State of Alaska 2010 Ambient Air Quality Network Assessment

Monitoring and Quality Assurance
Division of Air Quality
Department of Environmental Conservation
Anchorage

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BACKGROUND

The U.S. Environmental Protection Agency (EPA) finalized an amendment to the ambient air monitoring regulations on October 17, 2006. As part of this amendment, the EPA added the following requirement for state, or where applicable local, monitoring agencies to conduct a network assessments once every five years [40 CFR 58.10(e)].

> *"(e) The State, or where applicable local, agency shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in appendix D to this part, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby States and Tribes or health effects studies. For PM2.5, the assessment also must identify needed changes to population-oriented sites. The State, or where applicable local, agency must submit a copy of this 5-year assessment, along with a revised annual network plan, to the Regional Administrator. The first assessment is due July 1, 2010."*

This requirement is an outcome of implementing the National Ambient Air Monitoring Strategy (NAAMS, the most recent version is dated December 2005, U.S. Environmental Protection Agency, 2005). The purpose of the NAAMS is to optimize U.S. air monitoring networks to achieve, with limited resources, the best possible scientific value and protection of public and environmental health and welfare.

A network assessment includes (1) re-evaluation of the objectives and budget for air monitoring, (2) evaluation of a network's effectiveness and efficiency relative to its objectives and costs, and (3) development of recommendations for network reconfigurations and improvements. EPA expects that a multi-level network assessment will be conducted every five years (U.S. Environmental Protection Agency, 2005). Initial network assessments for the NAAMS were led by EPA and its 10 regional offices in 2001 through 2004 (U.S. Environmental Protection Agency, 2003b). This initial assessment, as well as peer-reviews of the NAAMS by subcommittees of the EPA Clean Air Scientific Advisory Committee (Hopke, 2003), (Henderson, 2005), produced the recommendation that guidance for regional-scale network assessments be established.

INTRODUCTION

The Department of Environmental Conservation (DEC) has been evaluating ambient air quality in Alaska since the late 1970s. Challenged by Alaska's size, over 572,000 square miles, and its relatively small population, currently 686,300, the department has had to rely on the public to help identify potential air quality issues. Because it has not been possible to monitor the air quality in every community, the Department (DEC) has had to take a three-pronged approach to the monitoring network design:

- Monitoring in larger communities to cover the largest possible population exposure. (State and Local Air Monitoring (SLAM) and Special Purpose Monitoring (SPM))

- Monitoring in designated smaller towns that are representative of multiple communities in a region. Generally this monitoring is done with Special Purpose Monitoring Sites.

- Monitoring in response to air quality complaints. This is performed using SPM samplers.

In the past, this has meant that air monitoring focused on Alaska's largest population centers: the Municipality of Anchorage (293,000), Fairbanks and Juneau (each approximately 31,000) There are no other communities with populations over 10,000. In recent years the monitoring network expanded to the population centers of Wasilla and Palmer (each 9,000), as the Matanuska Susitna Borough is experiencing significant growth. Throughout the State there are only a few communities with populations between 1,000 and 10,000. Approximately one third of Alaska's population lives in small rural communities of less than 1,000 residents.

Geography

Alaska comprises one sixth of the United State's landmass, spanning 20 degrees of latitude (51°N – 71°N) and 58 degrees of longitude (130°W – 172°E). Alaska contains 65% of the U.S. continental shelf, more shoreline than the rest of the 49 states combined, 17,000 square miles of glaciers, 3,000,000 lakes that are over 20 acres in size, and receives 40 % of the U.S. fresh water runoff. Figure 1.1 shows a map of Alaska and the diverse climate regions described below.

The **Panhandle** is a temperate rain forest in the southeastern part of Alaska that is mainly comprised of mountainous islands and protected marine waterways. Rainfall exceeds 100 inches per year in many areas. Most communities are small and have less than 5,000 year-round residents. Juneau, the State's capital, is the largest city in the region with a population of approximately 30,700.

The **South Gulf Coast** is one of the wettest regions in the world. Yakutat receives over 150 inches of non-thunderstorm rain per year and Thompson Pass averages over 700 inches of snow annually. The area is covered with rugged mountains and barren shoreline and is the target of many Gulf of Alaska storms. This coastline only contains a handful of small fishing communities.

Figure 1: Map of Alaska - the majority of the Aleutian Islands (west) is omitted.

Southcentral Alaska is fairly temperate in comparison to the rest of Alaska. Rainfall varies widely across the region, averaging between 15 inches per year in the Matanuska-Susitna (Mat-Su) Valley and 60 inches per year in Seward. This region contains 60% to 70% of the state's population with Anchorage, the state's largest city, home to 279,240 people. Bounded by active volcanoes on the southwest and glacial river plains to the northeast, this sector of the state has experienced 24-hour dust levels in excess of 1,000 $\mu g/m^3$.

The **Alaska Peninsula** and its westward extension, the Aleutian Chain, form the southwestern extension of the mountainous Aleutian Range. This region is comprised of remote islands and small, isolated fishing villages. This area is one of the world's most economically important fishing areas, as well as a vital migratory route and nesting destination for birds.

Southwest Alaska encompasses the vast Yukon-Kuskokwim River Delta, a wide low-lying area formed by two of the state's major river systems and dotted with hundreds of small lakes and streams. This region is heavily impacted by storm systems which rotate northward into the Bering Sea. Communities in this region receive between 40 and 70 inches of precipitation each year. This portion of the state is quite windy, experiencing winds between 15 – 25 miles per hour throughout the year. These winds, coupled with fine delta silt, help to create dust problems for some southwestern communities. Rural villages normally contain fewer than 500 people and are located along the major rivers and coastline. Regional hub communities, such as Galena (Interior Alaska) and Bethel (SW Alaska), may have up to 6,300 residents.

Interior Alaska describes the vast expanse of land north of the Alaska Range and south of the Brooks Range. This region contains Fairbanks, Alaska's second largest city, with a population of 32,000 people (93,000 in the borough). The climate varies greatly with clear, windless, -50°F winter weather giving way to summer days with 90°F temperatures and afternoon thunderstorms. Sectors of this region also experience blustery winds and high concentrations of re-entrained particulates from open riverbeds.

The **Seward Peninsula** is the section of Alaska which extends westward into the Bering Sea between Norton Sound and Kotzebue Sound. This hilly region is barren and windswept with 15-25 mile per hour winds common. Rainfall in this region averages between 15 and 24 inches per year. Villages in this region are small except for Nome which has over 3,000 people.

The **North Slope** region, located north of the Brooks Range, is an arctic desert receiving less than ten inches of precipitation annually. Wind flow is bimodal, with the easterlies dominating the meteorological patterns. Winter wind speeds average 15-25 mile per hour dropping off slightly during the summer. The North Slope is extremely flat and supports huge summertime populations of bears, caribou, and migratory birds.

Topography

Alaska topography varies greatly and includes seven major mountain ranges which are significant enough to influence local and regional wind flow patterns. The mountains channel flow, create rotor winds, cause up slope and down slope flow, initiate drainage winds, produce wind shear and extreme mechanical turbulence. For air quality impact analyses, Alaska's rugged mountains can only be described as complex terrain making many air quality models unsuited for use in the state. The complexity of most local meteorology renders the use of non-site specific meteorological data inadequate for most control strategy development.

In addition to mountains, Alaska has several deserts, some north of the Arctic Circle, thousands of lakes, extensive wet lands, numerous glaciers, large deep fiords with very high tides and strong tidal currents. Local wind flow patterns along the coast and near large lakes may be influenced by land breezes/sea breezes.

Economy

The Alaskan economy is centered on the oil industry, the mining industry, commercial fishing, logging and tourism. Of the five, only the oil and mining industries provide a year-round source of income to the state and require the full time operation of stationary, power generation equipment. The mining industry is scattered across the state with a lead and zinc mine near Kotzebue, a coal mine at Healy, a silver mine near Juneau, and major gold mines north of Fairbanks, north of Delta Junction and north of McGrath. Numerous other small mining ventures exist across the state.

The state's oil industry operates production wells in Cook Inlet and on the North Slope. North Slope oil is pumped 800 miles through the Trans-Alaska Pipeline System (TAPS) to Valdez for shipment to refineries in the lower 48 states. The TAPS has several pump stations to maintain the flow of oil in the pipeline. The majority of new oil exploration work is being conducted on the North Slope. There are four in-state refineries. Flint Hills Res. LLC. (North Pole) and PetroStar (Valdez and North Pole) process small amounts of North Slope crude. Cook Inlet crude is processed at the Tesoro refinery in Nikiski, located near Kenai, Alaska.

AIR QUALITY SUMMARY

In 1970 the Congress of the United States created the U.S. Environmental Protection Agency (EPA) and promulgated the Clean Air Act. Title I of the Clean Air Act (CAA) established National Ambient Air Quality Standards to protect public health. National Ambient Air Quality Standards (NAAQS) were developed for six *criteria pollutants*: total suspended particulate matter (TSP), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and lead (Pb). Subsequent revisions to the particulate matter standard resulted in two new standards; PM_{10} and $PM_{2.5}$. The first revision (1987) reduced the size particulate matter that was considered harmful to humans, measuring for particles less than 10 micrometers (or microns) in diameter (PM_{10}). That standard was later revised (1997) to separate the PM_{10} size particles into two size fractions: coarse and fine. The coarse particulate matter fraction represents particles between 10 and 2.5 microns and fine particulate matter represents particles 2.5 micron and smaller in diameter ($PM_{2.5}$). Thresholds limits established under the NAAQS to protect health are known as primary standards. The primary health standards are set to protect the most sensitive of the human population, including those people with existing respiratory or other chronic health conditions, children, and the elderly. Secondary standards established under the NAAQS are set to protect the public welfare and the environment.

Since promulgation of the original Clean Air Act, the EPA has had the requirement to review and revise the NAAQS based on the assessment of national air quality trends and on current (and ongoing) health studies. Since 2006, the EPA has strengthened the NAAQS for particulate matter, lead, ozone, sulfur dioxide, and nitrogen dioxide and is currently looking at ozone. Table 1 presents the NAAQS standards with the most recent updates.

Main pollutants of concern in Alaska are $PM_{2.5}$ and PM_{10} followed by CO, lead, ozone, SO_2 and NO_2.

Table 1: National Ambient Air Quality Standards

Pollutant	Level	Averaging Time
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour [(1)]
	35 ppm (40 mg/m^3)	1-hour [(1)]
Lead	0.15 µg/m^3 [(2)]	Rolling 3-Month Average
Nitrogen Dioxide	53 ppb [(3)]	Annual (Arithmetic Average)
	100 ppb	1-hour [(4)]
Particulate Matter (PM_{10})	150 µg/m^3	24-hour [(5)]
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3	Annual [(6)] (Arithmetic Average)
	35 µg/m^3	24-hour [(7)]
Ozone	0.075 ppm (2008 std)	8-hour [(8)]
	0.12 ppm	1-hour [(10)]
	0.03 ppm	Annual (Arithmetic Average)
Sulfur Dioxide	0.14 ppm	24-hour [(1)]
	75 ppb [(11)]	1-hour

[1)] Not to be exceeded more than once per year.
[(2)] Final rule signed October 15, 2008.
[(3)] The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard
[(4)] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).
[(5)] Not to be exceeded more than once per year on average over 3 years.
[(6)] To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m3.
[(7)] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m3 (effective December 17, 2006).
[(8)] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (Effective May 27, 2008)
[(9)] (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm. (b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard. (c) EPA is in the process of reconsidering these standards (set in March 2008).
[(10)] (a) EPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding"). (b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.
[(11)] (a) Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

Monitoring Priorities

The Air Monitoring & Quality Assurance (AMQA) section of the DEC Air Quality Division has a relatively small staff of professionals with which to conduct the state's air quality assessment efforts. To enhance the quality of work performed statewide the department's staff works closely with the Municipality of Anchorage (MOA), the Fairbanks North Star Borough (FNSB), the City & Borough of Juneau (CBJ) and environmental staff in other, smaller communities to assess air quality levels statewide. To continue to protect public health and the environment, the 2010 Alaska Monitoring Plans are focused on eight primary issues.

- Fine particulate matter ($PM_{2.5}$) monitoring
- Coarse particulate matter (PM_{10}) monitoring
- PM Difference ($PM_{10-2.5}$) monitoring
- Carbon monoxide (CO) monitoring
- Lead (Pb) monitoring
- Ozone (O_3) monitoring
- Wildland fire monitoring ($PM_{2.5}$)
- Rural communities and tribal village monitoring (primarily PM_{10})

Table 2: Criteria Pollutant by Priority Pollutant

Priority	**Pollutant**	**Extent of NAAQS Violations (list cities violating NAAQS)**	**Days above 100 on the AQI Contribution to downwind Violations?**
1	$PM_{2.5}$	Fairbanks North Star Borough	Minimal
2	PM_{10}	Several Communities *	None
3	CO	none	0
4	Pb	none	NA
5	Ozone	none	NA
6	SO_2	none	NA
7	NO_2	none	NA
** Dust monitoring in rural Alaska is limited. Results of existing monitoring suggest that the majority of rural villages have a summer and early fall road dust problem*			

Fine Particulate Matter - $PM_{2.5}$

The primary sources of fine particulates in the atmosphere are combustion processes. Health research in the lower 48 states and Alaska has found that $PM_{2.5}$ size particles are creating a major health problem in communities across the United States. As more and more health studies are undertaken, the results show a high rate of cardiovascular and respiratory disease associated with particles which penetrate deep into the lungs. For people in Alaska, this problem is exacerbated by increased exposure to fine particulate during extended wintertime temperature inversions, with extreme cold temperatures and wildland fires during the summer months.

Wood smoke has been a major contributor to elevated fine particulate levels in Southeast Alaska for years. Juneau's Mendenhall Valley exceeded the old PM_{10} standard numerous time in the late 1980s/early 1990s, but successfully reduced particulate matter levels with an effective wood smoke control program, public education and woodstove conversion to pellet stoves and oil fired space heaters.

Fine particulates have also been a concern in some Interior Alaska communities, especially during the winter months when extremely strong inversions trap emitted particles close to the surface. In the smaller, outlying villages, this problem is normally associated with wood smoke. In the large communities, like Fairbanks, the pollution mix is comprised of wood smoke, emissions from power generation (coal-fired), emissions from oil based home heating and automobile emissions.

Coarse Particulates - PM_{10}

PM_{10} or "dust' impacts most people living and visiting the State of Alaska and has been a pollutant of concern for over 40 years. Monitoring for dust in the major communities of Anchorage, Juneau, the Mat-Su Valley, and Fairbanks has been going on for over twenty years. As a result, two locations in the State were designated non-attainment for dust in 1991; the Municipality of Anchorage (Eagle River) and the City and Borough of Juneau (Juneau).

Eagle River, a community of about 30,000, located 10 miles northeast of downtown Anchorage, is currently designated as a nonattainment area for airborne particulate (PM_{10}). This designation was the result of air quality violations recorded between 1985 and 1987 when the community was largely "rural" and had many unpaved roads. In addition the TSP monitor was located on the top of a one story building extension adjacent to a highly trafficked gravel road. The Municipality developed a PM_{10} control plan which focused on paving or surfacing the communities gravel roads. This strategy was very effective (all local roads were paved or treated with recycled asphalt) and no violations have been measured since October 1987. After EPA decided not to adopt a proposed regulation provision that would have automatically reclassified areas like Eagle River with long periods of compliance with the standard from non-attainment to maintenance areas, the Municipality developed a "Limited Maintenance Plan" for Eagle River.[1] This was submitted to EPA for approval in September 2010.

Juneau's Mendenhall Valley was designated non-attainment for PM_{10} on November 15, 1990. The two primary sources of PM_{10} required the community to develop two separate action plans to minimize exceedance of the standard. The first was to issue alert notices for people to curtail use of their woodstoves to reduce the impact from smoke and the second was to start paving roads to minimize the impact of fugitive dust. The City and Borough of Juneau and the Alaska Department of Environmental Conservation submitted a request to re-designate Juneau as a limited maintenance area with the US Environmental Protection Agency in February, 2009[2].

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[1] The proposed regulation would have eliminated the need to prepare a maintenance plan. Normally the submission of a maintenance plan to EPA is required before reclassification can be considered.
[2] 2009 City and Borough of Juneau Limited Maintenance Plan http://www.dec.state.ak.us/AIR/anpms/doc-anpms/CBJ_PM10_LMP_20FEB09.pdf

Dust has also been identified as a problem in most of the rural communities in Alaska. With the exception of the "hub" communities, most of the smaller villages have a limited road system and little resources to pave roads. In addition, the soil composition is often frost susceptible and not conducive to paving. With the recent addition of all terrain vehicles (4 wheelers) and automobiles, the amount of re-entrained dust has increased substantially. On a dry summer day, dust levels can easily reach into the mid 300 $\mu g/m^3$ range with maximum concentrations easily exceeding 500 $\mu g/m^3$. To address the rural dust problem, which was identified during a several year joint-monitoring effort between DEC, village environmental staff, and the State Department of Transportation (DOT), DOT has secured funding from the State Legislature for a dust control program. It was started in summer 2010 as a demonstration project spearheaded by DOT in conjunction with researchers at UAF and DEC with eight villages throughout the bush. Each village was given the option of using various palliatives or water to control the dust during the summer months and a sprayer that would be adaptable for use on the back of a truck or pulled behind an ATV for the palliative or water application.

Carbon Monoxide-CO

Alaska's two largest communities, Anchorage and Fairbanks were designated non-attainment for carbon monoxide (CO) in the mid to late 1980s. Motor vehicle CO emissions increase in the cold winter temperatures experienced in Alaska. These elevated emissions combined with strong wintertime temperature inversions resulted in both communities exceeding the CO standards numerous times each winter. Anchorage and Fairbanks were both initially designated as *Moderate Non-attainment* for CO and later in 1996, re-designated as *Serious Non-attainment* after failing to reach attainment in the allotted time frame. Despite implementation of effective vehicle inspection and maintenance programs and other local air quality control strategies, neither community would have been able to reach attainment without the significant improvements in automobile emission controls that have been mandated by EPA in new vehicles over the past three decades. Neither community has had a violation of the CO standard in almost 15 years. Both communities requested re-designation to attainment and were reclassified as *maintenance* areas in 2004.

Lead Monitoring-Pb

To comply with the November 2008 revision of the state and federal air quality standard for lead, DEC explored establishing a source oriented, lead monitoring site near the Red Dog Mine in Alaska's Northwest Arctic Borough. The Red Dog Mine, fifty miles inland, extracts lead and zinc ore from an open-pit mine and concentrates the ore at their processing facility for transport to the coast where it is stored for barging and eventual export. The intent of the revised lead standard was source-oriented monitoring for all facilities that had potential annual emissions equal to or greater than one half ton of lead and the Red Dog Mine is the state's only emission source that meets this criterion. Unfortunately, the area around the mine is extremely rugged terrain with no road access or sources of power. As a compromise, EPA allowed the state to perform monitoring at one or both of the closest villages where the public (local residents) might be exposed. In effect, EPA sanctioned the change in the monitoring from source-oriented to population-oriented because of Alaska's rural character. After talking with representatives from the two closest villages, the decision was made to initiate monitoring in the Native Village of Noatak. Monitoring was started in mid January 2010 using the old PM_{10} lead monitoring site. The site consists of two, collocated total suspended particulate (TSP) samplers which are the reference method samplers for conducting lead monitoring. Because DEC has been unable to attract and keep site operators who can perform the sampling requirements for a SLAMS site, DEC will follow the option given by EPA to model emissions from the Red Dog Mine. If modeled levels at the ambient air boundary surrounding the mine are below 50% of the lead NAAQS monitoring will not be required. DEC and EPA are working together to develop a modeling protocol for DEC to follow for conducting this modeling. A schedule for this task has been delivered to EPA and accepted. DEC hopes to complete the modeling and documentation by September 14, 2012.

Ozone Monitoring-O_3

The March 27, 2008 revision of the national ozone standard required the State of Alaska to establish an O_3 monitoring program by April 1, 2010. The regulation required at least one State and Local Air Monitoring (SLAMS) O_3 site in a core based statistical area (CBSA) with a population greater than 350,000. The Anchorage/Mat-Su Valley population forms the only combined Metropolitan Statistical Area (MSA) in the State of Alaska which meets the criteria. The Municipality of Anchorage monitoring program established two O_3 monitoring sites in April 2010. These sites are initially designated as “special purpose monitors” until data analysis can be performed to determine which is the appropriate SLAMS site location. Another O_3 site will be located in Fairbanks with establishment of the NCore site. The US National Park Service operates a CASTNET O_3 monitoring site at the Denali National Park, which is under consideration for use by the state to provide background regional O_3 concentration data. The new ozone rule includes a requirement of sampling in a representative mid-sized community (30,000- 50,000 residents). The cities of Fairbanks and Juneau both meet the size requirement,. As Fairbanks already is scheduled to conduct ozone monitoring, DEC requests that EPA consider the combination of sampling objectives and allow the use of the NCore ozone monitor to also meet the mid size community sampling requirement. Due to the small difference measured between the two sites in Anchorage, MOA and DEC decided to move the equipment to a new site in Wasilla. Ozone monitoring in Wasilla was started in May 2011.

Sulfur Dioxide Monitoring-SO_2

No sulfur dioxide monitoring is currently being performed in Alaska. Monitoring for SO_2 was performed in Southeast Alaska in the 1980s and early 1990s in response to public concerns about emissions from the two regional pulp mills: Alaska Pulp Corporation (APC) at the head of Silver Bay in Sitka and the Ketchikan Pulp Corporation (KPC) on Ward Cove in Ketchikan. While elevated concentrations were observed during the monitoring, the 8 hour SO_2 standard at the time was not exceeded. With the revision of the SO_2 standard and introduction of the 1 hour standard additional monitoring in rural communities is warranted. Short term studies in St Mary’s and Fairbanks indicate a potential for exceedances of the SO_2 standard during the winter time. Especially in light of the ubiquity of diesel power generation in rural Alaska, elevated SO_2 levels might be a widespread issue. As staffing and funding allows, DEC will conduct studies in rural communities to better understand the issue. SO_2 will be monitored at the NCore site in Fairbanks.

Nitrogen Oxide Monitoring-NO_2

The Department is not currently operating any NO_x monitoring sites in the state other than the NCore site in Fairbanks. NO_2 monitoring was conducted as part of the Unocal Tesoro Air Monitoring Program (UTAMP) monitoring conducted in North Kenai during the early 1990s. The state operated its own independent monitoring site and measured for ammonia and NO_2. Elevated short term NO_2 values were observed, but the annual concentration was not exceeded.

With the revision to the NO_2 standard and introduction of the 1 hour NO_2 standard, DEC will have to evaluate if, and where, additional monitoring will be warranted. As part of the NCore suite of pollutants, NO_x and NH_3 (Ammonia), will be sampled in Fairbanks.

POPULATION SUMMARY

Latest census numbers (2006) show the state's total population at 670,053. Roughly half of Alaska's residents live in Anchorage and the surrounding communities in the Southern Matanuska –Susitna Valley. The state only has one medium sized core based statistical area, which combines the Municipality of Anchorage with the communities of Wasilla and Palmer (352,000 residents). The Fairbanks North Star Borough in the interior of Alaska is the second largest population center, followed by the Matanuska Susitna Borough. Table 3 shows a summary of population numbers for the six major Alaska regions. Roughly one third of Alaska's residents live in communities with less than 1000 people.

Population projections estimate a statewide growth of roughly 5% every five years up to 2025. For some areas like Southeast Alaska, including the City and Borough of Juneau, projections indicate stagnation or even population decrease. The Matanuska –Susitna Borough shows the largest increase with projections of 16% growth by 2015, tapering off to 14% and 12% the following two five year periods, respectively. By 2015 the Matanuska-Susitna Borough is expected to surpass the Fairbanks North Star Borough population predictions, see Figure 2.

Table 3: Population Projection Summary

	2006	2010	2015	% diff 2010-2015	2020	% diff 2015-2020	2025	% diff 2020-2025
State of Alaska	**670,053**	**698,573**	**734,999**	5.2%	**771,465**	5.0%	**806,113**	4.5%
Anchorage/Mat-Su Region	**359,987**	**377,651**	**404,745**	7.2%	**433,588**	7.1%	**462,005**	6.6%
Municipality of Anchorage	282,813	293,323	306,902	4.6%	322,087	4.9%	337,706	4.8%
Matanuska-Susitna Borough	77,174	84,328	97,843	16.0%	111,501	14.0%	124,299	11.5%
Gulf Coast Region	**74,611**	**77,107**	**79,279**	2.8%	**80,920**	2.1%	**81,951**	1.3%
Interior Region	**102,276**	**107,416**	**112,525**	4.8%	**117,026**	4.0%	**121,291**	3.6%
Fairbanks North Star Borough	87,849	92,868	97,706	5.2%	101,973	4.4%	106,106	4.1%
Northern Region	**23,676**	**24,904**	**26,299**	5.6%	**27,607**	5.0%	**28,854**	4.5%
Southeast Region	**70,053**	**70,315**	**69,593**	-1.0%	**68,335**	-1.8%	**66,661**	-2.4%
Juneau Borough	30,650	31,691	32,078	1.2%	32,252	0.5%	32,227	-0.1%
Southwest Region	**39,450**	**41,180**	**42,558**	3.3%	**43,989**	3.4%	**45,351**	3.1%

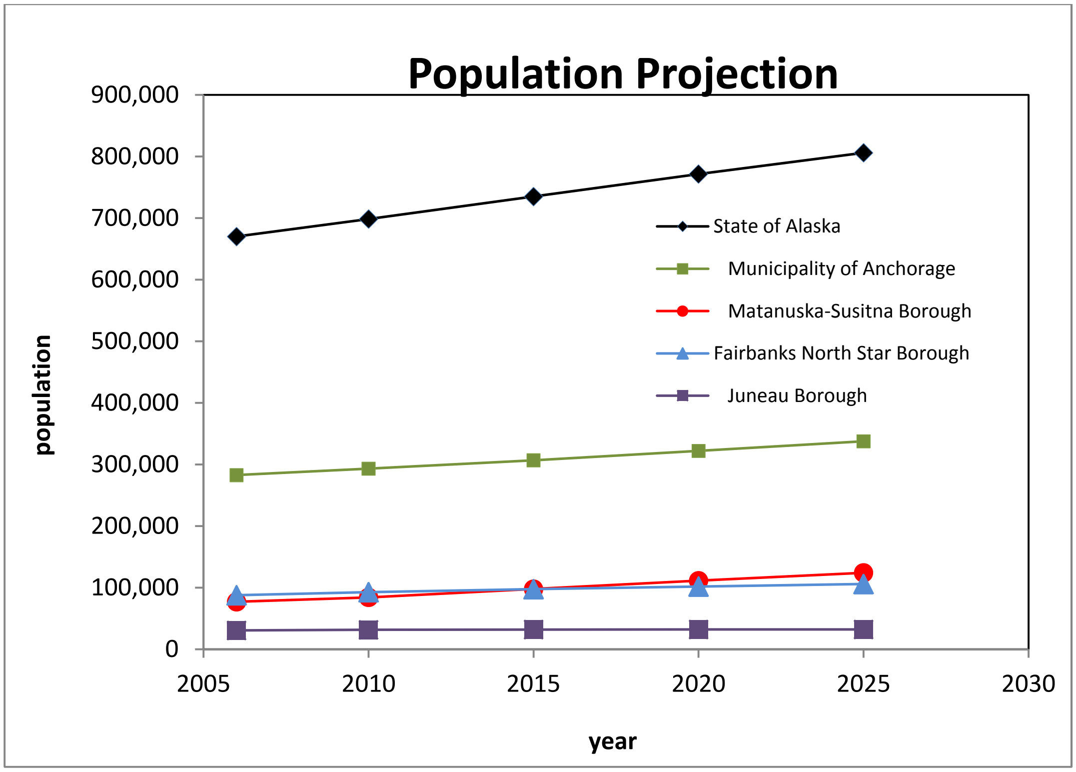


Figure 2: Population Projections for selected areas within the State of Alaska

Based on current growth and development, the southern Matanuska –Susitna Borough, with its sprawling communities of Palmer and Wasilla will likely require increased monitoring.

METEOROLOGICAL SUMMARY

Statewide Meteorology

Alaska experiences some of the most diverse weather patterns in the world. On any given day, temperatures across the state may vary by more than 100° F, winds may exceed hurricane force and it may be snowing on the North Slope and raining in the Panhandle. Driven by the position of the Polar Jet Stream, Alaska's weather may be influenced by strong North Pacific lows or a ridge of very high pressure over the Interior. When coupled with Alaska's complex topography, large temperature swings (both daily and seasonally) and large variation in daylight (zero to twenty-four hours), the resulting synoptic/micro-scale weather frequently causes or contributes to most, if not all, pollution events detected in the state.

Alaska's weather falls into four general climatic zones: (1) a maritime zone which includes Southeast Alaska, the South Central Coast, and the Aleutian Islands; (2) a maritime continental zone which includes the western portions of Bristol Bay and Southwest Alaska where summer temperatures are moderated by the Bering Sea, but winter temperatures act more "continental" due to the presence of sea ice; (3) a continental zone which starts north of the coastal mountains and east of the maritime-continental zone and includes most of Interior Alaska, and (4) an arctic zone which covers Northwest Alaska and the Arctic slope. Each one of these climate patterns causes weather which has the potential to contribute to an air pollution event by: drying out the surface layer and enhancing the potential for forest fire activity (fine particulates), increasing area-wide winds and causing dust to be blown high into the air (coarse particulates), increasing local winds which produce mechanically re-entrained dust (coarse particulates), or through the development of strong temperature inversions which trap pollution close to the ground (fine particulates and carbon monoxide).

In general, most of Alaska's weather is driven by two inter-related meteorological features: the position of upper level Highs and Lows and the tracking of the Polar Jet which is responsible for steering surface weather patterns across the North Pacific and into Alaska. During the summer months when the jet stream tracks further north, surface lows often rotate up through South Central Alaska into the Interior. In the winter, the jet often positions itself further south allowing high pressure to dominate a majority of Alaska's weather, especially in the Interior where temperatures frequently drop below minus fifty degrees Fahrenheit. As these pressure features move and develop, they may intensify north-south pressure gradients producing high winds [anthropogenic (man-made) or natural dust] or weaken the regional flow helping to intensify strong surface inversions which trap air pollution (smoke, carbon monoxide, ozone) close to the ground. As a result, the statewide meteorology has played a large role in most of Alaska's previously documented, air pollution events, including some violations of the NAAQS.

Air Pollution and Meteorology

A good knowledge of the local and regional meteorology is a key element in understanding air pollution episodes, how to control them and how to implement effective control strategies which will protect the public. While some air pollution events are man-made (community generated dust, industrial pollution) many would not occur without a direct contribution from the weather. Alaska did not have a large number of automobiles in Anchorage or Fairbanks during the 1980s and 1990s, yet both communities exceeded the federal standard for airborne carbon monoxide during periods of strong winter inversions. Similarly, winter inversions have helped create high levels of smoke in Juneau and Fairbanks as residents try to heat their homes. Alaska's high winds are notorious for scouring fine material off hillsides and river beds creating dust storms which obscure visibility and impact public health. Regional winds, while not directly causing pollution events, do transport dust and woodsmoke tens to hundreds of miles away from their sources, impacting public health.

In Alaska, the potential for an air pollution event is always present. Most rural communities do not have paved streets and four wheelers are notorious for raising fine dust. The problem is not as bad in the larger cities, but they may also have some dirt streets and winter sanding materials often become "road dust' in the spring. As home heating costs continue to rise, more people are re-discovering the wood-fired heater. While providing warmth at a lower cost, these units are not energy efficient and do create smoke. As the number of wood-fired heating sources increase, the concentration of smoke increases, especially on cold, clear winter nights. At too high a number, their emissions have the potential to exceed the air quality standards which were developed to protect public health.

Luckily, Alaska does not have a lot of major pollution sources in the vicinity of communities. The sources that do exist are controlled under air pollution permits which closely regulate their air emissions. At present, all major anthropogenic sources in the Cook Inlet Basin are in compliance with the air quality standards and their emissions do not travel towards other populated areas with significant pollution sources. While the impact from anthropogenic sources is believed to be minimal (not exceeding the NAAQS), Alaska's does have major sources of air pollution: wildland fires, windblown dust from natural sources of crustal materials and particle emissions from volcanic eruptions, all of which are uncontrollable.

When a controllable pollution event occurs repeatedly, the state is required to develop a control strategy which will lower emissions to an acceptable level. To better control sources of air pollution and minimize impact on the public, the US EPA has developed an enhanced control strategy for states which groups adjacent communities with similar man-made pollution sources into Core Based Statistical Areas (CBSAs). The intent is to make sure that if, elevated levels of pollution exists, the control strategy is effective and includes all sources which may be contributing. In Alaska, where most communities are small and geographically separated, the practicality of employing the CBSA concept to fix a localized air pollution problem does not make sense in most cases. For the few locations where multiple communities lie adjacent to each other; Fairbanks North Star Borough (City of Fairbanks, North Pole, Fort Wainwright and Eielson AFB), the Upper Cook Inlet Basin (Municipality of Anchorage (City of Anchorage, Girdwood, Eagle River, Chugiak), Wasilla, and Palmer) and the Northern Kenai Peninsula (Nikiski, Kenai and Soldotna), the meteorology does not necessarily support the need for development of a CBSA or the multi community airshed is already being legally controlled.

- Fairbanks North Star Borough: All of the communities and associated man-made sources of pollution are contained in the Borough. The Borough has legal and governing authority over the area making the development of a CBSA unnecessary. At present, the greater Fairbanks area does have a problem with elevated levels of fine particulates (smoke) in the winter when strong inversions help to trap air pollution close to the ground. The problem is being evaluated and studies are being conducted to determine which sources of air pollution are causing/contributing to the problem. The State and Borough governments are currently working to develop an effective control strategy.

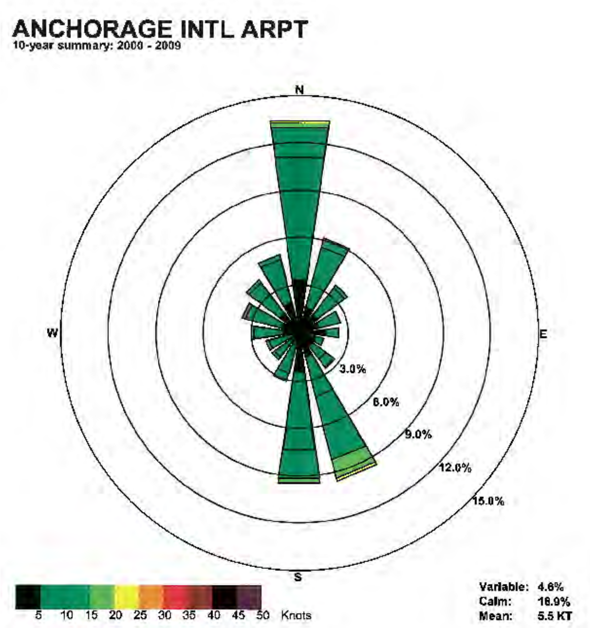
- Upper Cook Inlet Basin: Flow in the upper basin is generally bi-modal with the strongest flow due to northerly drainage winds and southerly storm flow. Combine these winds with the region's mountainous terrain and you get a flow pattern which is not conducive for transporting anthropogenic pollution from one community to the others. This is especially true during the high wind events when atmospheric mixing is at its best. In addition, there are no major industrial sources north of Anchorage and all of the existing sources are in compliance with the NAAQS and air quality increments. The region has had some air pollution problems in the past, but those have been localized (road dust, carbon monoxide and woodsmoke) and not transported between communities. The only transport of pollution into Anchorage occurred in the mid 1980s when the state allowed farmers at Point Mackenzie to the north of Anchorage, to burn slash from land clearing. The region does have occasional, naturally occurring, pollution events (volcanic eruptions, wildland fire smoke, windblown dust from the river drainages, episodic Asian dust events) for which the state issues air quality advisories as necessary, but which are not controllable.

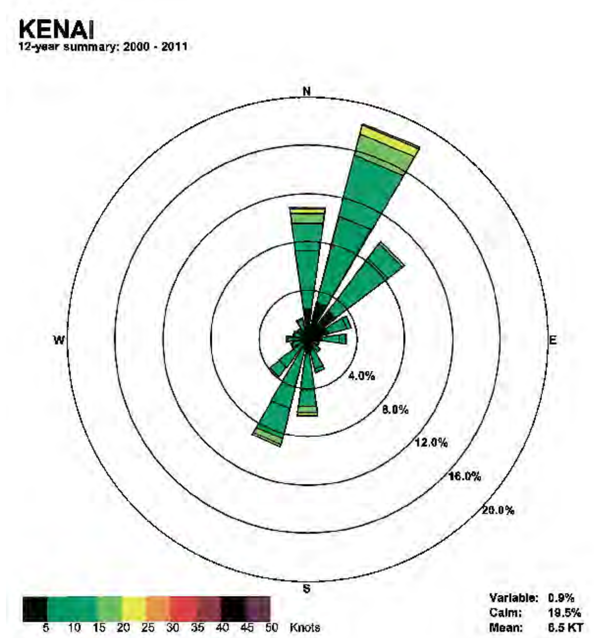
- Northern Kenai Peninsula: Flow on the northwest coast of the Kenai Peninsula is similar to that observed in Anchorage, primarily north-south. While southerly winds seem to occur at a similar frequency, Kenai experiences twice as many northerlies, probably because it lies forty miles of longitude west of Anchorage and experiences the northerly drainage winds coming down the west side of the Basin. The Kenai winds differ greatly from those observed in Soldotna which exhibits a much weaker flow that is more east-west and somewhat terrain induced. In general, the meteorological flow pattern for the peninsula does not suggest that these communities be considered a CBSA or be added to any other community to form one.

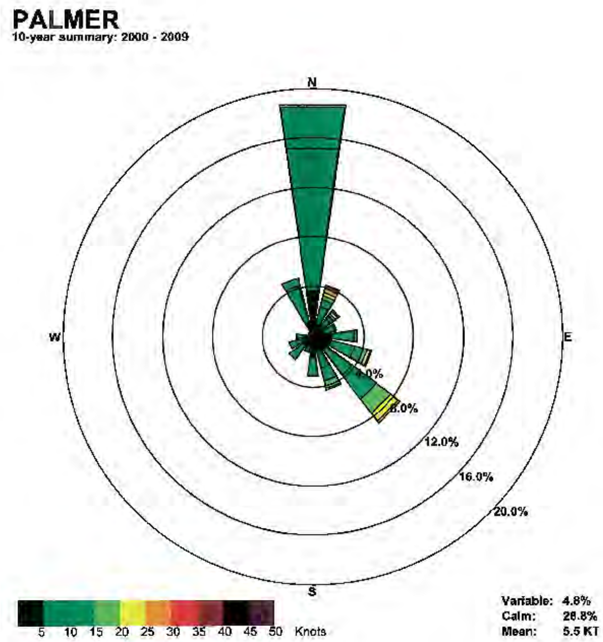
A good example of how different the local flow can be is seen in the Municipality of Anchorage where weather in Girdwood (south end of the Municipality) and Chugiak/Birchwood (northeast side of the Municipality) are often totally different from each other. At the same time, their winds do not represent those observed at Anchorage's airport, just to west of downtown. A dust event in east Anchorage does not normally equate to one in south Anchorage, Girdwood or Palmer. On the other hand, smoke from wildland fires in the Interior of Alaska can be transported into Anchorage or across greater distances.

<u>Conclusion:</u> Based on the State's analysis of local and regional meteorology which examined annual wind rose data (see windroses at the end of the chapter), short term wind events, the location of major anthropogenic sources of pollution and emissions modeling for the major sources of pollution, Alaska is not planning to create CBSAs for any portion of the state as a method for controlling man-made air pollution events in the state. Any exceedance encountered will be handled as in the past: locally between the state and local governments.

Note: The Department of Environmental Conservation's Division of Air Quality has a meteorologist on staff. The role of this employee is to provide meteorological support to the entire Air Quality Division as well as local air agencies and the public. This support includes all facets of meteorological data, data interpretation and analysis and weather forecasting. The meteorologist also issue air advisories to the public based on air pollutant data, satellite imagery and weather observations when an air quality episode is occurring, or is expected to occur. The state, through its meteorologist, has access to all recorded weather information in real-time and through the archives at the National Climate and Data Center in Asheville North Carolina.






PALMER
10-year summary: 2000 - 2009
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4.0%
8.0%
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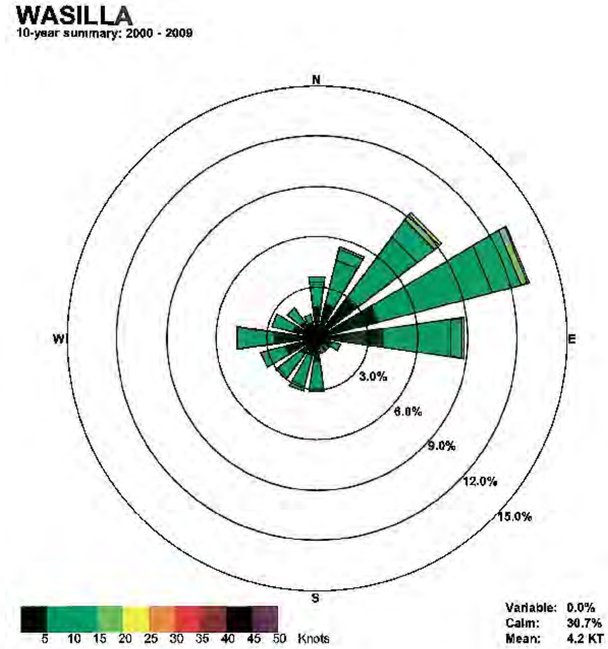
5 10 15 20 25 30 35 40 45 50 Knots
Variable: 4.8%
Calm: 28.8%
Mean: 5.5 KT


WASILLA
10-year summary: 2000 - 2009
N
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3.0%
6.0%
9.0%
12.0%
15.0%
5 10 15 20 25 30 35 40 45 50 Knots
Variable: 0.0%
Calm: 30.7%
Mean: 4.2 KT

MONITORING NETWORK

In the following sections we summarize data and trends for each of the criteria pollutants monitored in the Alaska Air Monitoring Network (AAMN) and describe the purpose of sites within the network and how they relate to overall monitoring objectives. The AAMN currently includes sites in the urbanized areas of Anchorage, Fairbanks, Juneau, Matanuska-Susitna Valley (Mat-Su), and in the rural village of Noatak. Additional permanent sites are planned for the city of Soldotna on the Kenai Peninsula. Special purpose monitoring to examine impacts of PM_{10} is currently being conducted in Seward. Seasonal monitoring is planned in various rural Alaska communities to address concerns about road dust (PM_{10}), wood smoke ($PM_{2.5}$) and forest fire smoke ($PM_{2.5}$). A new multi pollutant NCORE site is currently being installed in Fairbanks.

The Alaska monitoring network covers a large geographic area. Efforts are underway to include as much of the data collected from the network into a single Internet-based data acquisition and reporting system known as the Alaska Air Monitoring Network Data System (AAMNDS). Sites in Anchorage, Mat-Su, Fairbanks and Juneau are currently included in AAMNDS. We anticipate that Soldotna will connect to the system by fall 2011.

The two largest municipalities Anchorage and Fairbanks, had been designated non-attainment for CO in the mid to late 1980s, but have shown no exceedances of the CO standard in many years and have been re-designated as maintenance areas. Figure 3 shows the long-term trend of the number of days CO concentrations exceeded the 8 hour standard in Anchorage and Fairbanks since the early 1970s.

Figure 4 shows the maximum CO concentration measured in Anchorage and Fairbanks over the past 40 years. There have not been any violations of the standard recorded in over 10 years for both communities. Similarly, the maximum 8 hour concentrations have declined steadily for the same time frame.

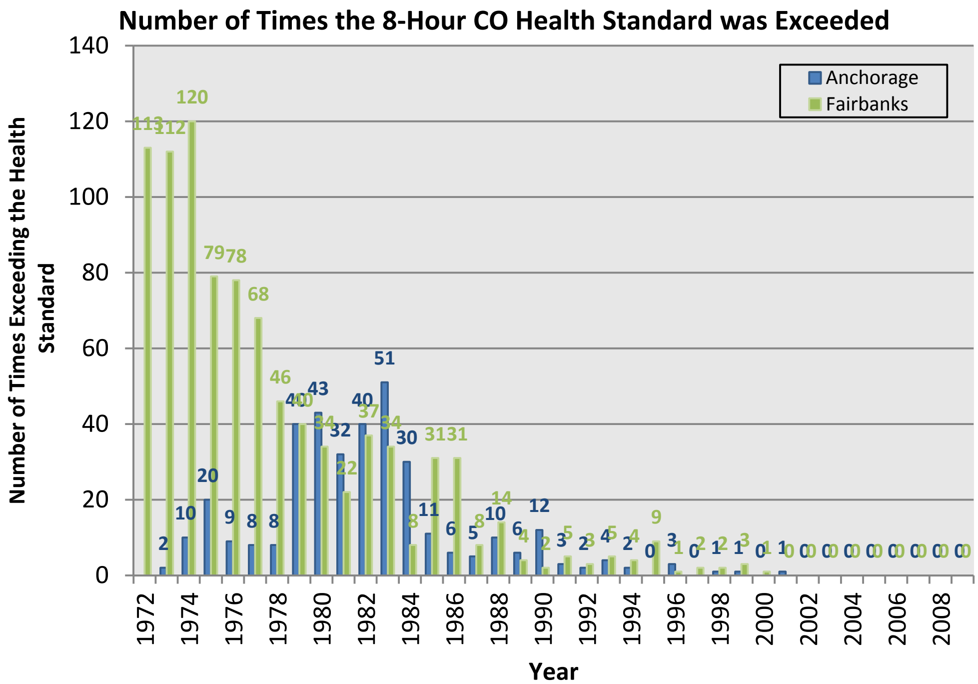

Figure 3: Number of times the 8 hour CO standard was exceeded since 1990.

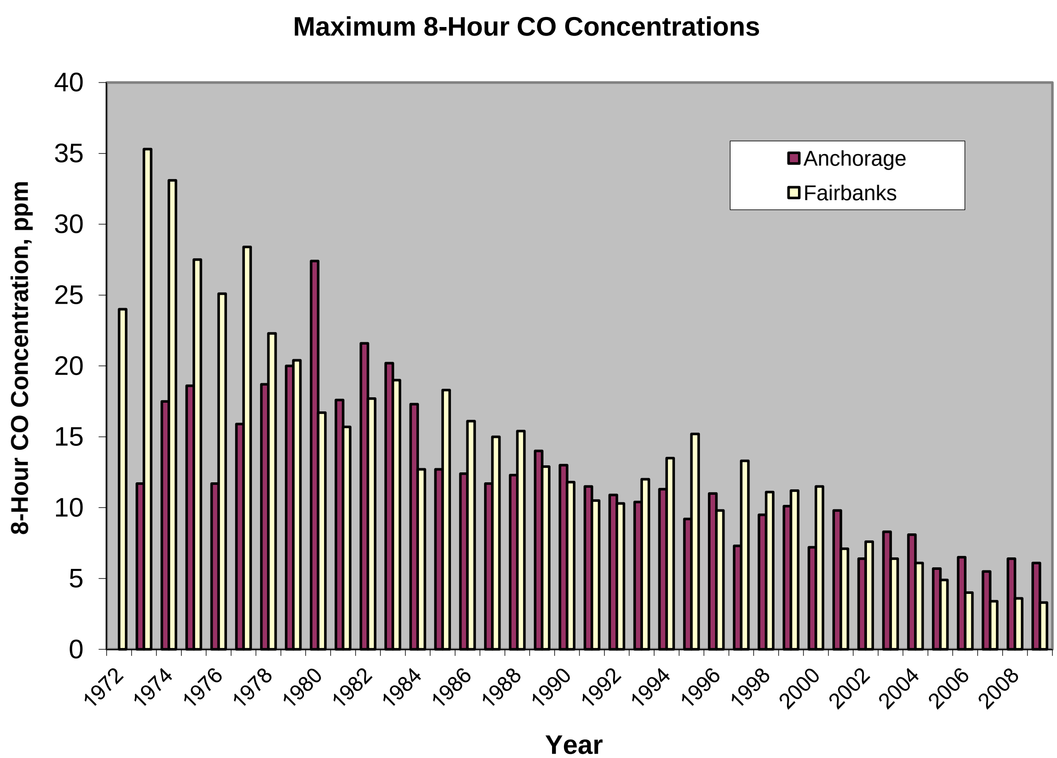

Figure 4 Maximum 8 hour CO concentration in Anchorage and Fairbanks since 1973

Particulate matter has been sampled in the state since the mid 1980s. Two areas recorded concentrations above the PM_{10} 24-hour standard and were declared non attainment, the Mendenhall Valley in Juneau and Eagle River within the Anchorage Municipality. Juneau had problems with PM_{10} from wood smoke that were addressed through a local curtailment program. Both areas had an extensive network of gravel roads. After paving most of the roads, the road dust related PM_{10} exceedances have disappeared by the mid 1990s. Figure 5 details the number of exceedance days statewide since 1985. Many of these sites have been shut down in the mean time: Parkgate, Garden and Tudor (all Anchorage) and Floyd Dryden are still active monitoring sites.

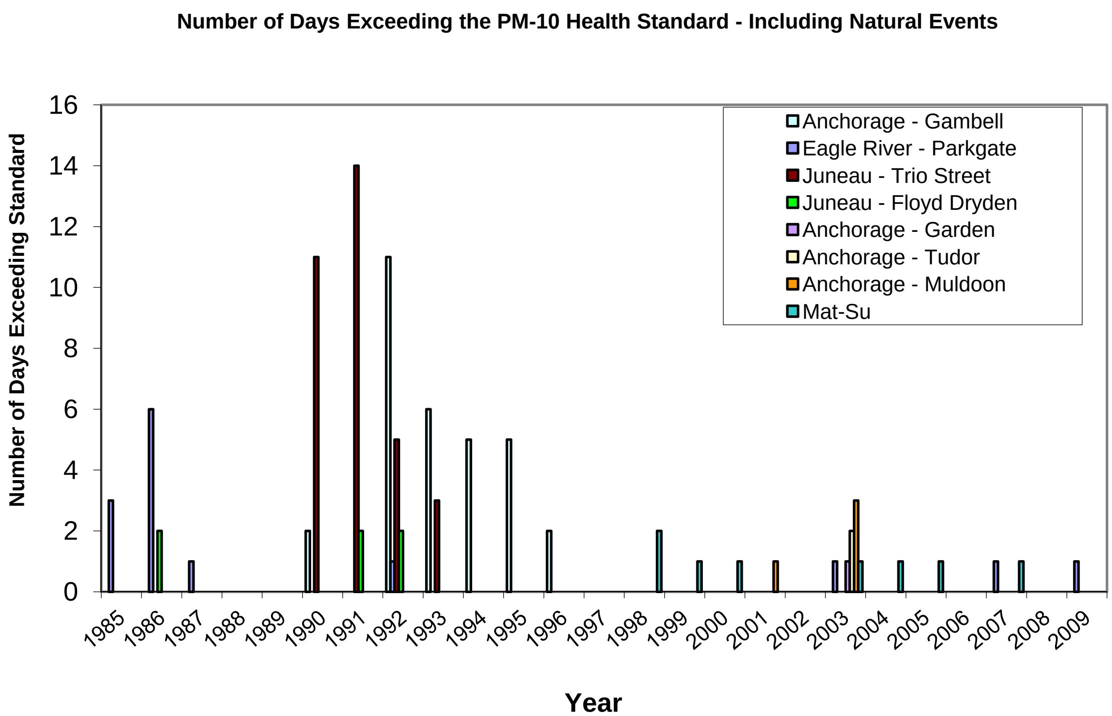

Figure 5: Number of Exceedances of the 24 hour PM_{10} standard statewide since 1985.

The Mat-Su site in this graph represents the Butte site.

Starting in the mid 1990s most of the remaining exceedances recorded to date are a result of natural causes, mainly windblown dust in Anchorage and the Matanuska Susitna Valley, see Figure 6. Note that the two Juneau sites show no exceedances in Figure 6. All the exceedances recorded occurred in the Mat-Su Valley and Anchorage. Usually these events occur once to twice a year and can impact several areas in South Central Alaska, for example high wind events along the Knik River, simultaneously impacting sites in the Mat-Su Valley and the Municipality of Anchorage.

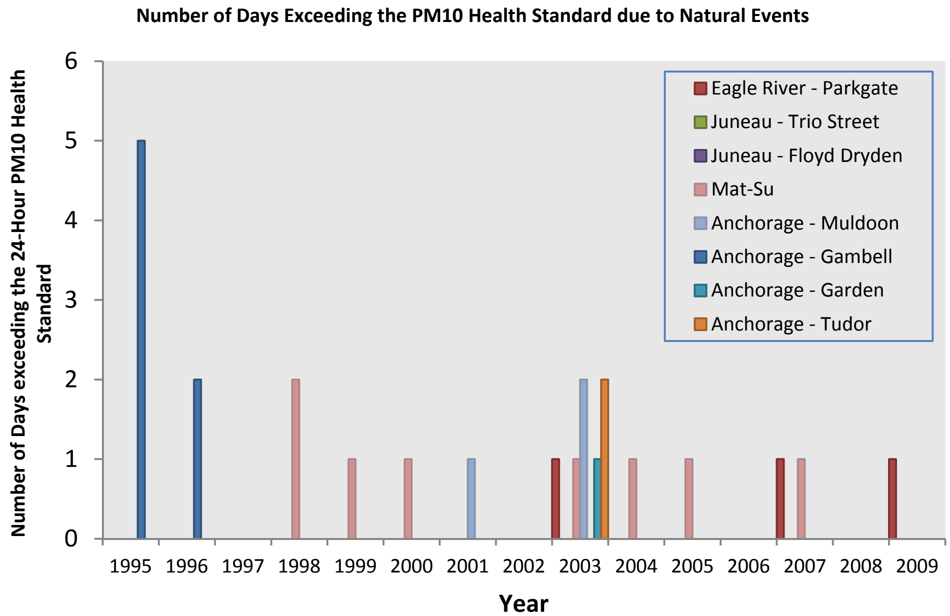

Figure 6: Number of days exceeding the 24 hour PM_{10} standards due to natural events since 1995.

In recent year the focus has shifted to fine particulate matter ($PM_{2.5}$) monitoring. A network of monitors was installed statewide in 1999 following the promulgation of the new fine particulate matter standard in 1997. The updated AAMN has recorded an increase in violations of the $PM_{2.5}$ NAAQS, especially after December 2006, when the $PM_{2.5}$ standard was strengthened. A large area in the Fairbanks North Star Borough was designated in non-attainment with the 24 hour $PM_{2.5}$ standard in December 2009. The following graphs summarize the exceedances during the last 10 years throughout the monitoring network. Figure 7 shows the number of exceedances recorded statewide since 1999. The large number of exceedances in Fairbanks in 2004 and 2009 are almost entirely due to wildland fire smoke, see Figure 8.

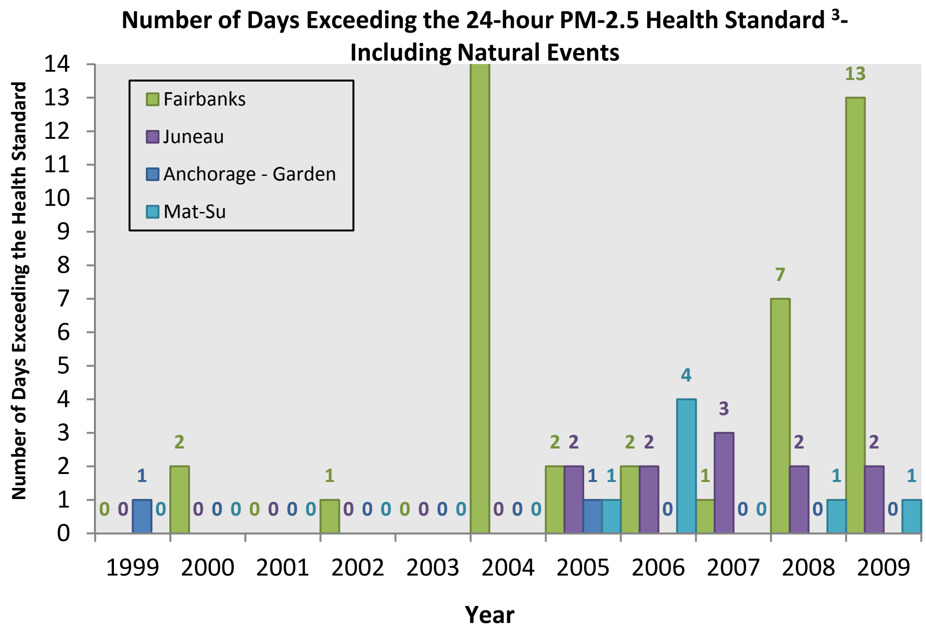

Figure 7: Number of days exceeding the 24 hour $PM_{2.5}$ standard since 1999[3].

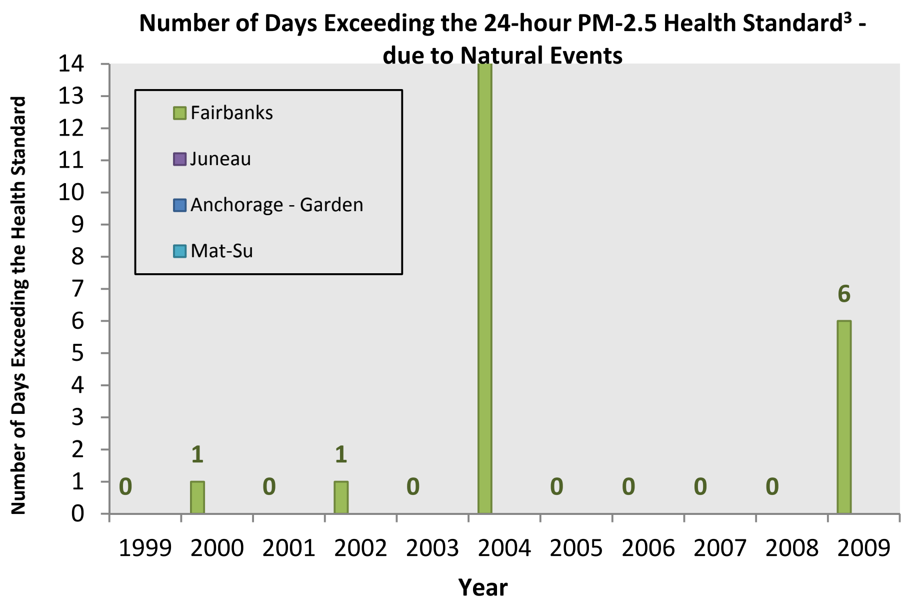

Figure 8: Number of days exceeding the 24 hour $PM_{2.5}$ standard since 1999 due to natural events

Unlike the trend for the 24-hour standard, the annual standard has been relatively stable throughout the past 10 years. Fairbanks has the highest annual average $PM_{2.5}$ concentration around 11-13 µg/m^3, while the rest of the state records an arithmetic mean around 6-8 µg/m^3. Figure 9 summarizes the results from the past 10 years of sampling statewide.

[3] The $PM_{2.5}$ Standard was changed in 2007. The number of exceedances displayed in the graph is based on the NAAQS for the respective sampling year

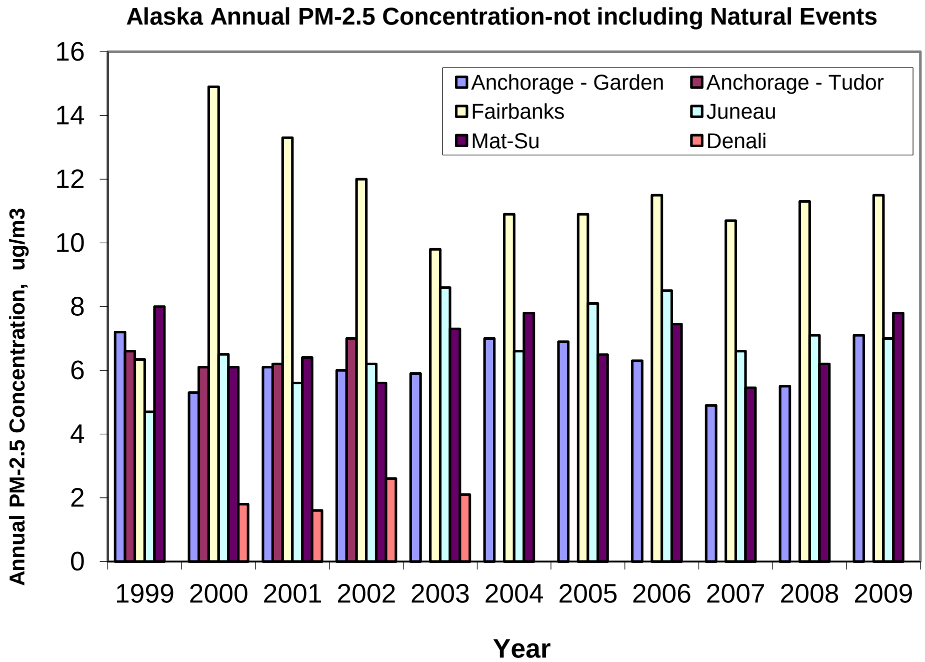

Figure 9: Annual $PM_{2.5}$ concentration measures since 1999 statewide

The next sections describe monitoring efforts for the various criteria pollutants on a site-by-site basis for the six sub-regions within the AAMN.

POLLUTANT SPECIFIC SUMMARY

$PM_{2.5}$ Monitoring

Municipality of Anchorage

$PM_{2.5}$ monitoring has been conducted in the Municipality of Anchorage (MOA) since January 1999.[4] To date, monitoring has been conducted at four sites. Site descriptions and the monitoring method(s) employed at each site are summarized in Table 4. The MOA has collocated a Thermo Electron Inc. Partisol 2000 and a Met One BAM 1020 together at the Garden site since January 2009 to assess inter-method precision.

Table 4: $PM_{2.5}$ Monitoring Sites in the Municipality of Anchorage

Site	AQS Site ID	Type	Time Period	Method	Sampling Frequency
Garden	02-020-0018	SLAMS	Jan 1999 - present	Partisol	1 in 3
Tudor	02-020-0044	SPM	Jan 1999 – Dec 2002	Partisol	1 in 3
Garden	02-020-0018	SLAMS	Jan 2009 - present	BAM 1020	continuous
Parkgate	02-020-1004	SPM	Jan 2009 - present	BAM 1020	continuous
DHHS	02-020-0052	SPM	Jan 2009 - present	BAM 1020	continuous

Although $PM_{2.5}$concentrations measured in the MOA occasionally exceed the 24-hr NAAQS, the 98^{th} percentile concentration has been consistently below the 35 $\mu g/m^3$ standard at all sites. High $PM_{2.5}$ concentrations have occurred in the summer when smoke from wild fires in the Alaska Interior or Kenai Peninsula reaches the Anchorage airshed. The Garden and Parkgate sites occasionally experience elevated $PM_{2.5}$ in the winter, presumably from residential wood burning, but concentrations rarely exceed the 24-hr NAAQS.[5] The annual average $PM_{2.5}$ concentration is quite low at all Anchorage sites. The highest annual average concentrations measured at all sites have been comfortably below the 15 $\mu g/m^3$ annual NAAQS. The American Lung Association ranked Anchorage fourth on its list of cleanest U.S. cities for year-round $PM_{2.5}$ pollution in their annual report published in 2010. $PM_{2.5}$ data for MOA (2007-2009) are summarized in Table 5.

[4] Some preliminary PM-2.5 sampling was performed in Anchorage as early as 1995 and 1996 using Andersen® dichotomous samplers. Although these samplers did not conform to the federal reference method established later, the concentrations measured by those samplers are comparable to those measured by FRM and EPA equivalent methods used today.

[5] The MOA has completed a report that summarizes results of a carbon-14 study conducted during the winter of 2009-2010 that quantifies the relative contributions of wood burning (new carbon) from fossil fuel combustion sources (old carbon).

Table 5: $PM_{2.5}$ Data Summary MOA Sites

	2004	2005	2006	2007	2008	2009
Max 24-hour concentration	43.7	55.9	34.1	17.6	22.1	23.9
Days above standard	0 (1)†	0 (1)†	0	0	0	0
Annual 98th percentile value	31.9	17.9	26.9	14.5	17.3	23.9
24-hour design value	21					
		22				
			26			
				20		
					20	
						19
Annual design value	6.0					
		6.6				
			6.7			
				6.0		
					5.6	
						5.9
† Prior to 2006 the numbers in parentheses would have exceeded the 35 μg/m^3 standard if it had been implemented earlier but did not exceed the 65 μg/m^3 standard at that time						

The MOA plans to continue $PM_{2.5}$ monitoring at the Garden, Parkgate and DHHS sites. Although $PM_{2.5}$ concentrations in the MOA have been relatively low, there is some concern that tightening natural gas supplies in the region could result in steep price increases and an increase in the use of wood as a heating fuel. Continued $PM_{2.5}$ monitoring and analysis of trends will be necessary to determine whether such a switch to wood heating is occurring and whether this switch is adversely affecting air quality. This will be particularly important if EPA decides to move to a more stringent $PM_{2.5}$ NAAQS.

The MOA uses $PM_{2.5}$ data from their continuous monitors at Garden, Parkgate and DHHS in the computation of the daily Air Quality Index (AQI) and for AQI forecasts. Although $PM_{2.5}$ concentrations are relatively low in Anchorage, in 2010, $PM_{2.5}$ was the controlling pollutant (i.e., the pollutant with highest sub-index compared with PM-10, CO, and O_3) more than one-third of the time. The MOA also uses data from these monitors to assess and declare air quality advisories. $PM_{2.5}$ data are particularly important in assessing wildfire smoke impacts which often vary significantly by location within the MOA. The Parkgate monitor is located in Eagle River, approximately 15 km north of downtown Anchorage and it is separated by complex and mountainous terrain. As a consequence, the Eagle River area can experience significantly different impacts than the rest of Anchorage. Occasionally, large differences are noted between the DHHS monitor located in downtown Anchorage and the Garden monitor located approximately 6 km to the SE. In one wild fire smoke event, the downtown area was significantly impacted while areas just a few kilometers south and east of downtown were lightly affected.[6]

Fairbanks North Star Borough

The Fairbanks North Star Borough started sampling for fine particulate matter in January 1999 on the second story roof of the State Office Building (SOB) site. Initially the site only housed a set of collocated Federal Reference Monitors. In 2003 a continuous Met One Beta Attenuation Monitor (BAM) was installed followed in the fall of 2005 by a Met One Super Sass Chemical Speciation sampler, as part of the National Speciation Trend Network (STN).

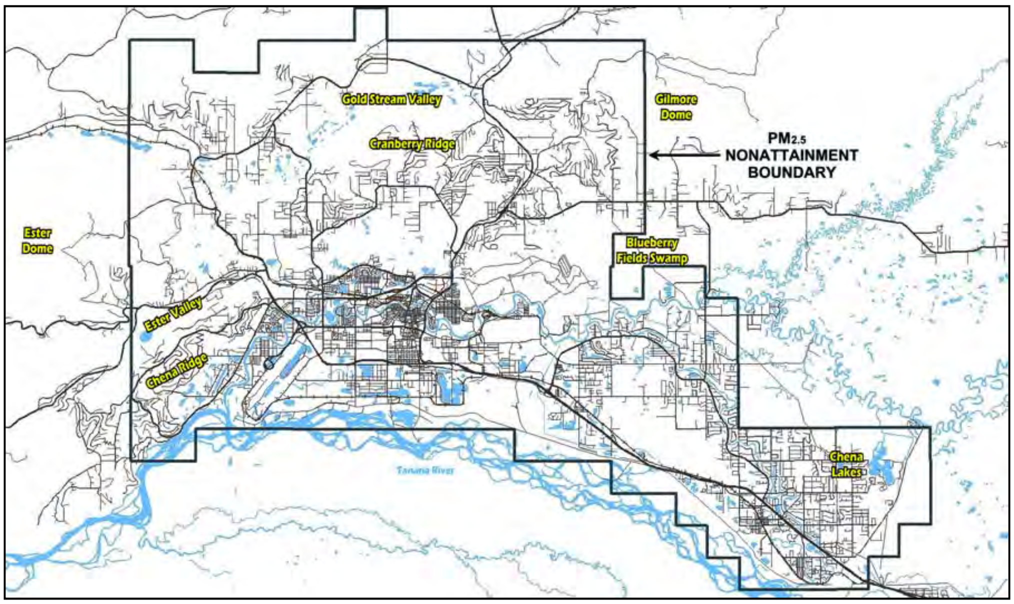

Figure 10: Map of the Fairbanks North Star Borough $PM_{2.5}$ non-attainment area.

Fairbanks and surrounding areas were designated non-attainment for fine particulate in December 2009, after the $PM_{2.5}$ NAAQS were strengthened in 2006. The Fairbanks non-attainment area includes the Fairbanks Bowl, North Pole, and the areas in between both cities. As shown in Figure 11 the non-attainment area is bounded to the south by the Tanana River, North Pole to the southeast, Ester to the west, and Goldstream Valley to the north. The non-attainment designation was based on the single monitor at the State Office Building in downtown Fairbanks.

In 2006 the State and the Borough installed additional sites to better characterize the spatial extent and severity of the $PM_{2.5}$ problem. Additional Federal Reference Monitors (FRM) were set up in an industrial part of town (Peger Road) and near two schools within residential neighborhoods (Nordale and North Pole). An additional site was established next to the State Office Building (Sadler Site) to investigate if the levels recorded at the second story SOB site were representative of levels on the ground. The Sadler site was shut down after one year when no significant differences between the two Federal Reference Monitors were measured. The

[6] This is based on anecdotal evidence; this event occurred prior to the installation of the continuous PM-2.5 monitors.

Nordale site was shut down due to logistical reasons and the equipment was moved to the new proposed NCore location to establish a correlation to the official SOB site. Currently the Fairbanks North Star Borough operates additional sites in downtown Fairbanks at the new NCore location, at Peger Rd, and in North Pole.

We currently believe that a major portion of the winter time $PM_{2.5}$ is attributed to wood smoke. Due to high heating fuel cost, the use of home heating wood stoves has gone up significantly since 2007.

The 2009 $PM_{2.5}$ 98^{th} percentile value and the 2010 design value (DV), provided in Table 6 for the Fairbanks SOB site are contingent on EPA concurring on the five flagged exceptional event days for 2009. Without EPA's approval of these exceptional events, the 2009 98^{th} percentile value for this site would be 89.7 $\mu g/m^3$, and the 2010 DV would be 63 $\mu g/m^3$.

Table 6: Summary statistics for Fairbanks State Office Building site, 2004 to 2009.

	2004	2005	2006	2007	2008	2009
Max 24-hour concentration						
Days above standard						
Annual 98th percentile value	46.2	40.6	**<u>42.2</u>**	33.1	**<u>46.7</u>**	**<u>51.0</u>**
24-hour design value	40					
		40				
			<u>43</u>			
				<u>39</u>		
					<u>41</u>	
						<u>44</u>
Annual design value	10.9					
		10.5				
			11.1			
				11.0		
					11.2	
						11.2

<u>City and Borough of Juneau</u>

In response to a variety of public concerns over degradation of air quality in Juneau during the late 1970s, DEC established several monitoring sites in the Juneau. These sites were established to determine whether the concentration of airborne pollutants in these glacier valleys could be impairing the health of local residents. Most of Juneau's population lives in two valleys. The Mendenhall Valley is located northwest of downtown Juneau and is separated from the Lemon Creek Valley by the 1000+ meter, north-south oriented Heintzelman Ridge. These valleys are susceptible to wintertime inversions which trap locally polluted air, particularly during extreme cold-weather events combined with minimal winds. Citizen complaints have primarily centered on woodstove emissions and road dust. With the exception of forest fire smoke from NW

Canada or Interior Alaska, pollution sources outside the valley are not expected to impact the monitoring site at Floyd Dryden Middle School in the Mendenhall Valley. The sources of particulate matter within the Mendenhall Valley include: residential heating wood smoke; automobile exhaust; dust from ball fields, playgrounds, construction/land clearing sites; dust from vehicular tracking; and smoke from open burns. On occasion, wildfire smoke from Western Canada and mainland Alaska has been known to impact the Mendenhall Valley, carried by long range transport.

Currently, there is one particulate matter monitoring site in Juneau which is operated by DEC staff (Table 7). The site, located on top of Floyd Dryden Middle School in the Mendenhall Valley has been run by the DEC since 1980 for TSP and/or PM_{10} and since 1999 for $PM_{2.5}$.

Table 7: Current $PM_{2.5}$ Monitoring Site in the City and Borough of Juneau

Site	AQS Site ID	Type	Time Period	Method	Sampling Frequency
Floyd Dryden	02-110-0004-88101	SLAMS	1999 - present	BAM	Hourly

$PM_{2.5}$ summary statistics for 2004 to 2009 are summarized in the table below (Table 8). Between 2004 and 2009 the maximum concentration did not exceed 50 $\mu g/m^3$. Under the new standard of 35 $\mu g/m^3$, promulgated December 16, 2006, the two highest values for 2006 were exceedances. In 2007, DEC installed a continuous analyzer at the site. To correlate the new instrument to the FRM sampler, the site operator collected additional samples during time frames when inversion caused elevated $PM_{2.5}$ levels. These additional samples were biased toward higher concentrations and are not representative of the sampling year. In 2008 the two high values of 40.1 $\mu g/m^3$ and 35.8 $\mu g/m^3$ exceeded the NAAQS. In 2009, only the first day of the year exceeded the NAAQS at 37.5 $\mu g/m^3$.

The 24-hour design values for 2004-2009 are all below 35 $\mu g/m^3$ except for 2007 when it was 36 $\mu g/m^3$. For the year 2007, all the data are used despite sampling above and beyond the scheduled sampling days. Usually only the creditable number of samples is applied for the 98th percentile calculation. However due to a miscommunication with the EPA, DEC was required to use the actual number of samples collected which included “extra” high values. The extra samples collected for a separate correlation study on $PM_{2.5}$ methods where days with high values were targeted to obtain a reliable correlation between the two instruments. As a result, the 2007 value is higher than it would normally be given an unbiased sampling schedule. The EPA did not designate Juneau as nonattainment; however, in 2008 they mandated daily sampling at Floyd Dryden because Juneau is just on the cusp of having a design value above the standard. Juneau has an active wood smoke control program. A combination of monitoring data and meteorological conditions are used to call wood burning bans in the Mendenhall Valley.

Table 8: Floyd Dryden $PM_{2.5}$ summary statistics for the years 2004 to 2009.

	2004	2005	2006	2007	2008	2009
Max 24-hour concentration	29.8	45.1	48.5	46.2	40.7	37.5
Days above standard	0	0 (2)†	2	3	2	2
Annual 98th percentile value	26.1	35.4	33.0	39.6	30.2	29.0
24-hour design value	25					
		30				
			32			
				36		
					34	
						33
Annual design value	7.2					
		7.8				
			7.8			
				7.8		
					7.4	
						6.9

† In 2005 and again in 2006 there were two values that exceeded the lowered standard of 35 $\mu g/m^3$ standard (December 16, 2006) but did not exceed the 65 $\mu g/m^3$ standard in place at that time.

In general, $PM_{2.5}$ shows a significant elevation in winter when wood heating is common and is lower in summer. $PM_{2.5}$ is mostly due to smoke from wood burning, wildfires, and vehicle exhaust. In the winter the Mendenhall Valley occasionally develops very stable air masses that tend to lead to inversion conditions usually lasting 2 to 5 days. These dry stable air masses trap smoke, vehicle exhaust and other combustion emissions. Generally during the summer months a combination of little to no wood smoke from home heating and enough precipitation keeps the $PM_{2.5}$ concentration in the air to a minimum. However during wildfire season, May through August, spikes in $PM_{2.5}$ mirror the smoke from local slash burning and/or distant wildfires.

Matanuska-Susitna Borough

DEC has operated many sites in the Matanuska-Susitna Borough (Mat-Su) throughout the last few decades. The longest standing site is at Butte, which was located near the outflow of the Knik River valley to capture windblown dust from the glacier river bed. The $PM_{2.5}$ samplers were installed to measure potential transport from Anchorage into the outlying communities. Only in recent years have we recorded elevated levels during the winter months. DEC believes that the site is impacted by wood smoke from home heating in the winter time, but has not yet been able to determine if this is a very local problem (the two homes closest to the site) or a result of increased wood stove use within the wider Butte community. An intergovernmental agreement with the Municipality of Anchorage has made additional sites in the Mat-Su Borough possible. Currently DEC operates three sites in the Mat-Su Valley (Table 9).

Table 9: Sites currently operating in the Matanuska-Susitna Borough.

Site	AQS Site ID	Type	Install Date	Method	Sampling Frequency
Butte	02-170-0008	SLAMS	1999	Partisol	1 in 3
Palmer	02-170-0012	SPM	2008[1]	Coarse BAM	Hourly
Wasilla	02-170-0013	SPM	2008[2]	Coarse BAM	Hourly
Wasilla	Not assigned yet	SPM	2008	Partisol[3]	1 in 6

[1]Data from this site invalid until 1/2010 (see text for more explanation)
[2] Data from this site invalid until 1/2011(see text for more explanation)
[3]Partisol installed to obtain correlation with $PM_{2.5}$ BAM

The Butte State & Local Air Monitoring Site (SLAMS) is located at Harrison Court in the unincorporated area of Butte. The monitoring objective of this site is to measure airborne glacial loess raised by high winds on the Knik and Matanuska river beds, as well as measure exposure to fine particulate matter from automobiles and home heating in this rural location.

General trends of the $PM_{2.5}$ data show a significant elevation in concentrations during the late fall to early spring of each year when the use of wood stoves for heating homes is common. $PM_{2.5}$ concentrations are typically associated with smoke from wood burning stoves, wildfires, and vehicle exhaust. In the summer the use of woodstoves significantly decreases, lowering $PM_{2.5}$ concentrations. However May through August is considered the wildfire season, spikes in $PM_{2.5}$ concentrations reflect wildfires and localized slash burns.

Under the old standard of 65 µg/m³ there were no exceedances for $PM_{2.5}$ at the Butte site. In 2006 the four highest values of 48.9 µg/m³, 40 µg/m³, 39.4 µg/m³, and 35.9 µg/m³ exceeded the 24-hour NAAQS of 35 µg/m³. In 2008 the first highest value of 35.2 µg/m³ met the 24-hour NAAQS. In 2009 the first highest value of 36.3 µg/m³ exceeded the 24-hour NAAQS. Concentrations that would have been considered exceedances if the 35 µg/m³ standard had been established prior to 2006 are underlined (Table 10). Concentrations which have exceeded the 35 µg/m³ standard since 2006 are bold and underlined (Table 10).

At the initiation of the $PM_{2.5}$ standard in 1997, the $PM_{2.5}$ federal standard for the annual mean was 15 µg/m³. Annual $PM_{2.5}$ means from 2004 through 2009 were well below the $PM_{2.5}$ annual mean standard (Table 10). All annual means are single digit numbers. The 24-hour design values for 2004 to 2009 all fell below the 35 µg/m³ standard.

Table 10: Butte $PM_{2.5}$ data summary statistics from 2004-2009.

	2004	2005	2006	2007	2008	2009
Max 24-hour concentration	35.9	45	48.6	32.7	35.2	**36.3**
Days above standard	0 (1)*	0 (1)*	4	0	0	1
Annual 98th percentile value	27.5†	25.2	40**.0**	20.1	30.8	28.8‡
24-hour design value	31					
		28				
			31			
				28		
					30	
						27
Annual design value	6.9					
		7.2				
			7.3			
				6.5		
					6.4	
						6.5

* Prior to 2006 the numbers in parentheses would have exceeded the 35 $\mu g/m^3$ standard if it had been implemented earlier but did not exceed the 65 $\mu g/m^3$ standard at that time

† Only two complete quarters

‡ Only 3 complete quarters

DEC installed two prototype Met One Coarse BAM sets, at Wasilla and Palmer, in the Matanuska-Susitna Borough in the fall 2008. Persistent problems plagued both sites until 2010. The Wasilla analyzer pair was still problematic into the spring of 2011 with errors and do not produce reliable data that can be entered into AQS. However, the Palmer pair has been producing data that mostly passes state and federal QA/QC standards since 2010. In general the Palmer site measures lower $PM_{2.5}$ values than Butte and the Wasilla site measures lowest of the three sites. It appears that the exceedance values measured at Butte are a local phenomenon limited to the Butte area, not to the entire Mat-Su Borough. However added data from the three sites and a closer look at the local Butte area are required for DEC to be able to characterize the scope of the $PM_{2.5}$ issue in the Mat-Su Valley.

PM_{10} Monitoring

Municipality of Anchorage

PM_{10} monitoring has been conducted in the Municipality of Anchorage since 1985. Currently monitoring is conducted at four locations. Three of these are in Anchorage (Tudor Road, Downtown Anchorage and Garden sites) and one site is in Eagle River (Parkgate site). Including the four current sites, monitoring has been conducted at ten locations in Anchorage and seven in Eagle River. This monitoring has helped to define the nature and extent of PM_{10} in the Municipality.

In 1991 the EPA designated a nine square kilometer area in Eagle River as a moderate nonattainment area for PM_{10}. Eagle River is a community of about 30,000 residents located about 10 miles north of downtown Anchorage. In response, the Municipality of Anchorage prepared and implemented a plan to pave or treat gravel roads in the area with recycled asphalt. A prior study had demonstrated that these unpaved roads were the source of most of the PM_{10}. All of the roughly 30 miles of unpaved roads in the area were paved or treated. Since this was accomplished there have been no exceedance recorded of the NAAQS. [7]

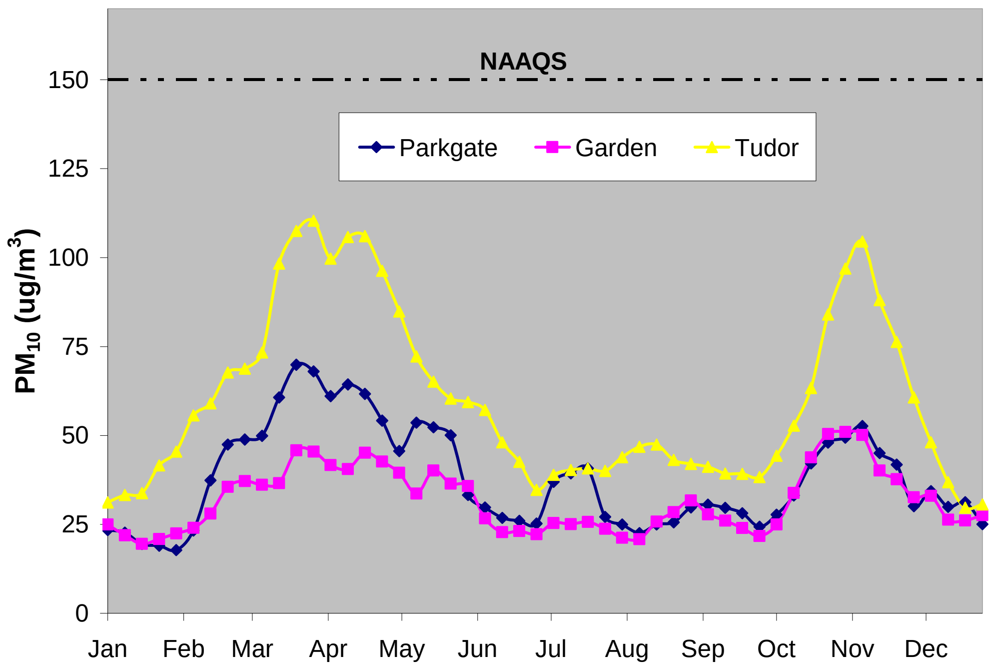

Figure 11: 98th percentile PM_{10} concentrations at monitoring stations in Anchorage and Eagle River (2000-2009)

The rest of Anchorage is considered in attainment with the NAAQS although PM_{10} concentrations have occasionally approached or exceeded the NAAQS. The highest PM_{10} concentrations are found near major roadways during the late-winter, early-spring "break-up" period in March and April, see Figure 11. During this period of snow and ice melt large amounts

[7] Eagle River has exceeded the NAAQS as a result of wind storms and volcanic ash fall events but these are considered uncontrollable natural events, not violations.

of pulverized traction sand and abraded roadway aggregate are exposed and re-entrained by traffic and wind. High PM_{10} concentrations are also occasionally experienced during the fall freeze-up especially if there is a lack of snow cover. Sub-freezing temperatures contribute to a "freeze-dry" effect which makes fine sediments on or near roadways more prone to re-entrainment and contributes to elevated PM_{10}.

The Municipality of Anchorage is also vulnerable to uncontrollable natural events that can result in PM_{10} concentrations well above the NAAQS. Ash fall from the eruption of volcanoes in the region in 1985 (St. Augustine), 1990 (Redoubt), 1992 (Spurr), 2006 (St. Augustine) and 2009 (Redoubt) have sometimes contributed to PM_{10} concentrations over the NAAQS. The eruption of Mt. Spurr resulted in both short and long term impacts on PM_{10}. Anchorage experienced hourly PM_{10} concentrations above 1000 µg/m3 during the initial ash fall event and exceedances of the NAAQS continued for months afterward as ash was reentrained during wind storms and by traffic along major thoroughfares. Data suggest that Anchorage experienced elevated PM_{10} concentrations for several years following the main eruption. "Natural" PM_{10} is also transported into Anchorage from the glacial river valleys of the Knik, Matanuska and Susitna Rivers during high wind events. PM_{10} exceedances resulting in large part from dust transport from these glacial river valleys were documented in 2001, 2003, 2007, 2009 and 2010.[8] During the most severe event 24-hour average PM_{10} concentrations greater than 500 µg/m^3 were measured at some Anchorage sites. Eagle River seems more susceptible to the effects of dust transport because it is in closer proximity to the glacier river valleys than the Anchorage bowl. The long term trend at the Parkgate site in Eagle River is shown in Figure 12. The effect of the road paving and surfacing program in the late 1980s is evident as is the impact of some of the natural events discussed above.

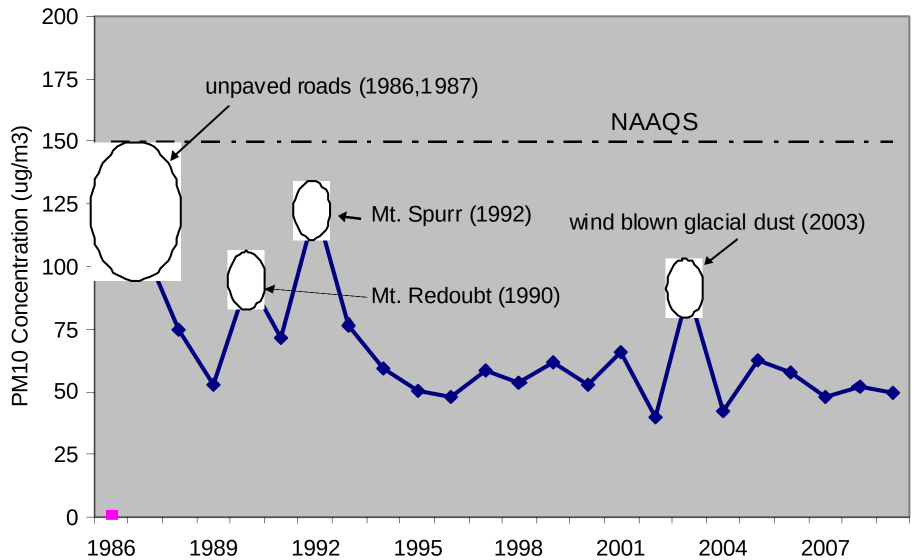

Figure 12: PM_{10} trend (shown as 98th percentile) at Parkgate site, Eagle River

8 The MOA has submitted the documentation necessary for EPA to make a determination of whether an exceptional event waiver should be granted so that the data are excluded when determining compliance with the NAAQS. All of these waiver requests have been approved or are pending approval from the EPA.

Finally, it should be noted that each of the three continuous $PM_{2.5}$ monitors are collocated with continuous CO and PM_{10} monitors. This affords the opportunity to analyze relationships between pollutants. These relationships can provide insight about sources of these pollutants and their health impacts. For example, coincident $PM_{2.5}$ and PM_{10} monitoring data have proven valuable in the analysis of the health impacts of PM_{10}. Data have shown that $PM_{2.5}$ concentrations in Anchorage are poorly correlated with PM_{10}; when PM_{10} concentrations rise $PM_{2.5}$ usually remains low (Figure 13). This has provided a unique opportunity to examine the health impacts of PM_{10} in a situation where the confounding influence of $PM_{2.5}$ is minimal. A number of published local studies (Gordian, et al, 1996, Choudhury, et al, 1997, and Chimonas and Gessner, 2006) have shown increases in outpatient doctor visits for asthma, bronchitis and other respiratory disease in Anchorage when PM_{10} concentrations increase. Because $PM_{2.5}$ is generally low and uncorrelated with PM_{10}, Anchorage provides a unique "laboratory" for evaluating the health impacts of PM_{10}. Thus, coincident PM_{10} and $PM_{2.5}$ data from the Garden, Parkgate and DHHS sites may prove valuable in future PM_{10} health studies.

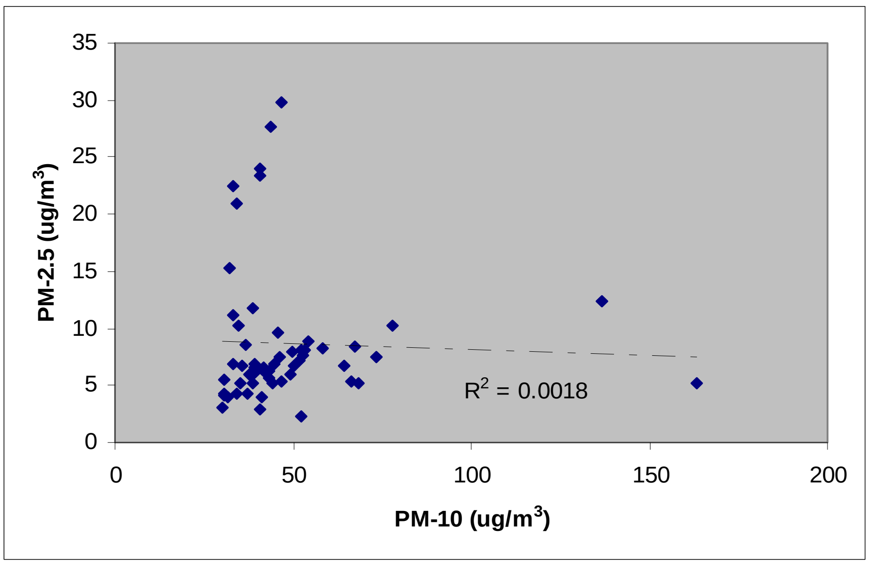

Figure 13: Relationship between 24-hour $PM_{2.5}$ and PM_{10} Concentrations at the Parkgate Site in 2009 (for PM_{10} > 30 µg/m^3)

City and Borough of Juneau

EPA designated the Mendenhall Valley area of Juneau, Alaska as a moderate non-attainment area for the National Ambient Air Quality Standard (NAAQS) for particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}), upon enactment of the federal Clean Air Act Amendments of 1990 (56 FR 56694, November 6, 1991). The non-attainment classification was based on violations of the 24-hour standard that occurred throughout the 1980s. Juneau has requested limited maintenance status and Floyd Dryden Middle School is in compliance for PM_{10}. The EPA fully approved Alaska's moderate PM_{10} non-attainment area plan as a State Implementation Plan (SIP) revision for the Mendenhall Valley PM_{10} non-attainment area in 1994 (Federal Register: March 24, 1994). Juneau has had no measured violation of EPA's PM_{10} standard since 1993. In 1993, the three violations were located at the Trio Street site a microscale roadside site (not a current monitoring site). The highest value recorded at the Floyd Dryden site was 86 $\mu g/m^3$ in 1995, which is about 57% of the standard. Annual means were well below 50 $\mu g/m^3$, the standard until 2006 when the annual standard was vacated. DEC has produced a Limited Maintenance Plan (LMP) for the Mendenhall Valley area of Juneau.[9] The LMP provides contingency plans should Juneau ever experience a PM_{10} problem in the future and allows for Juneau to be designated as attainment for PM_{10}.

DEC did not calculate the annual design values after the standard was vacated in 2006. Summary statistics for PM_{10} are shown in Table 11. The 24-hour design values for 2004 to 2009 are all far below 150 $\mu g/m^3$.

Table 11: PM_{10} summary statistics for 2004-2009.

	2004	2005	2006	2007	2008	2009
Max 24-hour concentration	34	42	33	21	30	33
Days above standard	0	0	0	0	0	0

In general, the Floyd Dryden PM_{10} increases in the winter due to wood smoke (for home heating) and fugitive dust from road sanding and decreases during the summer. As the ground freezes in the fall before it snows, dust is blown off nearby roads. A similar process occurs in the spring when roads are sanded for traction and uncovered by melting. Thus, as more and more roads have been paved in Juneau, the overall dust, measured as PM_{10}, should have decreased throughout the years of monitoring—1980 to 2009. In fact, the data show that winter PM_{10} did decrease with time. Winter highs in the 1990s were around 70-80 $\mu g/m^3$ and have progressively dropped to less than 30 $\mu g/m^3$ in the late 2000s. Summer PM_{10} values show values of about 15 $\mu g/m^3$ in the 2000s.

Matanuska-Susitna Valley

In general, PM_{10} concentrations increase in the early spring and late fall months due to glacial till being blown off the Matanuska and Knik glacier valleys during high wind events. Fugitive dust from roads and road sanding also contribute to high PM_{10} values at dry periods with little to no snow cover. The State operates three sampling sites in the Matanuska-Susitna Valley, see Table 12.

Annual averages of concentrations are considered weighted means, and are an average of each quarter's average PM_{10} concentration. The highest annual weighted mean is 29 $\mu g/m^3$. The statistical population of concentrations is not normally distributed; high concentration values have a disproportionate affect on the mean.

Four maximum concentrations exceeded the federally imposed limit for PM_{10} of 150 $\mu g/m^3$ for a 24-hour period (Table 13) between 2004 and 2010. The highest value recorded was 605 $\mu g/m^3$ in 2004 during a high wind. Prior to the annual standard of 50 $\mu g/m^3$ being vacated in 2006, the

[9] City and Borough of Juneau PM_{10} Limited Maintenance Plan http://www.dec.state.ak.us/AIR/anpms/doc-anpms/CBJ_PM10_LMP_20FEB09.pdf

annual mean averaged 17 µg/m³. All four maximum concentrations were flagged as high wind events in AQS. The annual standard of 50 µg/m³ was never exceeded in the years 2004 through 2006. This standard was vacated in December 2006 so the annual mean for 2007 - 2010 data is not relevant for federal reporting and compliance.

Table 12: PM_{10} sites currently operating in the Matanuska-Susitna Borough.

Site	AQS site ID	Type	Install Date	Method	Sampling Frequency
Butte	02-170-0008	SLAMS	1998	GMW Hi Vol	1 in 6
Palmer	02-170-0012	SPM	2008[1]	Coarse BAM	hourly
Wasilla	02-170-0013	SPM	2008[2]	Coarse BAM	hourly
[1] Data from this site invalid until 1/2010 (see test for explanation) [2] Data from this site invalid until 1/2011 (see test for explanation)					

Table 13: PM_{10} summary statistics for 2004-2009

	2004	2005	2006	2007	2008	2009
Max 24-hour concentration	**605**	**176**	84	**168**	**233**	33
Days above standard	1	1	0	1	1	0

Bush Alaska

Fugitive dust is an ongoing air quality issue in rural Alaska, especially communities that are off the road system. Exceedances of PM_{10} occur in rural Alaskan villages during 6 to 8 weeks of hot dry weather during the summer. Except for the larger regional hubs like Bethel, Kotzebue or Kodiak, most villages only have unpaved roads and most of the traffic on these roads after break up is comprised of all terrain vehicles (ATV) and trucks. Local governments are concerned about the high cost to effect compliance with the PM_{10} standard, and the long-term effect of any control measures. The State provides support to Alaska's rural communities in their efforts to assess local air quality. Because a majority of the citizens (percentages range from 50-95%) in these communities are Alaskan Native, much of the monitoring is being supported by EPA's General Assistance Program (GAP) or EPA's Tribal Air Grant process. The GAP program provides limited funding and training which places a large responsibility on the State to ensure that the "village" environmental assessment program actually works.

The "tribal air monitoring" program at DEC has included 11 active monitoring locations in the last decade but requests for assistance, especially in light of recent revisions to the national particulate standard, could see that number increase tenfold. DEC has actively supported eight environmental programs in the Northwest Arctic Borough: Buckland, Ambler, Kiana, Kivalina, Kotzebue, Noatak, Noorvik and Selawik. Mekuryuk, Bethel (currently monitoring with a TEOM) and St. Mary's (monitoring 2006 and 2007 summers) are the only communities in western Alaska that DEC has provided assistance with monitoring in the past.

Some results for the rural Alaska dust studies are presented in this paragraph. Kotzebue recorded 11 exceedance of the standard between 2003 and 2005 (FRM and BAM) before paving 2nd Avenue and no values exceeded the PM_{10} standard in the post paving monitoring years (2006 and 2007). Supplemental monitoring was conducted in 2008 at the corner of Turf and Sixth Street (both unpaved) and six days exceeded the NAAQS for PM_{10} (1 in 3 monitoring schedule was followed). Noorvik had exceedance values in 2004 and Noatak had eight exceedance values in 2005 with several values reaching 600 µg/m3. Bethel recorded one exceedance value in 2002 and two in 2003. Sampling in Bethel for 2004 missed the dust season. St. Mary's conducted monitoring from June 2006 to August 2007 and recorded three values that exceeded the NAAQS of 150 $\mu g/m^3$.

The state believes these high dust levels represent the conditions that would be found in other similar sized rural communities if they performed monitoring. Based on the monitoring results, the state considered requesting designation of affected rural villages/regions as non-attainment for PM_{10}. Rather than put the burden of a nonattainment designation on the rural local governments, DEC partnered with the Alaska Department of Transportation (DOT) and University of Alaska Fairbanks (UAF) to develop a strategy for reducing dust levels in the villages starting in 2009. The Alaska State Legislature appropriated funding for a pilot project in eight rural communities that had evidence of high levels of PM_{10} in summer (Ambler, Buckland, Bethel, Noorvik, Kotzebue, Noatak, Kiana and St Mary's). The demonstration project is to be conducted over the next few years and includes a DOT designed sprayer that can be mounted on either an ATV or pickup truck. Communities then have the choice of spraying water or one of a number of environmentally friendly palliatives during the dust season. DEC supplies the monitoring equipment, the training of site operators and analyses of the filters so that the effectiveness of the chosen method can be judged. UAF Department of Engineering has also developed an instrument to measure the level of dust kicked up by an ATV and is calibrating it to DEC's FRM PM_{10} high volume samplers. DEC will continue to work with DOT, the UAF Department of Engineering and the eight pilot communities to mitigate the PM_{10} issue hopefully expanding the program to all of rural Alaska in several years.

Ozone

Municipality of Anchorage

Federal regulations require that metropolitan statistical areas (MSAs) with populations of 350,000 or more have at least one ozone monitoring station.[10] In April 2010 two ozone monitors were deployed in response to this requirement: one at the Garden station in east Anchorage and the other at the Parkgate station in Eagle River. The Garden site is located in the core urban portion of Anchorage and is therefore most representative of population exposures.
Because ozone is a secondary pollutant formed from precursors, to measure peak concentrations, EPA ozone monitoring guidance recommends that monitors be placed in locations downwind of the population center where precursor pollutants are generated. Under stagnant conditions, when there is little or no wind transport, the Garden site is appropriately located to measure these peak

[10] 40 CFR 58 Appendix D, Table D-2.

ozone concentrations.[11] During the spring and summer, the prevailing wind is from the southwest. Under these prevailing wind conditions, the Parkgate station in Eagle River is located approximately 15 km downwind of the population center in the Anchorage bowl. In 2011 DEC plans to move and operate this monitor in the Wasilla area 30 to 50 km downwind and northeast.[12]

During this first season of monitoring, ozone concentrations were well under the NAAQS. Concentrations at the Parkgate site were slightly higher than the Garden site. MOA staff suspects that there is more ozone scavenging (i.e.; reactions with other NOx and other air pollutants) at the more urban Garden location. Ozone concentrations at both Garden and Parkgate were lower than those from the nearly pristine Denali National Park suggesting that most of the ozone in the Southcentral Alaska region is naturally occurring and is being reduced in urban areas by scavenging. Composite hourly data from the Parkgate and Garden site are compared to Denali National Park in Figure 14.[13]

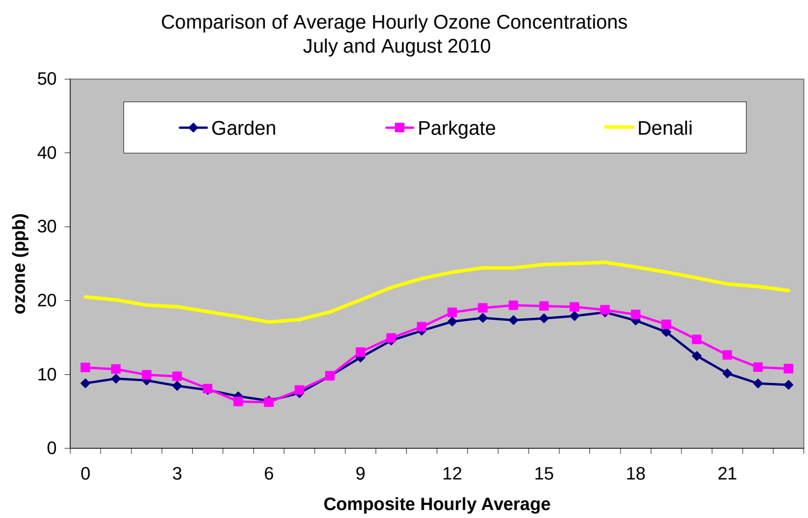

Figure 14: Hourly Ozone concentrations measured in Anchorage and at Denali National Park Headquarters

[11] In the spring and summer Anchorage usually experiences an afternoon "sea breeze" from the southwest. The highest summer time temperatures (rarely >80 ºF) usually occur when this sea breeze is absent.

[12] The selection of the Parkgate location is consistent with EPA guidance which states that "the maximum ozone concentration usually occurs 4 to 6 hours after maximum emissions, and under conditions of light winds, usually downwind of the urban region." The Parkgate location is suitably located to meet this guidance when the average wind is from the southwest at 2 to 3 mph. At higher wind speeds, the maximum location would be expected to be further downwind to the northwest.

[13] The Denali National Park monitor is operated by the National Park Service. Raw data were obtained from http://java.epa.gov/castnet/ prior to completion of final quality assurance procedures.

Carbon Monoxide (CO)

Municipality of Anchorage

Anchorage was first identified as experiencing high levels of ambient carbon monoxide (CO) concentrations in the early 1970's. Since that time, extensive monitoring has been conducted throughout the community. Anchorage violated the CO NAAQS every year from 1972 through 1994 and again in 1996. Ambient CO concentrations have declined by about 70% over the past three decades. Anchorage has been in compliance with the NAAQS since 1997. In 2004 the EPA declared Anchorage a CO maintenance area and it is now considered in attainment with the NAAQS.

A CO saturation monitoring study was conducted during the winter 1997-98. Monitors were deployed in residential areas, along major roadway corridors and in parking lots. Surprisingly, the highest concentrations were found in residential areas. There is now strong evidence that cold starts combined with extended warm-up idling by morning commuters are the primary contributors to these high concentrations. CO concentrations peak on cold winter weekday mornings because vehicle CO emissions are highest when the engine and catalytic converter are cold and morning temperature inversions limit the dispersion of these emissions.

CO monitoring in Anchorage is now focused on residential areas. The current CO monitoring network is comprised of three sites. The Garden and Turnagain monitors in Anchorage are located in residential areas and the Parkgate site in Eagle River is located in a transition area between commercial and residential development. CO monitoring is performed seasonally during the period October 1 – March 31.

The Garden and Parkgate monitors are collocated with $PM_{2.5}$ and PM_{10} monitors to examine inter-relationships between these pollutants. A strong association is observed between CO and $PM_{2.5}$ but little or no correlation is seen between CO and PM_{10}.[14]

The Garden monitor was collocated with a VOC and semi-volatile monitor for a one-year period between October 2008 and October 2009. Very strong ($R^2 > 0.9$) associations were observed between CO and BETX (benzene, ethylbenzene, toluene and xylene). All of the BETX compounds are found in significant quantities in Alaska gasoline. This suggests that cold start motor vehicle emissions, like CO, are a major source of ambient BETX in residential neighborhoods.

[14] There is virtually no correlation between the coarse fraction of the PM_{10} (PM_{10}-$PM_{2.5}$). The small correlation observed between CO and PM_{10} is related to the fact that PM_{10}, by definition, includes the fine fraction $PM_{2.5}$ mass. Thus a portion of the PM_{10} mass is correlated with CO.

Fairbanks North Star Borough (FNSB)

The first documentation of ambient CO in Fairbanks in the early 1970s recorded over 100 exceedances of the 8-hour CO standard. The number of exceedances has declined steadily since then. The number of exceedances dropped to less than 80 in 1975 and below 50 in 1978. Similarly the maximum 8-hour CO concentrations dropped from over 25 ppm to less than 5 ppm. Fairbanks was designated non-attainment for carbon monoxide (CO) on November 15, 1990, but has been in compliance with the NAAQS since 1999. Not having had any CO exceedances for several years, Fairbanks requested re-designation and was placed in CO "maintenance" status on July 23, 2004.

The Fairbanks CO monitoring network initially was comprised of 3 sites, the State Office Building, the Old Post Office and Hunter School sites. The State Office Building site CO was closed in 2002 and the equipment moved to the Armory site to investigate if the new site experienced elevated CO levels. Because of continued compliance with the standard since 1999 and the need to refocus on $PM_{2.5}$ non-attainment, the Fairbanks monitoring program requested and EPA approved a reduction in the number of CO monitoring sites within the FNSB. First the Armory site was shut down in March 2007 and in 2009 the Hunter School site was dismantled. Fairbanks currently operates one CO monitoring site at the Old Post Office in downtown and will add CO monitoring to the multi-pollutant NCORE site during the summer of 2011.

Lead (Pb)

Noatak

Red Dog Mine (operated by Teck Alaska Inc.) has lead emissions of more than 1 ton per year and thus it is subject to federal source oriented monitoring requirements. The Red Dog Mine is remote and is in the rugged terrain of the northern part of the Northwest Arctic Borough (NWAB) which covers an area of approximately 40,000 square miles, or an area about the size of Indiana. It is off the road system and borders on federal and Native Corporation owned lands. The entire population of the NWAB is 7047[15]. Kotzebue, the largest town (population about 3200) in the borough, is about 144 km (90 miles) south of the mine. The remaining population is spread among 12 smaller communities. Because of the isolated nature of the mine, monitoring at its boundaries is prohibitively expensive. In 2009, EPA granted the State of Alaska a waiver from the source oriented monitoring requirements and allowed population based monitoring in the Village of Noatak, 30 miles south of the mine. DEC began collocated TSP lead monitoring in the Village of Noatak on January 15, 2010. The second quarter sample data all were invalidated due to data quality issues. The contract Noatak site operator resigned in June 2010. After a year of searching, DEC finally found another person in Noatak willing to be the lead monitoring site operator. Thus there are no lead samples for June 2010 until June 2011.

Table 14: Noatak TSP lead summary statistics (μg/m^3 local conditions).

	1st quarter 2010	2nd quarter 2010
Average	0.003	--
Maximum	0.006	--
Exceedances	0	--
N	0	--[1]
% capture rate	71%	0%
[1] samples were all collected but the data subsequently invalidated		

Noatak TSP lead concentrations fall well below the new standard with a maximum of 0.006 μg/m^3 which is 4% of the NAAQS of 0.15 μg/m^3 (see Table 14). Six grab samples of soil from the village were also analyzed. The limited data (collected in winter with complete snow cover) available thus far show that lead emissions from the mine have minimal deleterious effects on air quality in Noatak.

[15]Nwabot.org (2008 DCCED Certified)

TECHNOLOGY

Below is a detailed description of the sampling equipment used throughout the state. The main focus over the past ten years has been particulate matter monitoring, followed by CO sampling. This is reflected in the instrument inventory. With the changes to the ozone rule and the start-up of the NCore site the responsible air agencies had to add gaseous pollutant monitoring to their repertoire. This poses a significant change and added substantially more tasks to the monitoring programs.

Monitors

$PM_{2.5}$ Equipment

The State operates four different types of $PM_{2.5}$ sampling equipment:

- Thermo Electron (formerly Rupprecht & Patashnick) Partisol 2000 samplers. These FRM samplers are slowly being replaced by continuous analyzers. The state will continue to collocate the FRM next to the new FEM samplers until an acceptable correlation can be established, either proving that the continuous samplers truly meet the FEM requirements, or to establish a correlation, which can be used to correct the collected data to FRM-like data reportable to AQS.
- Met-One Beta Attenuation Monitors (BAM 1020), both as part of the PM_{coarse} BAM sampling pair and as a standalone $PM_{2.5}$ FEM.
- Thermo Electron TEOM and TEOM FDMS. Currently we are operating three TEOMS in the Field and two TEOM FDMS systems.
- Met-One Super SASS Speciation Monitor.

PM_{10} Equipment

The State operates two different types of PM_{10} sampling equipment:

- Anderson High Volume samplers.
- Met-One Beta Attenuation Monitors (BAM 1020), both as part of the PM_{coarse} BAM sampling pair and as a standalone PM_{10} FEM.

An equipment inventory table is included at the end of the section (Table 15). Currently all SLAMS and SPM sites (except Soldotna) are operational and all equipment is in good working order. Our main equipment needs include the replacement parts for main instrument components of our FRM samplers, like mass flow controllers and motherboards, which have shown an average lifetime of about 10-12 years.

Gaseous Analyzer Equipment

Over the past years the air agencies within the state have consolidated their CO and ozone equipment. All agencies now use:

- Thermo Electron 48C CO sampler, the NCore site has a trace level Thermo Electron 48i
- Teledyne 403E ozone analyzers

The other gaseous analyzers at the NCore site are also from Thermo Electron. A detail list is in Table 15.

Additional Needs

Over the past few years, the program has transitioned from manual filter based methods to continuous analyzers. As part of the transition meteorological parameters should be collected at each site. Especially in Alaska with extremely variable micro climates, meteorological data are critical to assessing local conditions which affect pollutant dispersion and population exposure. Currently none of our SLAMS sites are equipped with met sensors. DEC is working on selecting met equipment for each of the existing SLAMS sites and most SPM sites. The instrumentation would include new sensors, data acquisition systems, and calibration devices.

Additionally the new short term NAAQS for SO_2 and NO_x will require the State to conduct sampling in representative locations to assess the need for a monitoring network. Additional gaseous analyzers will be needed for this initial assessment.

Table 15: Equipment inventory

#	Parameter	Equipment	Manufacturer	Location	Comments
			PM		
6	PM 2.5	Partisol 2000	Thermo Electron	SOB (2), NCore, Reger, Butte, Wasilla	Peger seasonally(Oct-Mar)
3	PM 2.5	BAM 1020	Met One	SOB, Peger, Juneau	FEM, Juneau SLAMS
4	PM 2.5	Super SASS	Met One	SOB, NCore, Peger, North Pole	3 are property of FNSB
1	PM 2.5	3000N	URG	SOB	STN
8	PM 10, PM2.5	BAM 1020 coarse	Met One	Anchorage, NCore, Ma-Su, Soldotna	SPM
3	Elemental C	Aethalometer	Magee Scientific	Ncore, North Pole, Peger	2.5µm sharp cut cyclone
3	PM 2.5	TEOM/FDMS 1400a/8500	One Thermo Electron	North Pole (2), Peger	
3	PM 2.5	TEOM	Thermo Electron	Ford Yukon, Galena, Peger	Seasonally(Oct-Mar)
3	PM 10	Partisol 2000	Thermo Electron	Juneau (2), Butte	1-3
1	PM 10	BAM 1020	Met One	Anchorage	
7-10	PM 10	High-volume sampler	Anderson	Anchorage (3) rural communities	project specific
3	TSP	High-volume sampler	Anderson	Noatak, Kivalina	Kivalina project not yet started
			Gaseous		
5	CO	Thermo 48C	Thermo Electron	Fairbanks, Anchorage (4)	Seasonally(Oct-Mar)
1	CO	Thermo 48C	Thermo Electron	Fairbanks- NCore	
1	SO_2	Thermo 43i-TLE	Thermo Electron	Fairbanks- NCore	
1	NO	Thermo 42i-TLE	Thermo Electron	Fairbanks- NCore	
1	NOy	Thermo 42i-Y	Thermo Electron	Fairbanks- NCore	
1	NH_3	Thermo 17i	Thermo Electron	Fairbanks- NCore	
4	O_3	Teledyne 403E	Teledyne Model	NCore, Garden, Wasilla, (primary)	Seasonally (Apr-Oct)
1	Relative humidity		Met One	Fairbanks- NCore	
2	Ambient temperature		Met One	Fairbanks- NCore	
1	Wind speed/direction	Windbird+ Vane nanometer	R. M. Young	Fairbanks- NCore	
3	Wind speed/direction	Sonic Anemometer 50.5H	Met One	Fairbanks- NCore	

Not in operation					
1	PM 2.5	TEOM/FDMS	One Termo Electron	intended for special studies	
3	PM 2.5	FDMS	One Termo Electron	intended for special studies	
7	PM 2.5	Partisol 2000	Thermo Electron	being used for spares, some on loan to MOA	
2	PM 10	BAM 1020	Met One	old style, intended for rural projects	not PM2.5 FEM quality
10	PM 10	High-volume samper	Anderson	used for spare parts, some are functional	
7	Ambient temperature		Met One		
7	Wind speed/direction	Windbird+ Vane nanometer	R.M.Young		

Long term strategy for aligning equipment makes and models

The Department started out with continuous Anderson Beta Attenuation Monitors, then purchased two Met One BAMS and three R & P (now Thermo Electron) TEOMs for a study. It was DEC's intent to replace all continuous samplers with TEOMS and we purchased 3 more TEOM FDMs units. When EPA started the discussion regarding a $PM_{10-2.5}$ standard Met One was the only company that provided a system that would satisfy the proposed EPA rule. Right around this time, the Municipality of Anchorage received funds to expand their monitoring network into the outlying boroughs and decided to purchase Met One BAMs keeping the new proposed PM_{coarse} rule in mind. The state currently operates the Municipality owned Met One BAMs in Palmer, Wasilla and Soldotna. We recently expanded the Butte site with a Met One BAM PM_{coarse} system.

While the state has a majority of continuous PM10 equipment from Met One, we continue to have problems with the data quality for the new FEM $PM_{2.5}$ samplers. The samplers in Fairbanks do not meet the FEM requirements of slope and intercept, when correlated to the FRM samplers. Until these problems can be resolved, the state will not make a final decision of aligning all continuous PM sampling equipment to the same make and model.

Most of our gaseous analyzers are of similar make and model and DEC does not plan a re-alignment any time soon.

Calibrator (field)/Zero Air Source/ Auditing equipment

PM calibration and auditing equipment:
For calibrating low flow PM equipment, both FRM and continuous, we use BGI Delta Cals, which are sent back to the manufacture for annual re-certification. The state's air quality auditor maintains separate equipment for the sole purpose of independent quality control checks. The Met One Super SASS speciation samplers are calibrated and audited with either a BGI Tri Cal or Delta Cal.

Gaseous Analyzer calibration and auditing equipment
Zero-Air Sources
For most of the CO and Ozone SLAMS and SPM sites, zero air is provided through air gas canisters. The NCore site has a Teledyne zero air generator

Data Acquisition System

DEC and the Municipality of Anchorage entered into a cooperative agreement with the state of Washington Department of Ecology (DOE) to use the DOE's expertise in automating air quality networks (using Envitech software provided by DR DAS Ltd) and to contribute to their centralized air quality monitoring database for states in the northwest United States. To keep track of the increasingly large data sets that are produced by continuous instruments, a centralized data logger system and database are necessary. Alaska Air Monitoring Network Data System (AAMNDS) is a system of servers with the DR DAS software on them at several sites around the state that all report back to a statewide website and a central database at DOE. DR DAS allows for remote access of site servers which record measurements and run some QC checks automatically. Email, phone or text alarms are automatically triggered and autonomously sent when the system detects malfunctions or errors that have been specified during the setup of the site logger. It was designed for gaseous monitors specifically and is not so functional for particulate monitors which are the bulk of DEC's network. Error and diagnostic checks on gaseous monitors can also be performed remotely and automatically resulting in reduced travel time to the sites that are away from the DEC offices. With some particulate monitors, like the Thermo TEOM, DR DAS allows for remote control of the instruments. The MetOne BAM, however still requires onsite programming should an error be recorded by the data acquisition system. Data processing, manipulation and analysis for the particulate monitors still takes a significant amount of DEC staff time due to the significant limitations in the DR DAS system with respect to particulate monitoring.

Currently, the sites that have DR DAS servers are Juneau, Anchorage (5 sites operated by MOA), Wasilla, Palmer, Fairbanks Grassy Knoll and North Pole (operated by FNSB). DEC anticipates establishing more monitoring sites in the future as federal regulations grow increasingly more stringent. Additional sites to be installed by the end of summer 2011 include Soldotna, Butte, and two sites at Fairbanks (State Office Building and NCore sites to be operates by FNSB). Butte (Harrison Court) is slated to be connected to the Palmer server or to have its own server in 2011 depending on available funds. Also a site at Soldotna in the Kenai Borough will be installed in summer 2011. DEC has already bought the license and server for this site.

PROPOSED NETWORK CHANGES

Potential Network Reductions

Currently there are no long term plans to significantly reduce the state air monitoring network. The state would like to eliminate the requirement for PM_{10} sampling at the Juneau Mendenhall Valley sampling site as no exceedances have been measured there in several years and the cause for the PM_{10} exceedances has been removed. A more detailed discussion of the network by pollutant and location follows below. Only $PM_{2.5}$, PM_{10} and CO are measured in more than one site in the network, so the discussion will focus on these pollutants.

Separately, the MOA has developed a method of prioritizing sites in their sub-network that is based on the measured magnitude of the pollutant concentration at the site, the historical value of the site for assessing trends, and the number of other pollutants measured at the site. Sites that are determined to be redundant geographically or redundant in terms of spatial scale or land use type were scored lower. A detailed description of how this prioritization was performed can be found in the Appendix.

$PM_{2.5}$

The $PM_{2.5}$ monitoring network consists of sites in the Municipality of Anchorage, Fairbanks North Star Borough, Matanuska Susitna Borough and the Juneau Mendenhall Valley. With the non-attainment issue in the FNSB and the single monitor located in Juneau, which barely skirted non-attainment designation in 2008, a reduction of monitoring in these locations is unlikely for the next five years.

The MOA reported $PM_{2.5}$ values at three locations for 2010, the Trinity Church site, the Eagle River Parkgate site and the DHHS site. The State operates three sites in the Mat-Su Valley, in Wasilla, in Palmer and at the Harrison Ct site at the Butte. All sites are equipped with continuous analyzers, for which the data are reported in Table 16 below.

Table 16: Summary of the 2010 $PM_{2.5}$ concentrations measured in Southcentral Alaska

$PM_{2.5}$ concentrations in µg/m^3						
2010	**Garden MOA**	**Parkgate MOA**	**DHHS MOA**	**Butte [1] Mat-Su**	**Palmer [1] Mat-Su**	**Wasilla[2] Mat-Su**
98th percentile	23.3	22.0	15	37.5	11.6	N/A
Annual max	34	31	22	42.5	21.8	N/A
Annual average	6.2	5.2	4.8	7.5	3.1	N/A
[1]The site did not meet data capture requirements [2]The site did not have sufficient valid data for 2010 to calculate the statistics						

When MOA scored their $PM_{2.5}$ sites in accordance with the scheme discussed in the Appendix, the Garden site ranked as highest priority followed by Parkgate, and DHHS.

The sites in Palmer and Wasilla are new, and provide information in areas that will see the largest population growth and development. DEC has not yet had enough data to characterize these new areas. Any reduction of the network within the next five years therefore would mainly affect the sites in the MOA. For more detail on the new Mat-Su sites see page 36.

PM_{10}

The PM_{10} monitoring network consists of sites in the Municipality of Anchorage, Matanuska Susitna Borough and the Juneau Mendenhall Valley. The Mendenhall Valley and Eagle River were designated non-attainment and continue to monitor for PM_{10}. The State and MOA have submitted maintenance plans for their respective sites. The State supports shutting down the Juneau PM_{10} site immediately to free up monitoring staff and funds for higher priorities, because monitoring data have not shown any high values in years. If the MOA Parkgate site continues to exhibit low concentrations it should be allowed to be shutdown when the MOA monitoring requirements as maintenance areas have been fulfilled. For a more detailed discussion regarding the MOA and Mat-Su Valley issues with natural windblown dust see pages 39 through 43.

The MOA reported PM_{10} values at four locations for 2010, the Trinity Church site, the Eagle River Parkgate site, the Tudor Road site and the DHHS site. The State operates a site in Juneau and three sites in the Mat-Su Valley: the Wasilla site, the Palmer site and the Harrison Ct site at the Butte. DEC just recently switched from a Federal Reference Monitor operating every third day to a continuous monitor as the primary for PM10 at the Butte site. The sampling frequency is likely to blame for the discrepancy in the concentrations summarized in Table 17. The Juneau site obviously records the lowest values, followed by the MOA Garden site, and the MOA DHHS site. The Municipality uses all of their PM_{10} monitoring sites for posting the AQI on the web. Seasonally several of these sites have the potential to record values near or above the standard, like for example during springtime road cleaning, windblown events mostly during spring and fall, and volcanic eruptions which can occur year round. To save funds in the future, some of these sites might be reduced from annual to seasonal operation. When MOA scored their PM_{10} sites in accordance with the scheme discussed in the Appendix, the Parkgate site ranked as highest priority followed by Garden, Allstate and DHHS.

Table 17: Summary of 2010 PM_{10} concentrations measured in South Central Alaska and Juneau

PM_{10} concentrations in μg/m^3								
2010	**Garden MOA**	**Allstate**	**Parkgate MOA**	**DHHS MOA**	**Juneau**	**Butte Mat-Su**	**Palmer Mat-Su**	**Wasilla[1] Mat-Su**
Maximum	54	155	93	89	27	49	116	N/A
2nd Maximum	49	98	72	65	27	45	115	N/A
[1]The site did not have sufficient valid data for 2010 to calculate the statistics								

CO

The CO monitoring network consists of sites in the Municipality of Anchorage and the Fairbanks North Star Borough. Both communities were declared in maintenance status in 2004. FNSB has reduced their monitoring sites over the years and shifted focus to $PM_{2.5}$ monitoring. With CO monitoring at the new NCore site FNSB suggested collecting CO data at both sites for comparison over the 2012/13 winter with the intent to shutdown the Old Post Office CO site. In 2010 the MOA collected CO at four sites during the winter CO sampling season, see Table 17. When MOA scored their CO sites in accordance with the scheme discussed in the Appendix, the Garden site ranked as highest priority followed by Turnagain, Parkgate and DHHS.

Table 18: 2010 CO concentrations in Anchorage

	8 hour average CO concentrations (ppm)			
2010	**Garden**	**Turnagain**	**Parkgate**	**DHHS**
Maximum	4.6	6.9	2.7	2.9
2nd Maximum	3.8	6.1	2.5	2.8

Ozone

In the meteorological summary we discussed that the concept of a CBSA for the Anchorage, Wasilla and Palmer area does not make sense from an airshed perspective. Due to the complex topography, we observe very different weather in these cities on a daily basis. Ozone monitoring is required for any CBSA with more than 350,000 residents. DEC believes that while operating the ozone monitor in Wasilla might meet the letter of the law, it does not make sense from a scientific standpoint. As noted earlier, ozone concentrations measured at the Garden site in Anchorage, the Parkgate site in Eagle River and the Wasilla site in the Matanuska- Sustina Valley have been well below the NAAQS. Indeed, ozone concentrations measured in Denali National Park are consistently higher than any of the Anchorage-Mat Su CBSA sites. This suggests that the ozone is naturally occurring and that the lower concentrations observed at the more urban CBSA sites are the result of local scavenging. (See the more detailed section devoted to ozone monitoring on page 44.) The State believes that valuable staff time and resources could be dedicated to higher priorities if ozone monitoring were terminated. Alaska is interested in pursuing a waiver to the ozone monitoring requirement.

New Pollutant Monitoring Needed

Currently an expansion of the particulate matter monitoring network in urban areas of Alaska is not planned, except for the installation of the Soldotna PM_{coarse} site. A significant amount of staff time is devoted to measuring and understanding the sources of $PM_{2.5}$ in the Fairbanks area. It is reasonable to assume that if Fairbanks has an inversion related $PM_{2.5}$ air quality problem mainly caused by wood stove emissions, similar problems may exist in smaller communities, especially in Interior Alaska. An extended network of reliable $PM_{2.5}$ FEM analyzers is necessary to investigate whether, and to what extent, $PM_{2.5}$ problems exist in rural Alaska. The State is planning to move ahead, but due the significant travel expense and the difficulty of working in remote areas, a comprehensive plan will need to be developed and additional funding will be needed. Changes in the sampling technology, telemetry and online data acquisition make a remote special purpose monitoring network much more feasible.

The State may decide to add additional criteria pollutant monitors to study impacts of the new 1 hour NAAQS for sulfur dioxide and nitrogen oxide. The area-based lead sampling project at the Merrill Field Airport in Anchorage is in progress and slated for completion in October 2012. The State may add NO_x samplers to the ozone sampling site in Wasilla to better understand and measure the ozone scavenging.

Air Toxics

Although the monitoring plan does not address air toxics, it should be noted that a number of air toxic pollutants are of concern. A 2008-2009 monitoring study in Anchorage showed that ambient benzene concentrations were among the highest in the U.S. The data suggested that motor vehicle emissions were the predominant source. The gasoline sold in Anchorage and most of Alaska contains about 5% benzene, which is three to ten times higher than found in the gasoline in most parts of the U.S. New EPA regulations are expected to reduce the amount of benzene in Alaska gas four-fold in 2012 and this should result in lower ambient concentrations. The Municipality of Anchorage is planning to monitor ambient benzene after the gasoline regulations are implemented in Alaska. EPA grant funding should be forthcoming by mid-year 2012. The Fairbanks North Star Borough is also interested in an Air Toxics program to better understand the hazardous air pollutants the community might be exposed to during the inversion related $PM_{2.5}$ events. No federal funding has been allocated for such a program to date.

Other air toxics besides benzene are also of concern. Monitoring data from Anchorage and Fairbanks show that ambient concentrations of volatile organic compounds such as toluene, ethyl benzene, xylenes and 1,3-butadiene and some polycyclic aromatic hydrocarbons (PAHs) are very high compared to other communities in the U.S.[16] Obtaining funding for additional air toxics monitoring is a high priority for Alaska.

Meteorology

Currently only a handful of DEC's pollutant monitoring sites have on-site meteorological sampling equipment. Especially in light of the significant impact that micro meteorology has on site pollutant concentration and the potential need to document exceptional events, DEC plans to install met sensors at a minimum of 5 sites within the next 2 years. Many of the sensors have been purchased for other studies and are still in excellent condition. DEC anticipates little additional costs, mainly for parts and supplies.

[16] The Municipality of Anchorage has prepared a report, *Assessment of the Effectiveness of New Mobile Source Air Toxics Regulations in Reducing Ambient Concentrations of Benzene and Other Air Toxics in Anchorage, Alaska*, December 2010, that summarizes the results of a one-year monitoring study conducted between October 2008 and October 2009. Air toxics data collected in this study are compared and contrasted with data from other communities in the U.S.

Cumulative Impact on North Slope

The Department is currently summarizing available information on the cumulative impact of industrial development on the North Slope. After the analysis of the existing data has been completed the department might find it necessary or advantageous to set up additional air quality and meteorological monitoring stations in the region to fill data gaps or to monitor any impacts previously missed.

Discretionary samplers

Regional Haze

Regional Haze monitoring using the IMPROVE samplers currently occurs at three of the four Class I areas in the state, two at Denali National Park (Trapper Creek and Denali NPP Headquarters), Tuxedni Wilderness Area and Simeonof Wilderness Area. Sampling is coordinated by the Federal Land Managing Agencies, the National Park Service and the U.S. Fish and Wildlife Service. No sampling is conducted at the Bering Sea Wilderness Area due to the remoteness of this wildlife refuge. An 18-month sampling monitoring study around Denali NPP was conducted in 2008/9. Data analysis is still ongoing. One of the objectives of the study is to determine which if any of the two Denali NPP IMPROVE sites best represents this large Class I area.

Smoke Monitoring for Air Quality Advisories

Smoke from wildland fires can affect large areas and impacts air quality in regions both close to and far away from the burning fire. Almost every summer, large areas of the State are impacted by smoke from wild fires, with air quality degrading into the very unhealthy to hazardous range. DEC assists the Alaska Fire Service in assessing air quality impacts in areas affected by fires and provides information needed to protect public health. The DEC Air Quality Division uses two separate methods to assess air quality impacts and issue air quality advisories statewide: monitoring data and visibility information. Often a combination of both data sets is used to issue air quality advisories. (The DEC meteorologist or AQ staff with assistance from the NWS) use meteorological and air monitoring data to forecast smoke movement and predict where air quality impacts might be experienced.

DEC currently operates two continuous analyzers in rural Alaska during the wild fire season, in Galena and Ft Yukon, with the help of local site operators. DEC also has two portable, battery operated particulate matter monitors (E-BAM) equipped with satellite communication devices, which can transmit the data to a website. The continuous instrument requires little maintenance and staff is typically only needed at set-up and to insure proper operation for the first day. Remote data access allows staff in the DEC office or in the field to use the data for advisories and briefings. Currently no additional samplers are requested, as staff time and travel funds are the limiting factor in expanding the smoke monitoring network.

Mercury Monitoring

DEC is managing the operation of two Mercury Deposition Network (MDN) sites (measuring wet deposition mercury) as part of the National Atmospheric Deposition

Program. DEC established a site in Kodiak in 2007 which was operated by a Kodiak DEC employee until 2009. Staffing changes and instrument problems resulted in data loss of some data collected in 2009 and part of 2010. DEC has found new operators with the Kodiak Borough Soil and Water Conservation District and has begun regular monitoring again. DEC established a second MDN site in Unalaska (Dutch Harbor) in 2009. The State of Alaska Department of Fish and Game operates the site with the DEC's support. The State plans to keep both of these sites in operation for 5 years in order to obtain a long term record of the wet deposition of atmospheric mercury that will complement fish tissue data collected at both sites (DEC Environmental Health Division project). Given the international transport of pollutants into the Arctic, DEC would like to establish a more robust network of mercury/heavy metal deposition monitors in Alaska if funding could be identified to do so.

Radiation Monitoring

The State has three radiation monitoring network sites (RadNet) located in Anchorage, Fairbanks and Juneau. Various agencies and groups operate the equipment: The site in Anchorage is run by the Alaska Department of Health and Social Services, the University of Alaska Fairbanks operates the Fairbanks site and the DEC air quality program operates the site in Juneau. A decision needs to be made if these sites are intended as early warning stations or to document radiation levels experienced throughout the state. If early warning is the goal, the sites in Anchorage and Fairbanks are not the best locations to meet this objective. The sites should either be moved to the coast to allow for early detection and actions before the radiation reaches the population centers inland or additional coastal monitors should be installed to meet this need.

FUNDING AND BUDGETARY CONSIDERATIONS

Alaska's Air Monitoring and Quality Assurance Program has a small staff to cover a large state. Eight full time permanent positions are dedicated to DEC's air monitoring efforts along with two non-permanent positions that are currently funded for special projects. DEC's air monitoring program has oversight responsibility and cooperates with the two largest local air agencies, the Municipality of Anchorage and the Fairbanks North Star Borough that operate air monitors within their jurisdictions. The remainder of the state's monitoring needs are covered by DEC program staff. In addition, the Fairbanks North Star Borough has a $PM_{2.5}$ non-attainment area and faces enormous challenges to meet the attainment deadlines.

The ever expanding quality assurance requirements, which translate into additional work for site operators and data analysts, and the desire both by the public and EPA to have immediate access to near real time quality data online pose challenges which significantly impact the limited workforce. On line data reporting and analysis, the move from 24 hour averages for PM monitoring to hourly averages, added gaseous pollutant monitoring, which are all routine program tasks are contrasted by the, at best, level funding from EPA. Exceptional event documentation and waiver requests in a state where summer wildland fires and spring time windblown dust events are regular events, rather than the exception, put an additional strain on a program already stretched thin.

DEC received additional funding for new instrumentation and site start-ups in recent years, but no additional operational funding has been made available for the NCore site. While the initial influx of the funding has provided for the site installation, the long term burden of operating the sites falls to the state and the local air agencies.

DEC is committed to saving staff time and resources by investing in additional, and enhancing existing, telemetry and automated sampling systems. Issues to be resolved in the future are the creation of an in-state long term state-owned monitoring data repository, a fully functioning statewide data acquisition system, and the submission of monitoring data to EPA through the Exchange Network.

Capital Funding Needs

Many of the gaseous instruments in use, listed in Table 15, are fairly new and additional capital funding will not be needed to update the gaseous or continuous sampling inventory for awhile. The exception to this would be a need for additional SO_2 and NO_x analysis to address new short term NAAQS assessments.

Several of our FEM $PM_{2.5}$ samplers operated in Fairbanks are biased high. This is particularly troubling in a $PM_{2.5}$ non-attainment area, which will have difficulties reaching the attainment deadlines. Because the continuous analyzers cannot be trusted to accurately replace the FRM samplers, DEC will need to replace our current aging inventory of FRM $PM_{2.5}$ samplers within the next 5 years. We expect to replace at least five of the FRM Thermo Electron Partisol samplers, which would cost an estimated $100,000.

Extended telemetry to enable remote control of some of the continuous PM equipment in rural Alaska will also require additional funds. The demand for near real time data accessible on the web will extend into any future sampling project anywhere in the state. Our rural sites could especially benefit from the new technology, but maintenance is more complex and will add time and costs. We estimate that every additional site will cost approximately $10,000, which includes the data loggers/servers, DSL connection and data acquisition system licensing fees.

Any expansion of the sampling network in Anchorage and Fairbanks, to include air toxics, would require both capital and operational funds. The implementation of an air toxics program in both major communities would cost in the range of $300,000.

Operational Funding Needs

<u>NCore</u>

The State received capital funding from EPA for the establishment of the NCore site in Fairbanks, but no operational funding was provided. DEC estimates that the site requires approximately 1.5 FTE of staff time without considering the time spent by the Quality Assurance Auditor and the Program Manager for oversight functions. DEC is providing limited funding to the FNSB for staff to operate the NCore site. FNSB can support the site because it has other special project funds that can assist in some aspects of the NCore monitoring effort. However, operational funding should be made available to ensure continued focus on the site.

While DEC was able to procure a state of the art shelter and sampling equipment, the site still needs additional attention due to the extreme cold during the winter, which can pose problems to many of the instruments on site. Also, additional samplers had to be installed to meet EPA requirements. The Fairbanks North Star Borough has graciously agreed to allow us the use of one of their $PM_{2.5}$ speciation monitors (Met One SuperSASS). $PM_{2.5}$ speciation is a requirement for the NCore site and ordinarily the NCore site would have been identical to the Speciation Trend Network (STN) site. In Fairbanks the STN site was too crowded to house the additional gaseous NCore equipment, which is why a new location for the NCore site had to be found. The STN sampler remained in its original location (State Office Building) because it is an integral part of the $PM_{2.5}$ non- attainment demonstration. EPA did not make additional funding available for a second speciation sampler. DEC estimates the duplicate speciation sampler at the NCore site will need to collect data for at least one full year to establish a good correlation between the two sites. Negotiations with EPA will then have to resolve the issue of final placement of the STN sampler.

Exceptional Event Documentation

The new, stricter National Exception Events Rule places a significant burden on states like Alaska. Every year large parts of the state experience wildland fires, which are a vital part of the natural ecosystem. Smoke from wildland fires routinely impacts communities for several weeks at a time. The onerous requirements of the Exceptional Events Rule for documenting and demonstrating a recurring natural event, absorb almost one FTE of staff time, in addition to the contractual costs for regional modeling to satisfy the "would not have been an exceedance but for this event" requirement. The modeling effort for the 2009 wild fire season cost approximately $50,000. DEC has not yet tackled the 2010 or 2011 wildfire impacted data, but assumes that similar funding will have to be allocated almost on an annual basis.

New NAAQS

The new 1 hour NAAQS for SO_2 and NO_x pose another strain on DEC's annual operating budget. Currently additional monitoring for SO_2 and NO_x is not planned, because resources and staff are not available. Both criteria pollutants might pose a health impact to the State, but at this time DEC cannot incorporate routine monitoring into the monitoring network due to a lack of resources. However, EPA will require Alaska to review compliance with the NAAQS which may necessitate additional monitoring.

Fiscal Health

Level budgeting for many years has resulted in significant fiscal constraints for the state's air monitoring program. Due to its large landmass and minimal infrastructure, Alaska poses unique challenges for monitoring that impact the costs of what would be considered routine site operations. While site operators are usually responsible for multiple sites, these sites can be many hundreds of miles apart. This means that these sites either have to be managed remotely or that frequent travel is required. DEC's site operators spend significant time traveling and training local (lay) site operators. Often we are limited by the number of staff we can send out to the various sampling sites. Any additional special studies, special projects or emergency monitoring for wildfires or volcanic eruptions require additional personnel and it can be difficult to address these emergencies while maintaining the core monitoring site operations. Currently DEC receives additional funding for special studies and is able to use a combination of permanent staff and project-related hires to fulfill some of the routine programmatic tasks.

Current Clean Air Act 105 and 103 grant funding including the state match for the 105 grant received by the program must cover not only air monitoring network costs but the costs of other core Clean Air Act related activities, like State Implementation Plans. Currently the share of the federal grant allocated to air monitoring only pays for 57% of the Air Monitoring & Quality Assurance Program's personnel costs for eight permanent staff. Even if all the allocated air monitoring grant funds were used for personnel costs they would only cover 95% of the current personal services costs. Any future cuts to program funds or the loss of special project funds would lead to a significant downsizing of the program including staff reductions. Staff reductions will severely impact monitoring activities, especially as monitoring sites are spread throughout the state and cannot be serviced by one single operator. New and more stringent quality assurance requirements already add to the work load and site costs (for example tight temperature requirements, necessitate better insulated shelters and add to the overall cost of monitoring). In the future, the State may have to make the difficult choice of whether it should continue to provide unfunded monitoring functions, like NCORE, meet its unfunded obligations to replace aging instrumentation, or fund the personnel needed to operate the required monitoring network.

Summary

Alaska's air monitoring network is faced with higher costs that result from a number of unique challenges including the state's extreme climate, varied ecosystems, large size, limited road system, decentralized power grid, and limited and unstable phone and internet network. Due to these factors, air monitoring travel and site maintenance costs are likely among the highest in the nation per capita served. In the past, Alaska's situation was partially compensated by appropriate federal funding allocations.

Despite State and EPA efforts, Alaska remains well behind the rest of the country in both the spatial coverage of its monitoring network and technical advancements for sampling automation and web-based data reporting. While DEC continuously strives to improve our aging monitoring network, current staffing and funding levels have not been supportive of the goal of narrowing the technological gap between the State and the nation. We believe it would be logical and far more economical for EPA to develop a universal data acquisition and AQS coding / reporting system and deliver it to state and local agencies rather than provide funding to individual state and local agencies to purchase and develop such a system on their own. This is particularly important for small states like Alaska.

During the next five years, we anticipate an increased public demand for real time data access via the internet, not just in Alaska's growing communities like the Matanuska Susitna Borough, or problem areas like the Fairbanks North Star Borough, but also from rural and tribal communities, which face many of the same issues as the metropolitan areas do. Public awareness of the affects of poor or compromised air quality is growing throughout the state. DEC cannot add more monitoring sites, expand the number of pollutant and meteorological parameters monitored at each site, or initiate a badly needed air toxics program in Anchorage and Fairbanks when, at the same time, it is trying to meet its ongoing obligations for quality assurance/quality control, exceptional event documentation, AQS data submission, and data reporting to the public. We do not have the budget and staff to meet these increasing demands. DEC and EPA will need to make difficult choices in how to best use limited resources.

Additionally, the type of personnel required to operate and maintain an air quality monitoring network and data reporting system has changed dramatically over the past two decades. Some of the skills needed now are more in line with those found in an IT or communication specialist rather than an air monitoring technician. Small states, like Alaska, will have to develop technicians with a broad range of sophisticated skills. While additional funding might help remedy some of the State's shortcoming in this area, more explicit programmatic help from EPA might not only benefit Alaska, but also other smaller state and local programs that do not have the potential to develop this special expertise in house.

APPENDIX: Municipality of Anchorage Monitoring Site Prioritization

Scoring Scheme

1. <u>Pollutant magnitude</u> *(20 points for DV = NAAQS)*
   The number of points assigned to a monitoring site is determined by comparing the measured design value at that site as a percentage to the applicable NAAQS. A DV equal to 100% of the NAAQS is assigned 20 points. Sites with DVs higher or lower than the NAAQS are assigned proportional higher or lower points depending on measured DV at that site. For example, the Turnagain DV for CO in 2010 was 6.1 ppm. This is 68% of the 9 ppm CO NAAQS. The number of points assigned to the Turnagain site is therefore 0.68 x 20 = 14.

2. <u>Value as Trend Site</u> *(20 points)*
   The value of a particular site for assessing long term air quality trends increases the longer that it remains in service. Points are assigned as follows:

Years of Service	Points
>20	20
11 – 20	15
6 – 10	10
3 – 5	5
<3	0

3. <u>Value for assessment of relationships with other pollutants and parameters</u> *(10 points)*
   The value of a site increases when other pollutant and meteorological data is collected at that same site. The collection of other data can provide greater insight into the sources and meteorological factors that contribute to the pollution measured at a particular site.

Number of Other Parameters Measured	Points
5+	10
4	8
3	6
2	4
1	2

4. <u>Geographical redundancy with other higher scoring sites *(up to 10 negative points)*</u>
   The redundancy of a particular site should be evaluated if the sub-total of it scores in the three categories above is lower than at least one other site. If that is the case, "negative points" are assigned if that site if it is located in close proximity to

another site or if is located in an area with similar land use, traffic volumes and/or industrial development. Because this process is somewhat subjective, rationale used in assigning or not assigning negative points should be explained.

5. Other considerations *(20 points)*
   There may be other factors not considered above that are important. A site may be necessary for special purpose monitoring such as measurement of background concentrations, response to citizen complaints, measurement of pollutant gradients. Because this process is somewhat subjective, rationale used in assigning or not assigning negative points should be explained.

Carbon Monoxide sites

	Garden	**Parkgate**	**DHHS**	**Turnagain**
(1) Pollutant magnitude				
2010 DV 2nd max 8-hour avg (ppm)	3.8	2.5	2.8	6.1
Points (20 possible)	*8*	*6*	*6*	*14*
(2) Value as Trend Site				
Years in service	32	1.5	1.5	12
Points (20 possible)	*20*	*0*	*0*	*15*
(3) Value in assessing relationships with other pollutants and parameters				
Number of other pollutants measured	5	4	4	1
Points (10 possible)	*10*	*8*	*8*	*0*
Subtotal	*38*	*14*	*14*	*29*
(4) Geographical redundancy with other higher scoring sites				
Points (negative 10 possible)	0	0	-2	-5
(5) Other Considerations				
Points (20 possible)	0	0	0	0
TOTAL	***38***	***14***	***12***	***24***
RANK	**1**	**3**	**4**	**2**

Negative points (-5) were assigned to Turnagain because it is geographically redundant with the higher (sub-total) scoring Garden site. More importantly, the Turnagain site is located in a residential neighborhood similar to that of the higher scoring Garden site.. Negative points (-2) were assigned to DHHS because it is geographically redundant with higher scoring Garden and Turnagain sites.

PM-10 sites

	Garden	Parkgate	DHHS	Allstate
(1) Pollutant magnitude				
2010 DV (µg/m^3) Highest 2nd max past 3 yrs	62	74	71	109
Points (20 possible)	*8*	*10*	*9*	*15*
(2) Value as Trend Site				
Years in service	12	25	1.5	15
Points (20 possible)	*15*	*20*	*0*	*15*
(3) Value in assessing relationships with other pollutants and parameters				
Number of other pollutants measured	5	4	4	1
Points (10 possible)	*10*	*8*	*8*	*0*
Subtotal	*33*	*38*	*17*	*30*
(4) Geographical redundancy with other higher scoring sites				
Points (negative 10 possible)	*0*	*0*	*-2*	*0*
(5) Other Factors				
Points (20 possible)	0	0	0	0
TOTAL	***33***	***38***	***15***	***30***
RANK	**2**	**1**	**4**	**3**

Negative points (-2) were assigned to DHHS because it is geographically redundant with the higher scoring Garden and Allstate sites. Although Allstate and Garden are geographically close, surrounding land use near the two sites are very different. Negative points were therefore not assigned to Allstate.

PM-2.5 sites

	Garden	Parkgate	DHHS
(1) Pollutant magnitude			
2010 DV (µg/m^3) 3-yr avg [98th percentile]	21.8	19.5	16.0
Points (20 possible)	*12*	*11*	*9*
(2) Value as Trend Site			
Years in service	12	1.5	1.5
Points (20 possible)	15	0	0
(3) Value in assessing relationships with other pollutants and parameters			
Number of other pollutants measured	5	4	4
Points (10 possible)	10	8	8
Subtotal	*37*	*19*	*17*
(4) Geographical redundancy with other higher scoring sites			
Points (negative 10 possible)	0	0	-2
(5) Other Factors	0	0	0
Points (20 possible)	0	0	0
TOTAL	***37***	***19***	***15***
RANK	**1**	**2**	**3**

Negative points (-2) were assigned to DHHS because it is geographically redundant with higher scoring Garden site.