions under subsequent conformity determinations.

- *Be supported by documentation that has been provided to EPA* - This plan contains documentation supporting the motor vehicle emission budget. See Section III.D.5.6. The $PM_{2.5}$ and NOx vehicle emission inventories are described in further detail in Appendix III.D.5.6.

- *Address any EPA concerns received during the comment period*

- *Clearly identify and precisely quantify the revised budget* - This section clearly identifies the motor vehicle emissions budget for Fairbanks.

- *Demonstrate that the budget is consistent with and clearly related to the emissions inventory and the control measures in the plan revision* - The motor vehicle emissions budget is established based on the Fairbanks $PM_{2.5}$ emission inventory and control measures included in the plan. In particular, see Sections III.D.5.6, III.D.5.7, III.D.5.8, and III.D.5.9.

- *Explain and document revisions to the previous budget and control measures, and include any impacts on point or area sources* - The budget presented in this plan is the initial emission budget for the $PM_{2.5}$ non-attainment area.

- *Address all public comment on the plan's revisions and include a compilation of these comments* - The response to comments received will be included in Appendix III.D.5.13.

Once a motor vehicle emissions budget is found to be adequate by EPA, the Fairbanks non-attainment area Transportation Plans and Transportation Improvement Programs (TIP) must be less than or equal to the motor vehicle emissions budget. For projects not from a conforming plan and TIP, the additional emissions from the project together with the transportation plan emissions must be less than or equal to the budget.

Interagency Consultation - Under 40 CFR 93.105, the Fairbanks Metropolitan Area Transportation System (FMATS), the MPO in the Fairbanks North Star Borough PM2.5 non-attainment area, must coordinate interagency consultation procedures for regional transportation conformity determinations to ensure transportation plan emissions are properly calculated in a manner consistent with the applicable SIP.

5.13.3. PROJECT-LEVEL CONFORMITY

Interagency Consultation - Under 40 CFR 93.105, FMATS must similarly coordinate interagency consultation procedures for project-level conformity determinations (as is the case for regional conformity). Because the boundary of the non-attainment area is larger than the MPO boundary, in 2010, the transportation and environmental agencies within the area (Alaska DOT&PF, ADEC, FMATS, and FNSB) established a *Memorandum of Agreement for the Development of Transportation Conformity Determinations within the Fairbanks PM2.5 Non-attainment Area*.[6] The agreement was established for the purpose of conducting cooperative planning and analysis of, and determining transportation conformity, for all transportation projects within the Fairbanks $PM_{2.5}$ non-attainment area and outlines the roles and responsibilities for the agencies. It includes discussion of the extent of FMATS's involvement in any specific project-level determination. Interagency consultation is used in all project-level conformity determinations and FMATS data may be valuable in hot-spot analyses, especially regarding regional transportation and traffic conditions and emissions.

The interagency consultation process will be the key means of ensuring emissions are properly calculated. The interagency consultation process will also be important in ensuring that appropriate analyses of project emission impacts are conducted. As always, conformity determinations will be subject to the applicable public review requirements required under regulation. This provides the public an opportunity to comment on the approach that is taken for the conformity determination for each plan, program and project.

The project sponsor is the agency responsible for implementing the project. Typically, the project sponsor is a local government, transit operator, or state department of transportation. The project sponsor is responsible for providing the $PM_{2.5}$ and/or PM_{10} hot-spot analysis described in 40 CFR 93 or the approved conformity SIP. The interagency consultation process is critical to completing project-level conformity determinations and $PM_{2.5}$ and PM_{10} hot-spot analyses. The project sponsor, in cooperation with federal agencies, is also responsible for conducting the environmental analysis and review to comply with NEPA as required by the Council on Environmental Quality regulations (40 CFR 1500-1508) and the FHWA/FTA Environmental Impact and Related Procedures (23 CFR Part 771).

Analysis Guidance - EPA released guidance for the preparation of Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Non-attainment and Maintenance Areas in November 2013.[7] It provides guidance on estimating project level PM emissions using MOVES. It also provides

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[6] http://fmats.us/wp-content/uploads/2012/08/MOU-for-FBX-Transportation-Conformity-PM-2-5-Final.pdf

[7] http://www.epa.gov/otaq/stateresources/transconf/policy/420b13053-sec.pdf

guidance in selecting appropriate air quality models, determining background concentrations from nearby and other emission sources, calculating PM design values and preparing conformity determinations. These requirements should be addressed in the interagency consultation process, so that FMATS and the State can determine the support needed to:

- prepare MOVES-based emission estimates which reflect appropriate fleet characterization, activity and meteorological inputs and plug-in adjustments;
- access monitoring data available to characterize background concentrations; and
- specify meteorological conditions used in air quality modeling to assess conformity.

5.13.4. GENERAL CONFORMITY

For projects requiring general conformity determinations, it is also important to consider the impacts of off-road motor vehicle emissions (e.g., idle emissions) in developing conformity determinations. Interagency consultation shall be used to determine whether off-network mobile source emissions are significant and what analysis of these emissions is appropriate for determining general conformity. An example of this type of project is an airport expansion. Federal actions not funded or approved under Title 23 or the Federal Transit Act should assess project emissions relative to de minimus thresholds established for $PM_{2.5}$ and precursor emissions[10] and applicability requirements established in § 93.153 to determine whether general conformity requirements apply.

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