State of Alaska
2015 Ambient Air Quality Network Assessment

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Air Quality Division

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&
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Program

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Executive Summary

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 requirement for state, or where applicable local, monitoring agencies to conduct a network assessment once every five years to discuss the current existing ambient air quality monitoring network and anticipated network changes for the next five year period. This is the second assessment of the Alaska network under the requirement.

The Air Monitoring & Quality Assurance (AMQA) section of the Department of Environmental Conservation (DEC) Air Quality Division is responsible for the state's air quality assessment efforts. The Department's staff works closely with the Municipality of Anchorage (MOA), Fairbanks North Star Borough (FNSB), the Matanuska-Susitna Borough (Mat-Su) the City & Borough of Juneau (CBJ), and environmental staff in other, smaller communities to assess air quality levels statewide.

The Alaska State Network

Most of Alaska's monitoring network is dedicated to characterizing the two pollutants that have been shown to pose the greatest risk to public health — Fine Particulate Matter ($PM_{2.5}$) and Larger Particles (PM_{10}). The remainder of the network is made up of monitors that measure Carbon Monoxide (CO), Ozone (O_3), Sulfur Dioxide (SO_2), Reactive Oxides of Nitrogen (NO_y), fine particle chemical composition, and meteorological parameters.

As of July 1, 2016 DEC and its partners have operated a network of 33 monitors at 11 sites. The data from these monitors serve a variety of needs. The data are used to:

- Determine if air quality is meeting federal standards
- Provide near-real-time air quality information for the protection of public health
- Forecast air quality
- Make daily burn decisions and curtailment calls
- Assist with permitting activities
- Evaluate the effectiveness of air pollution control programs
- Evaluate the effects of air pollution on public health
- Determine air quality trends
- Identify and develop responsible and cost-effective pollution control strategies

Findings

Most of the air monitoring activities are focused on population centers and area that have shown in the past to have air quality problems. The Alaska Department of Labor and Workforce Development projects the highest growth rate within the state to occur in the Matanuska- Susitna Borough (12% increase between 2017 and 2022) (http://labor.alaska.gov/news/2016/news16-01.pdf).

DEC had enlarged its monitoring network to three monitoring sites in this area in response to population increases in 2010. However due to budget cuts and reduced staffing, DEC consolidate some of its operations by decommissioning the Wasilla site in March 2015. The sites in Palmer ($PM_{2.5}$, PM_{10}, O_3) and Butte ($PM_{2.5}$, PM_{10})) remain operational and are intended to remain in the monitoring network for the long term. Due to budget cuts over the past several years, DEC has reduced the ambient monitoring network to include mostly only regulatory required sites. Looking ahead due to fiscal constraints, DEC does not expect to be extending the network significantly during the next 5 years.

Recommendations

Retain:
Retain nearly all of the existing monitoring network.

Add:
The only new site DEC anticipates to establish is a Special Purpose Monitoring (SPM) site for $PM_{2.5}$ and PM_{10} in Bethel.

Replace:
Where continuous Federal Equivalence Method (FEM) meet the performance criteria DEC will replace existing FRM sampler with FEM and replace aging FEM equipment. In the Fairbanks Non-Attainment area, DEC expects to replace the PM2.5 Federal Reference Method (FRM) monitors with newer models. In the coming years DEC will have to replace aging gaseous analyzers at the NCore site.

Remove:

PM_{10}

DEC is proposing to remove the PM10 samplers from The Juneau Mendenhall Floyd Dryden site and use the PM2.5 samplers as a surrogate.

Ozone

Ozone monitoring is federally required for any Core Based Statistical Area (CBSA) with more than 350,000 residents. Ozone concentrations that have been measured in the past at the Garden site in Anchorage, the Parkgate site in Eagle River and the Wasilla site in the Mat- Su Valley have all shown ozone concentrations well below the NAAQS. Indeed, ozone concentrations measured in Denali National Park north of the CBSA 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. DEC believes that valuable staff time and resources could be dedicated to higher priorities if ozone monitoring were terminated. DEC will continue monitoring at the Palmer site for three consecutive years and then submit a waiver request to EPA to discontinue ozone monitoring in the CBSA. Ozone monitoring will continue at the NCore site in Fairbanks.

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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(d)].

> *"(d) 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).

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 586,000 square miles, and its relatively small population, currently 737,625, the department has had to rely on the public to help identify potential air quality issues. Because it is not feasible to monitor the air quality in every community, DEC has taken a three-pronged approach to the monitoring network design:

- Monitoring in larger communities to cover the largest possible population exposure by means of State and Local Air Monitoring Stations (SLAMS) and Special Purpose Monitoring (SPM) sites.
- Monitoring in designated smaller towns that are representative of multiple communities in a region. This monitoring is generally done with SPM 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 (299,000), Fairbanks (99,000), and Juneau (33,000). Alaska has no other communities with populations over 10,000. In recent years the monitoring network expanded to the expanding population centers of the Matanuska Susitna Borough namely Wasilla and Palmer (each 9,000). 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.

Alaska's Geography, Climate, Topography, and Economy

Geography and Climate

Alaska comprises one sixth of the United States landmass and has a population density of 1.2 persons per square mile. The state spans 20 degrees of latitude (51°N – 71°N) and 58 degrees of longitude (130°W – 172°E) and 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 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 mainly comprises 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 33,000.

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 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 299,000 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 comprises 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 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 (99,000 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, extensive wetlands, numerous glaciers, and large deep fjords with very high tides and strong tidal currents. Local wind flow patterns along the coast and near large lakes may be influenced by land/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.

Approximately 24.7 million acres of state land are organized into five areas designated for oil and gas exploration, development, and production. Currently, 4.8 million acres, nearly 20 percent of these areas, have active leases, and are located mostly on Alaska's North Slope and in and around Cook Inlet. These areas are producing oil and natural gas and providing royalties, rents and taxes the state depends on for 85 percent of Alaska's state budget. 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.- now closed (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 (https://www.commerce.alaska.gov/web/ded/DEV/MineralsDevelopment/MineralsProduction.aspx).

Mining is a high-growth employment sector in Alaska. Total mineral industry employment in 2014 is estimated at 2,967 full-time equivalent jobs, an overall decrease of about 1,084 jobs from 2013. The value of the industry is well over $1 billion annually and growing rapidly. The state has six large lode mines and an estimated 241 placer operators. The large mines are the Teck Resources Ltd.-NANA Red Dog Mine (zinc, lead, silver) near Noatak, the Coeur Alaska Inc. Kensington complex (gold) near Haines, the Hecla Mining Greens Creek mine (silver, gold, zinc, lead) near Juneau, the Kinross Gold Fort Knox Mine (gold) near Fairbanks, the Sumitomo Mine (gold) near Delta Junction, and the Usibelli Mine (coal) near Palmer. Numerous other small mining ventures exist across the state (Athey, et al., 2013).

With 28 million acres of commercial forest, Alaska's timber industry supplies world markets with logs, lumber, pulp, and other forest products. Much of Southeast Alaska is part of the Tongass National Forest, a 16.8 million acre rainforest. The Chugach is the nation's second largest national forest with 4.8 million acres (http://alaska.gov/kids/learn/economy.htm).

Tourism is also a major sector of Alaska's economy attracting over 1.1 million visitors annually. The tourism industry is Alaska's second largest primary employer (http://alaska.gov/kids/learn/economy.htm).

The seafood industry contributes to roughly 60,000 jobs and approximately $5.8 billion in total economic activity in Alaska. Each year nearly 6 billion pounds of seafood are harvested. Alaska is the number one producer of wild salmon in the world and has the only salmon industry certified as "sustainable" by the Marine Stewardship Council. Commercially important seafood species include salmon, crab, Pollock, halibut, cod, sablefish, herring, shrimp, and rockfish and aquatic farms produce oysters and clams (http://ebooks.alaskaseafood.org/ASMI_Seafood_Impacts_Dec2015/pubData/source/ASMI%20Alaska%20Seafood%20Impacts%20Final%20Dec2015%20-%20low%20res.pdf).

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 (CAA). Title I of the Clean Air Act established National Ambient Air Quality Standards (NAAQS) to protect public health. 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 of 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 ($PM_{2.5}$). Table 1 contains the current NAAQS.

Threshold 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.

EPA has to periodically review and revise the NAAQS based on the assessment of national air quality trends and on current and ongoing health studies. Main pollutants of concern in Alaska are $PM_{2.5}$ and PM_{10}, followed by CO, Pb, O_3, SO_2, and NO_2.

Table 1. National Ambient Air Quality Standards - Primary Standard

Pollutant		Primary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary	Rolling 3 month average	0.15 μg/m^3 (1)	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary	1 year	53 ppb (2)	Annual Mean
Ozone (O_3)		primary	8 hours	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 μg/m^3	annual mean, averaged over 3 years
		primary	24 hours	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary	24 hours	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

(1) In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m3 as a calendar quarter average) also remain in effect.

(2) The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O_3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

(4) The previous SO_2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2) any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a SIP call under the previous SO_2 standards (40 CFR 50.4(3)). A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the require NAAQS.

Alaska's Air Quality 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, FNSB, the Matanuska-Susitna Borough (Mat-Su), the CBJ, and environmental staff in other, smaller communities to assess air quality levels statewide. While DEC is required to look at all NAAQS, the following issues are the ones that concern Alaskans the most:

1. Fine particulate matter ($PM_{2.5}$) monitoring
2. Coarse particulate matter (PM_{10}) monitoring
3. Carbon monoxide (CO) monitoring
4. Lead (Pb) monitoring
5. Ozone (O_3) monitoring
6. Wildland fire monitoring ($PM_{2.5}$)
7. Rural communities and tribal village monitoring (primarily PM_{10})

Table 2 summarizes the extent of these seven pollutants by listing communities violating the NAAQS.

Table 2. Communities violating the NAAQS

Priority	Pollutant	Cities violating NAAQS	Days above 100 (AQI) contributing to downwind violations
1	$PM_{2.5}$	Fairbanks North Star Borough	Minimal
2	PM_{10}	Several rural communities *	None
3	CO	none	0
4	Pb	none	NA
5	Ozone	none	0
6	SO_2	none	0
7	NO_2	none	0

** Road 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.

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 in the Fairbanks North Star Borough, the pollution mix is comprised of wood smoke from home heating, emissions from oil based home heating, automobile emissions and to a lesser extent emissions from power generation (coal-fired).

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 Mendenhall Valley in the City and Borough of Juneau (Juneau).

Eagle River, a community of about 30,000 located 10 miles northeast of downtown Anchorage, was designated as a nonattainment area for airborne particulate (PM_{10}) in 1987. 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 of Anchorage 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 of Anchorage developed a "Limited Maintenance Plan" (LMP) for Eagle River.[1] This was submitted to EPA for approval in September 2010. EPA approved the LMP on January 7, 2013.[2]

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 CBJ and the DEC submitted a request to re-designate Juneau as a limited maintenance area with the US EPA in February, 2009[3]. EPA approved it on May 9, 2013.

Road 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

[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] 2013 Eagle River Limited Maintenance Plan http://dec.alaska.gov/air/anpms/SIP/anchIM_ERLMP_QAPP_Oct2010.htm
[3] 2009 City and Borough of Juneau Limited Maintenance Plan http://www.dec.state.ak.us/AIR/anpms/doc-anpms/CBJ_PM10_LMP_20FEB09.pdf

summer day, dust levels can easily reach into the mid 300 µg/m^3 range with maximum concentrations easily exceeding 500 µg/m^3. To address the rural dust problem, which was identified during a several year joint-monitoring effort among 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 University of Alaska Fairbanks (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. DEC continues to work with EPA, Alaska DOT, the University of Alaska Fairbanks (UAF) and tribal communities to find suitable palliatives and improve techniques and technologies for their 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 since 1999. Both communities requested re-designation to attainment and were reclassified as Limited Maintenance Areas in 2004. EPA approved the second ten year LMP for Fairbanks on February 22, 2013[4] and for Anchorage on July 13, 2011[5] with amendments from March 3, 2014.

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. 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

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[4] 2013 Fairbanks North Star Borough CO Limited Maintenance Plan, http://dec.alaska.gov/air/anpms/SIP/SIPDocs/ANCH_FNSB_CO_LMP/Fbks_CO_LMP.pdf

[5] 2013 Anchorage Limited Maintenance Plan, http://dec.alaska.gov/air/anpms/SIP/SIPDocs/Anchorage%20CO%20Maintenance%20Plan%20Combined%20July%2022%2014.pdf

the two closest villages, the decision was made to initiate monitoring in the Native Village of Noatak. DEC has been unable to attract and keep site operators who can perform the sampling requirements for a SLAMS site.

After consultation with EPA, DEC decided to pursue a modeling demonstration to show that lead concentrations at the ambient boundary of the Red Dog Mine meet the new lead standard. For this alternative demonstration the modeled lead concentration outside the ambient air boundary has to be less than 50% of the NAAQS. Under 40 CFR 58, Appendix D, section 4.5 (ii) DEC submitted a modeling protocol on October 23, 2012 as part of a waiver request to avoid the monitoring requirement. After initial review EPA requested updated information for the model's emissions inputs. EPA, DEC, and Red Dog Mine cooperatively set a schedule for submission of the updated information. Additional soil sampling was required to adequately determine emission factors for the gravel roads. Laboratory analysis of the required soil sampling was completed in August, 2014. DEC and EPA reviewed and approved the laboratory analysis report. EPA subsequently approved the new emissions inventory and DEC finally performed the modeling analysis and submitted the waiver request with modeling analysis to EPA on April 14, 2016. On August 11, 2016, EPA approved the State of Alaska's waiver request for lead monitoring at the Red Dog Mine based on the results of dispersion modeling. Pursuant to 40 CFR Part 58, Appendix D, section 4.5(a)(ii), this waiver must be renewed every 5 years as part of the Alaska 5-year Air Monitoring Network Assessment. Therefore, if DEC elects to renew the lead source-monitoring waiver, a formal written request for renewal must be submitted to EPA 120 days prior to the expiration of this waiver. The formal request to renew the lead source-monitoring waiver must demonstrate that the site conditions for which the previous modeling was conducted are still appropriate. If site conditions have changed such that the previous modeling is no longer appropriate, then DEC must update the modeling based on the current conditions. A copy of the EPA approval letter is in Appendix A.

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 SLAMS O_3 site in a 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 established two O_3 monitoring sites in April 2010. Another O_3 monitoring site was located in Fairbanks with the establishment of the NCore site. The US National Park Service operates a Clean Air Status and Trends Network (CASTNET) O_3 monitoring site at the Denali National Park, which provides information on natural background level ozone concentrations. The Municipality of Anchorage decommissioned the Anchorage based monitoring site in October 2012 after EPA approval, while DEC established ozone monitoring at the Wasilla PM monitoring site. Ozone monitoring in Wasilla began in May 2011. DEC moved the monitor to an existing particulate monitoring site in Palmer in 2015 as a part of consolidating site operations. The concentration measured in Anchorage and the Mat-Su Valley are consistently lower than the NPS Denali site, indicating, that South Central Alaska does not experience net ozone production, rather ozone scavenging below the natural background levels.

Sulfur Dioxide Monitoring-SO_2

No sulfur dioxide monitoring, other than that conducted at the Fairbanks NCore site, 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.

Nitrogen Oxide Monitoring-NO_2

DEC currently only conducts NO_x monitoring at 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. Even with the revision to the NO_2 standard and introduction of the 1 hour NO_2 standard, DEC does not expect to see any elevated ambient levels.

Alaska’s Population

Alaska comprises one sixth of the United States landmass and has a population density of 1.2 persons per square mile. The 2010 census map (Figure 2) illustrates the actual population distribution across the state. There are vast stretches of the state having less than 1.0 persons per square mile and a few small areas with approximately 8,000 persons per square mile.

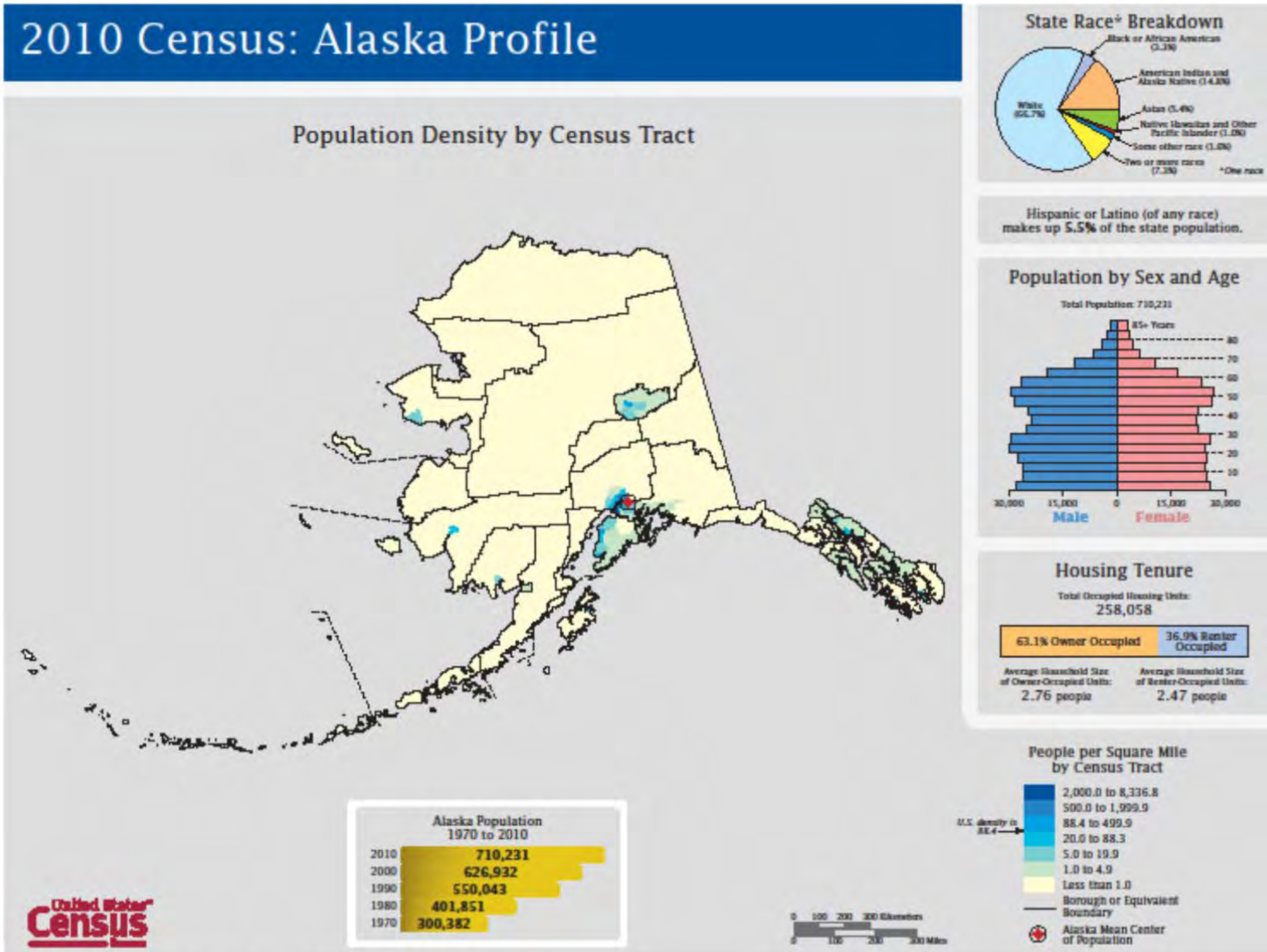

Figure 2. 2010 Census profile map for Alaska

The 2010 census numbers show the state’s total population at 710,231. Roughly half of Alaska’s residents live in Anchorage and the surrounding communities of the Matanuska – Susitna Valley (Table 3). The state has one medium-sized, core-based statistical area comprising the Municipality of Anchorage (the central unit of this CBSA) and the communities of Wasilla and Palmer (the outlying portion of the CBSA) (Figure 3). The Fairbanks North Star Borough in the interior of Alaska is the second largest population center and a small CBSA. The Juneau City and Borough and Ketchikan Gateway Borough, in Southeast Alaska, are both micropolitan areas. Approximately one fourth of Alaska residents live outside a CBSA.

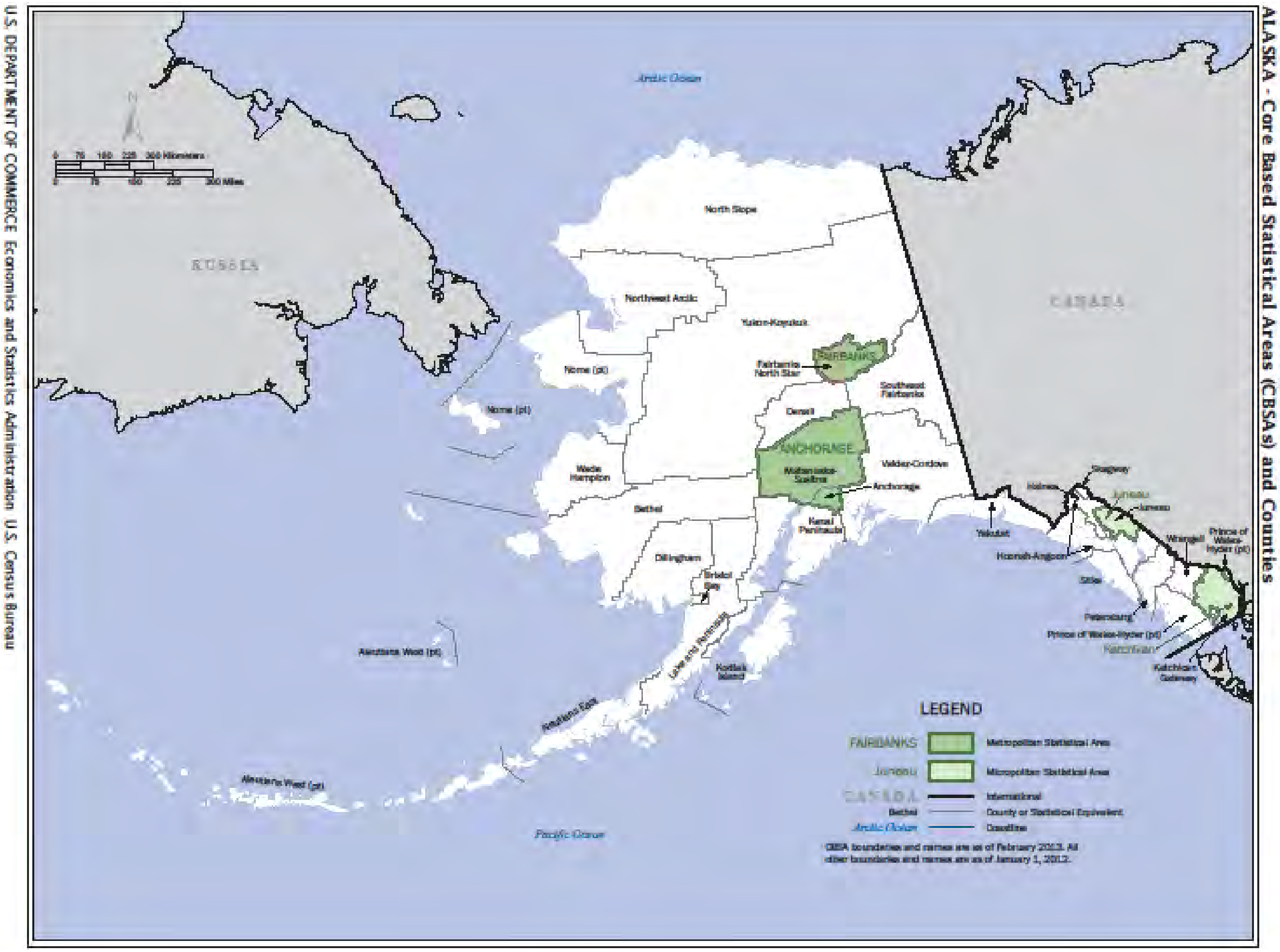

Figure 3. Alaska Core Based Statistical Areas (CBSA) and Counties (US Census Bureau)

Table 3. Alaska CBSA populations and categories. Metropolitan and micropolitan statistical areas are delineated by the US Office of Management and Budget using 2010 US Census Bureau data.

Community		Population	Total	CBSA category
Anchorage	Anchorage Municipality (Anchorage MSA)	297,826	380,821	Metropolitan (Medium CBSA)
	Matanuska-Susitna Borough (Anchorage MSA)	88,995		
Fairbanks North Star Borough			97,581	Metropolitan (Small CBSA)
Juneau City and Borough			31,275	Micropolitan
Ketchikan Gateway Borough			13,477	Micropolitan
All other areas			168,035	Outside of CBSA

Table 4 summarizes the population distribution among the six major Alaska population regions (http://live.laborstats.alaska.gov/pop/projections/pub/popproj.pdf). Roughly one third of Alaska's residents live in communities with fewer than 1,000 people. The Alaska Department of Labor and Workforce Development projects the highest growth rate within the state to occur in the Matanuska- Susitna Borough (12% increase between 2017 and 2022). DEC had enlarged its monitoring network to three monitoring sites in this area in response to population increases in 2010. However due to budget cuts and reduced staffing, DEC consolidate some of its operations by decommissioning the Wasilla site in March 2015. The sites in Palmer ($PM_{2.5}$, PM_{10}, O_3) and Butte ($PM_{2.5}$, PM_{10})) remain operational and are intended to remain in the monitoring network for the long term.

Table 4. Alaska Population by Region, Borough, and Census Area, 2015 to 2030

	July 1, 2015 Estimate	July 1, 2020 Projection	July 1, 2025 Projection	July 1, 2030 Projection
Alaska	737,625	771,529	802,352	829,620
Anchorage / Mat-Su Region	399,086	423,107	445,773	466,780
Anchorage, Municipality of	298,908	309,692	318,629	325,533
Matanuska-Susitna Borough	100,178	113,415	127,144	141,247
Gulf Coast Region	81,111	83,703	85,819	87,404
Kenai Peninsula Borough	57,763	60,493	62,845	64,772
Kodiak Island Borough	13,819	13,971	14,053	14,061
Valdez-Cordova Census Area	9,529	9,239	8,921	8,571
Interior Region	112,818	116,478	119,402	121,504
Denali Borough	1,781	1,763	1,726	1,686
Fairbanks North Star Borough	98,645	102,237	105,139	107,276
Southeast Fairbanks Census Area	6,899	7,192	7,456	7,676
Yukon-Koyukuk Census Area	5,493	5,286	5,081	4,866
Northern Region	27,802	28,707	29,597	30,522
Nome Census Area	10,040	10,449	10,859	11,298
North Slope Borough	9,895	10,152	10,390	10,634
Northwest Arctic Borough	7,867	8,106	8,348	8,590
Southeast Region	74,395	75,600	76,272	76,411
Haines Borough	2,493	2,525	2,541	2,533
Hoonah-Angoon Census Area	2,178	2,164	2,133	2,086
Juneau, City and Borough of	33,277	34,115	34,719	35,073
Ketchikan Gateway Borough	13,778	13,934	14,000	13,969
Petersburg Borough	3,199	3,132	3,046	2,932
Prince of Wales-Hyder Census Area	6,446	6,596	6,699	6,769
Sitka, City and Borough of	8,929	8,920	8,851	8,718
Skagway Borough, Municipality of	1,040	1,111	1,165	1,222
Wrangell, City and Borough of	2,442	2,508	2,550	2,570
Yakutat, City and Borough of	613	595	568	539
Southwest Region	42,413	43,934	45,489	46,999
Aleutians East Borough	2,854	2,832	2,807	2,770
Aleutians West Census Area	5,649	5,637	5,616	5,584
Bethel Census Area	18,153	18,942	19,738	20,553
Bristol Bay Borough	887	837	790	731
Dillingham Census Area	5,007	5,158	5,289	5,420
Kusilvak Census Area	8,195	8,843	9,541	10,225
Lake and Peninsula Borough	1,668	1,687	1,708	1,716

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, 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 [increasing entrainment of 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 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 the Fairbanks North Star Borough as residents use wood or other solid fuel burning devices 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 wood smoke tens to hundreds of miles away from their sources, impacting public health. Ash from volcanic eruptions as well as sulfur dioxide plumes can travel far distances.

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. However, they may also have some dirt streets, and winter sanding materials often become "road dust' in the spring. After the rise in fuel oil home heating costs, more people are continuing to re-discover the wood-fired heater. While providing warmth at a lower cost, these units are not always 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 that 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 that 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 CBSA. The intent is to make sure that if elevated levels of pollution exist, the control strategy is effective and includes all contributing sources. In Alaska, where most communities are small and separated significantly by geography, 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 e.g., Fairbanks North Star Borough (City of Fairbanks, North Pole, Fort Wainwright and Eielson AFB), the Upper Cook Inlet Basin (Municipality of Anchorage, Girdwood, Eagle River, Chugiak, Wasilla, and Palmer) and the Northern Kenai Peninsula (Nikiski, Kenai, and Soldotna), either the meteorology does not necessarily support the need for development of a CBSA or the multi-community airshed is already being legally controlled.

<u>Fairbanks North Star Borough:</u> 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 Fairbanks North Star Borough non-attainment area boundaries include the cities of Fairbanks and North Pole, and Fort Wainwright,

but not Eielson Air Force base. Over the past five years, control strategies have resulted in a downward trend in PM2.5 concentrations in Fairbanks, while the North Pole area has experienced extreme wintertime pollution. The State and Borough governments are currently working to refine an effective control strategy.

<u>Northern Kenai Peninsula:</u> 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.

<u>Upper Cook Inlet Basin (Anchorage, Wasilla, Palmer):</u> Flow in the upper basin is generally bi-modal with the strongest flow due to northerly drainage winds and southerly storm flow. The combination these winds with the region's mountainous terrain create a 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 very localized (road dust, carbon monoxide, and wood smoke) 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.

The Municipality of Anchorage is a good example of how different the local flow can be. In Girdwood (south end of the Municipality) and Chugiak/Birchwood (northeast side of the Municipality) weather conditions 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. The windroses in Figures 4 and 5 for Anchorage, Wasilla, and Palmer show how different the wind patterns are.

Based on the State's analysis of local and regional meteorology which examined annual wind rose data (Figures 4, 5), 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 it has been in the past: locally between the state and local governments.

DEC'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 issues 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.

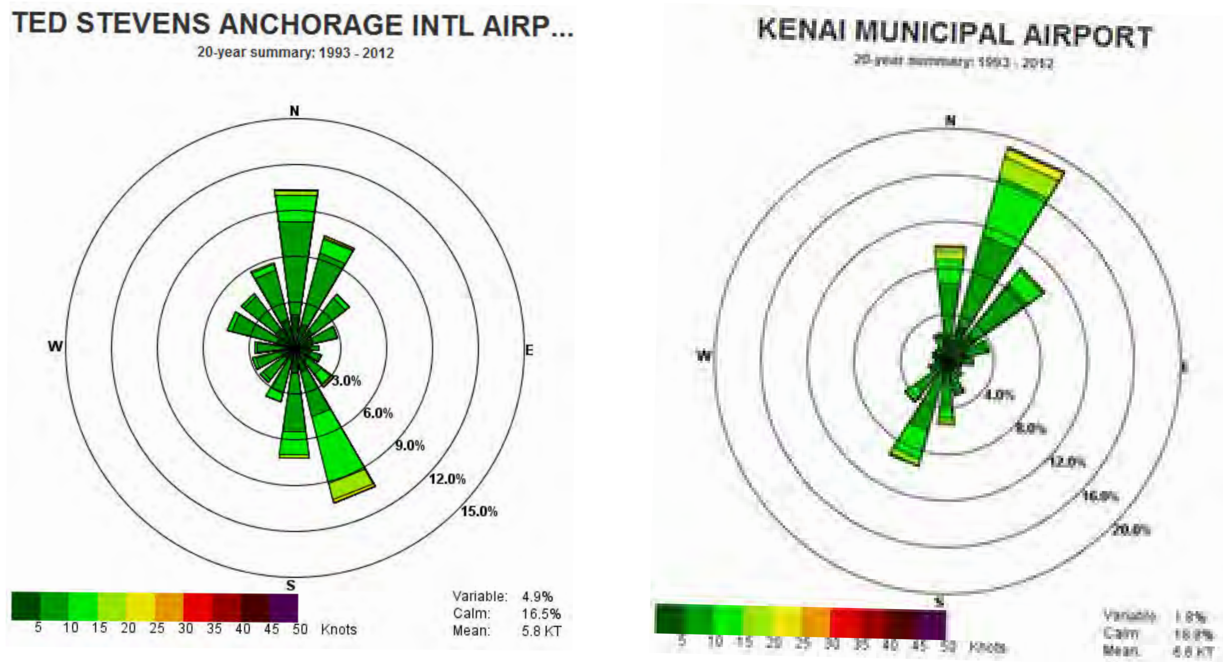

Figure 4. Windroses summarizing wind data from 1993 through 2012 at Ted Stevens International Airport, Anchorage and Kenai Municipal Airport

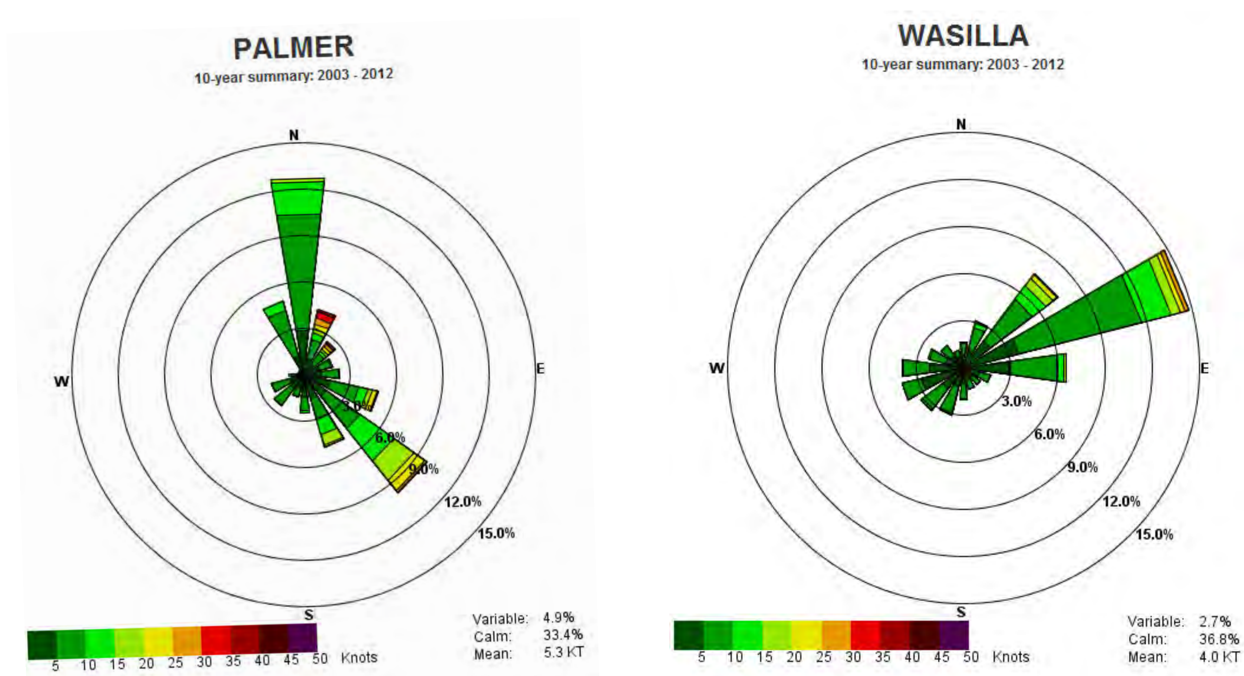

Figure 5. Windroses summarizing wind data from 2003 through 2012 at Palmer Airport and Wasilla Airport

Alaska's Air Quality Monitoring Network

The following sections summarize data and trends for each of the criteria pollutants monitored in the Alaska Air Monitoring Network in order of pollutants of concern, (i.e $PM_{2.5}$, PM_{10}, CO, O_3, Pb, SO_2, NO_2). The monitoring network currently includes long-term sites in the urbanized areas of Anchorage, Fairbanks, Juneau, and the Matanuska-Susitna Valley (Mat-Su). Seasonal $PM_{2.5}$ monitoring in Yakutat began in November 2014 and will continue through winter of 2016/2017. Seasonal PM_{10} road dust monitoring in Ruby as part of a multi-agency project began in May 2015 and continued through the spring and summer of 2016. Seasonal monitoring for wildland fire smoke ($PM_{2.5}$) impacts in the interior of Alaska will continue in Galena and Ft Yukon. A new SPM site (PM_{10}, $PM_{2.5}$) is planned for Bethel.

Alaska Pollutant Specific Summaries

$PM_{2.5}$

The primary monitoring focus for the past several years focus has shifted to fine particulate matter ($PM_{2.5}$). $PM_{2.5}$ particles are largely the result of combustion processes e.g., home heating, wildfires, automobile exhaust, etc. A network of monitors was installed statewide in 1999 following the promulgation of the fine particulate matter standard in 1997. Alaska monitoring network sites have recorded an increase in violations of the $PM_{2.5}$ NAAQS, especially after December 2006, when the 24-hour $PM_{2.5}$ standard was strengthened from 65 $\mu g/m^3$ to 35 $\mu g/m^3$. A large area in the FNSB was designated non-attainment with the 24-hour $PM_{2.5}$ standard in December 2009. The North Pole Fire Station 3 (NP Fire) was designated a SLAMS site in 2013. The large concentrations measured at this site determine the design value for the entire non-attainment area.

The following graphs summarize the exceedances of the 24-hour $PM_{2.5}$ NAAQS throughout the monitoring network since 2000. Figure 6 shows the number of exceedances from all causes recorded statewide since 2000 while Figure 7 shows the number of exceedances from natural events, e.g., wildfire smoke. The summer exceedances in Fairbanks in 2004 and 2015 are entirely due to wildland fire smoke.

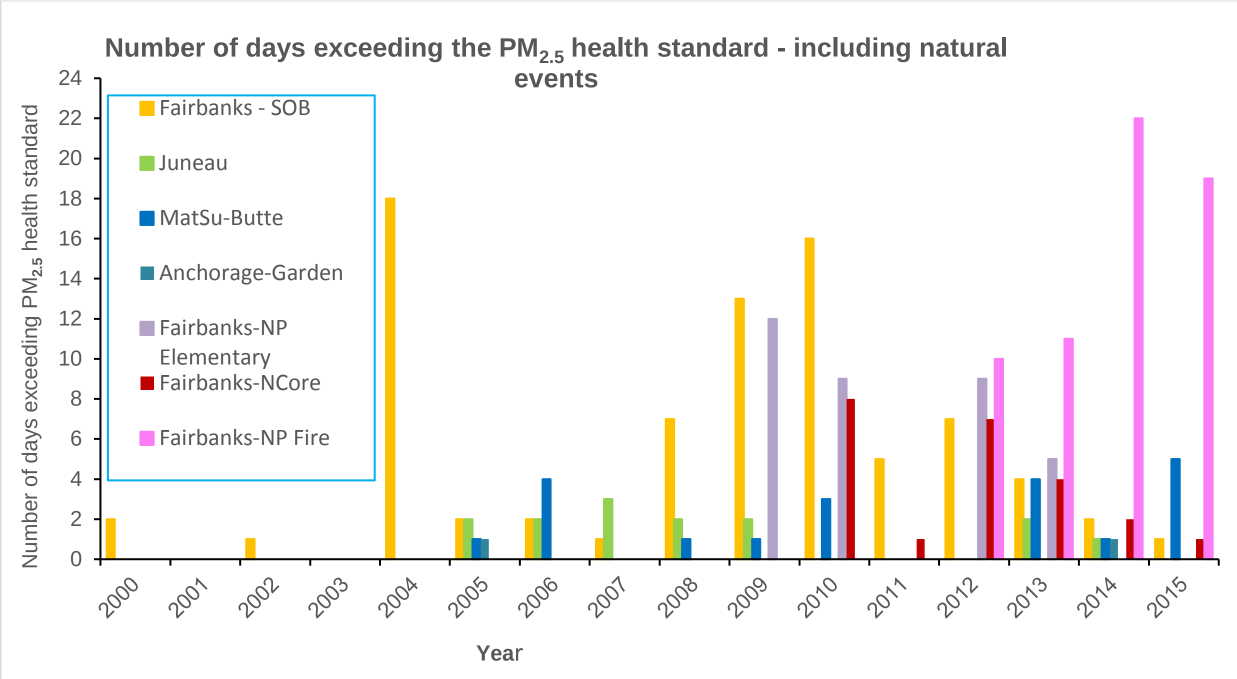

Figure 6. 24-hour $PM_{2.5}$ exceedance days including natural events

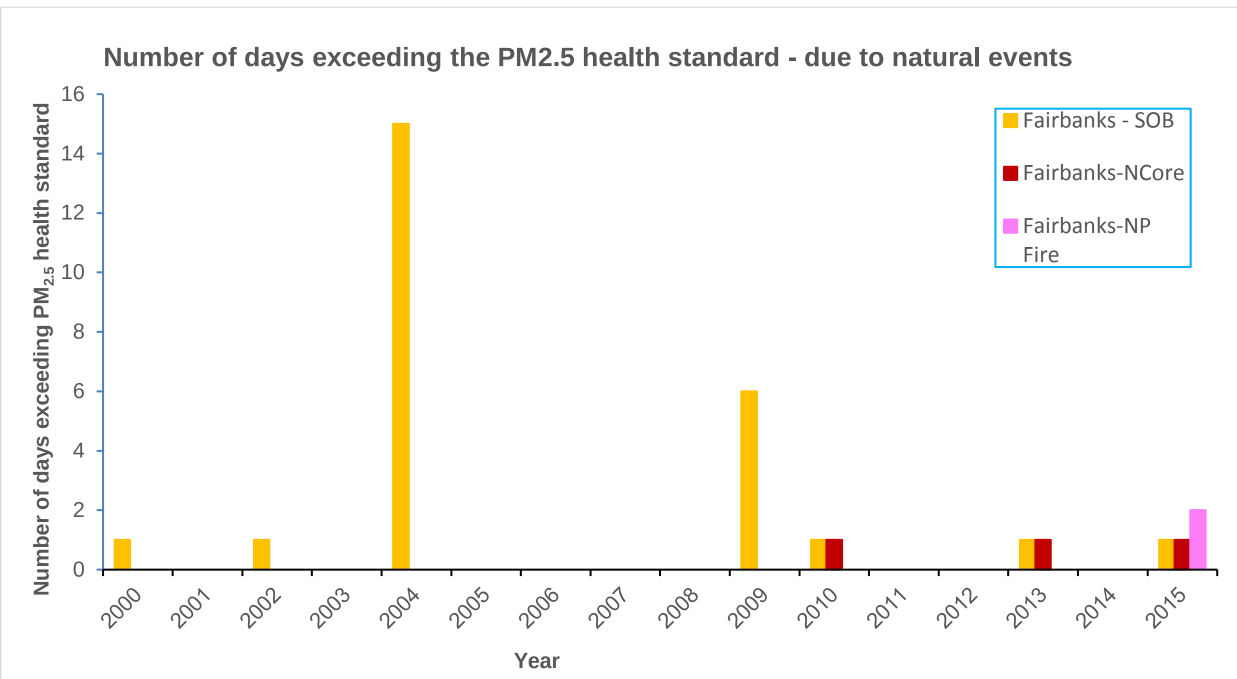

Figure 7. 24-hour $PM_{2.5}$ exceedance days due to natural events

The annual $PM_{2.5}$ values across the state since 2000 have been relatively stable (Figure 8). Fairbanks has the highest annual average concentrations (11 to 13 µg/m^3) while the other parts of the state average 5 to 8 µg/m^3. An annual design value is not calculated for the NP Fire site, since year-round sampling started only in 2015 and three calendar years of annual data are required for the calculation.

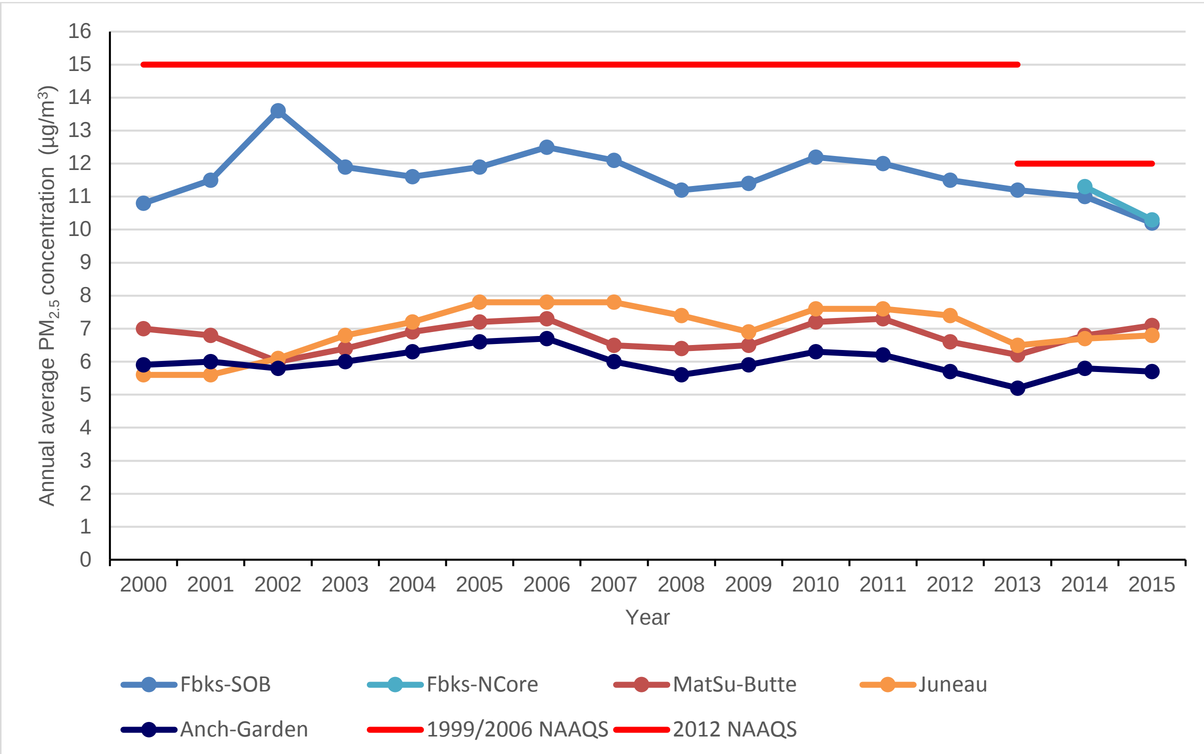

Figure 8. Annual average $PM_{2.5}$ concentrations from 2000 through 2015

PM_{10}

Although DEC's monitoring focus has shifted to $PM_{2.5}$, Alaska has remained aware of PM_{10} impacts due to natural events as well as human-caused road dust in rural villages and spring road sweeping in the Muncipality ofAnchorage. Exposed glacial river beds combined with gap winds through mountain passes cause several natural PM_{10} exceedances each year on average (Figures 9 & 10). In 2015, the Fairbanks NCore site had such high $PM_{2.5}$ levels due to extreme wildfires in Interior Alaska that three days also were recorded as PM_{10} exceedances.

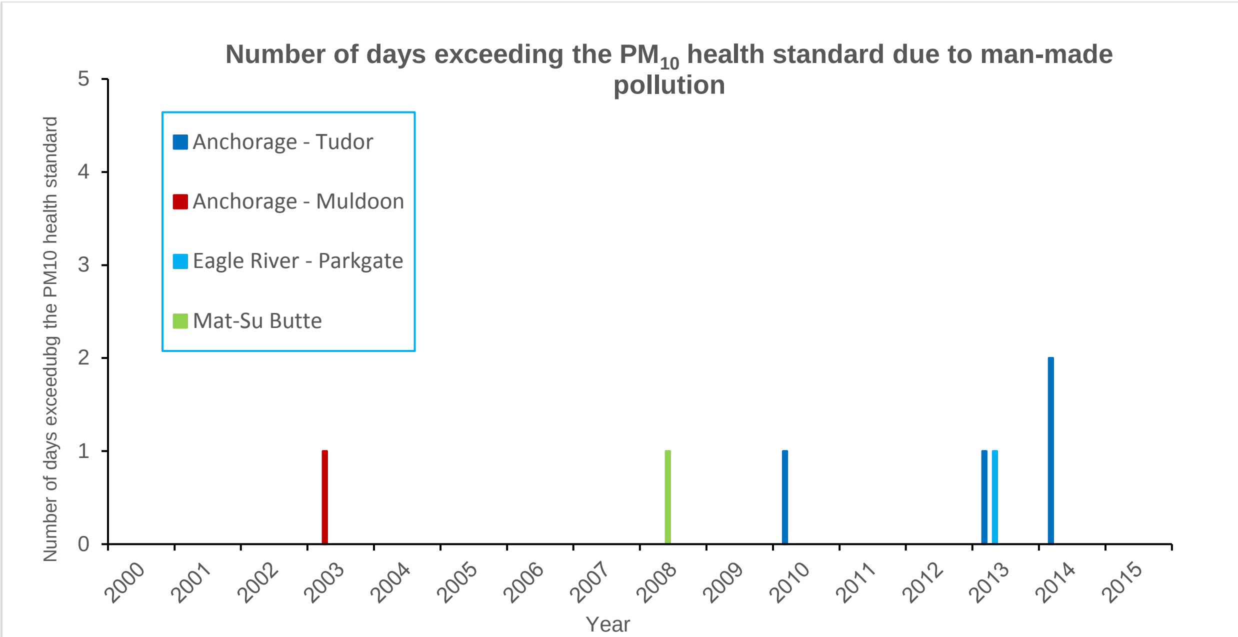

Figure 9. Number of days exceeding PM_{10} due to human caused pollution

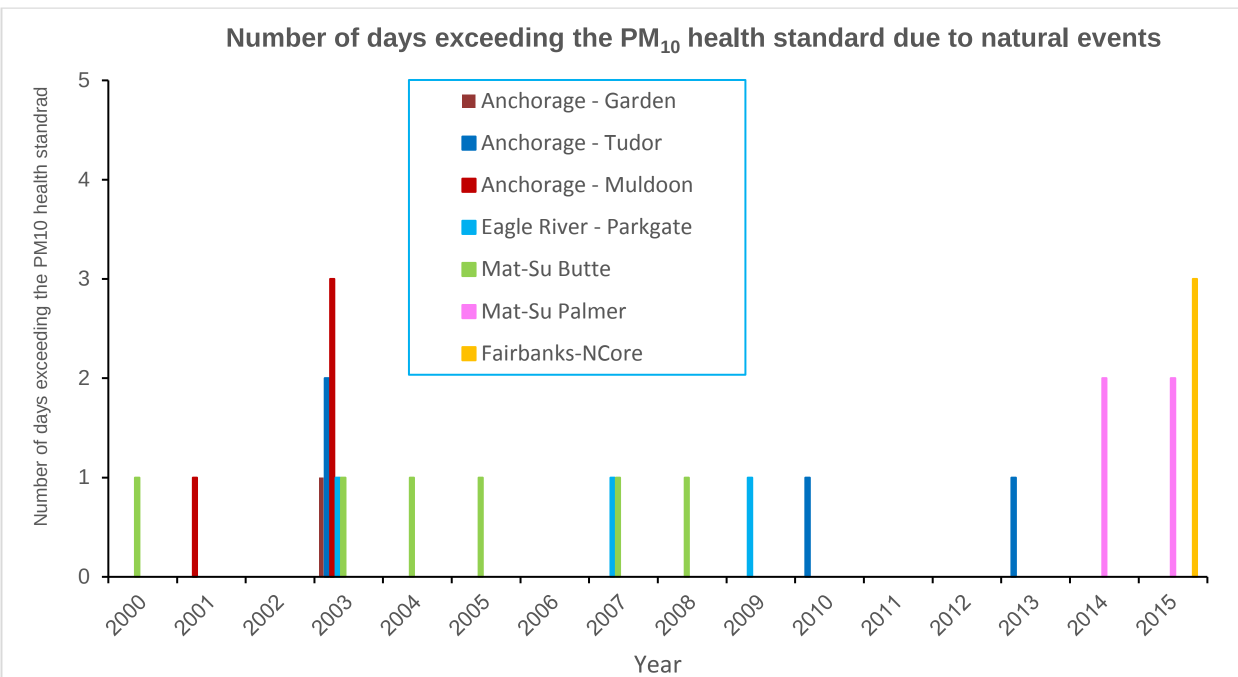

Figure 10. Number of days exceedingPM_{10} standard due to natural events

CO

CO has been measured in the Municipality of Anchorage and the FNSB since 1972. The most recent exceedance occurred at the Anchorage Turnagain site in 2001. A graph of the maximum 8-Hour CO concentrations is shown in Figure 11. The old Fairbanks Old Post Office SLAMS site (Fairbanks OPO) was shut down after the CO sampling season in 2014.

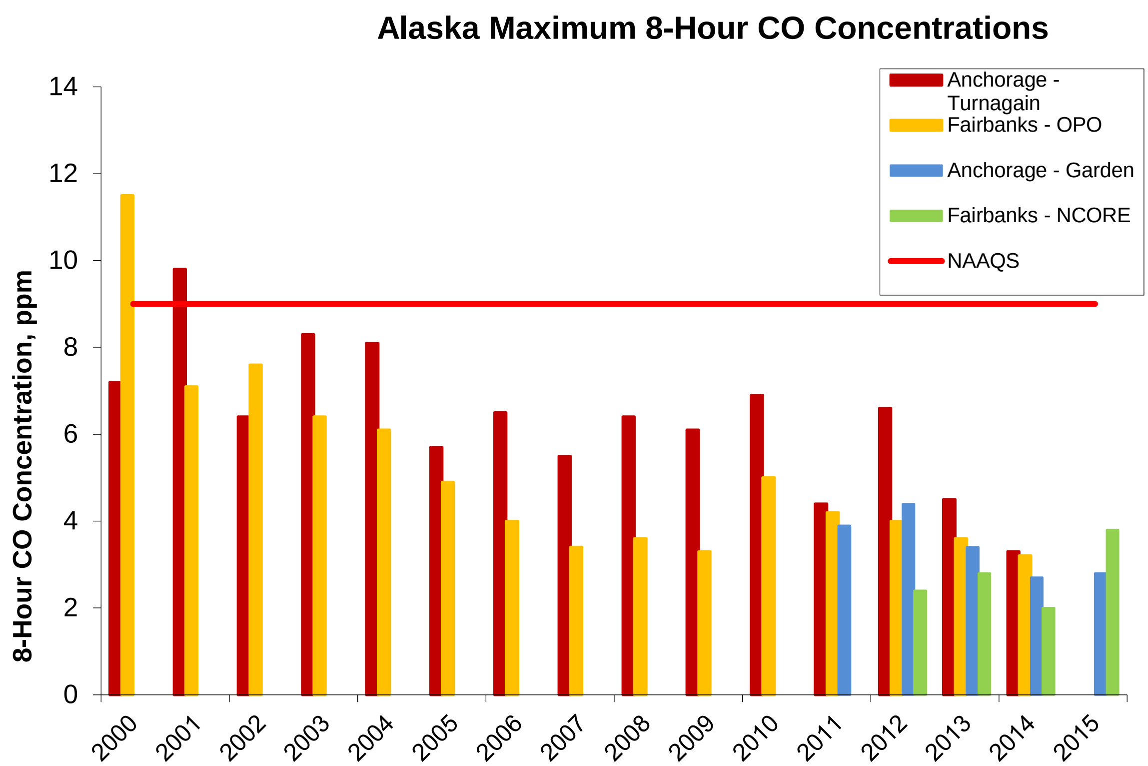

Figure 11. Maximum 8-Hour CO Concentrations since 2000

O_3

Ozone has been measured at Fairbanks NCore site and in the Mat-Su Valley at the Wasilla and Palmer sites from 2011 to 2015 (Tables 5 and 6). All sites are well below the 2012 standard of 0.070 ppm. The maximum 8-hourly concentration was 0.057 ppm on May 11, 2014 at the NCore site. General trends are consistent among years and sites with the monthly average of the maximum houly ozone concentrations per day highest in April and May and lowest in December and January (Figure 12).

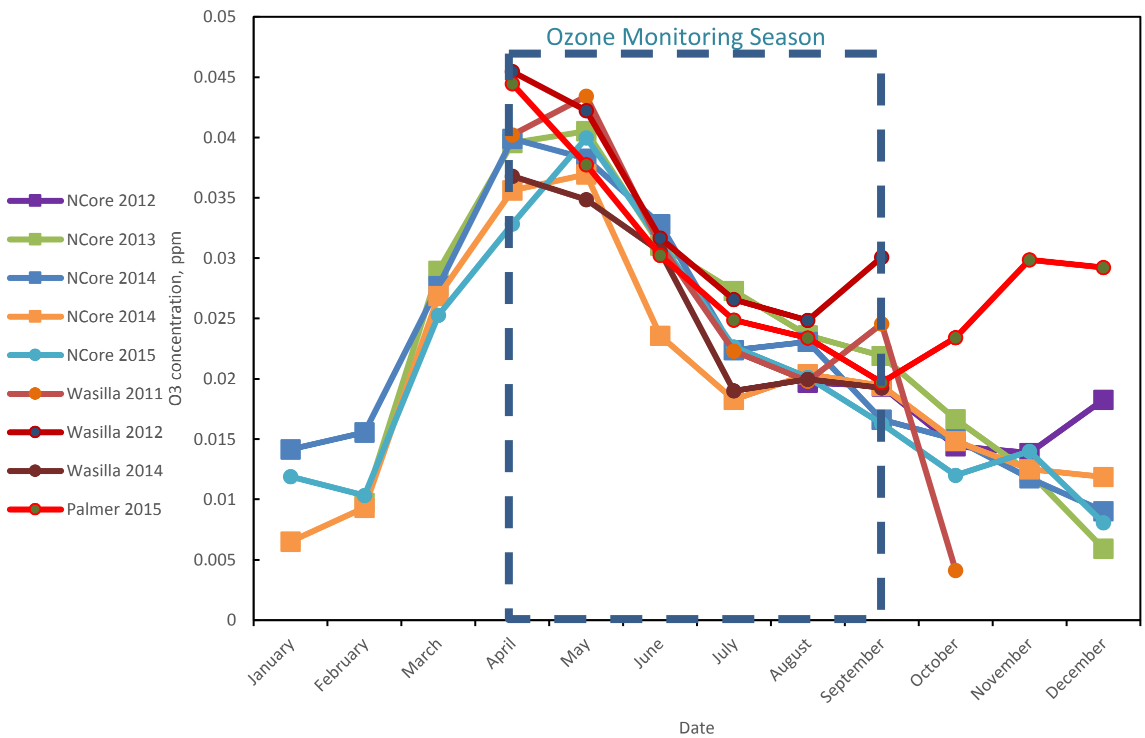

Figure 12. Year trends of ozone (monthly average of the daily 1-hour maximum)

SO_2

The SO_2 analyzer was installed at the Fairbanks NCore site on August 1, 2011 and it started recording valid data on August 19, 2011. Trends are consistent among years with highest concentrations measured in December and lowest concentrations measured in September (Figure 12). Daily maximum 99th percentiles are mostly in January/February with the exception of the 2015 99th percentile that was in December. All values recorded are well below the national standard.

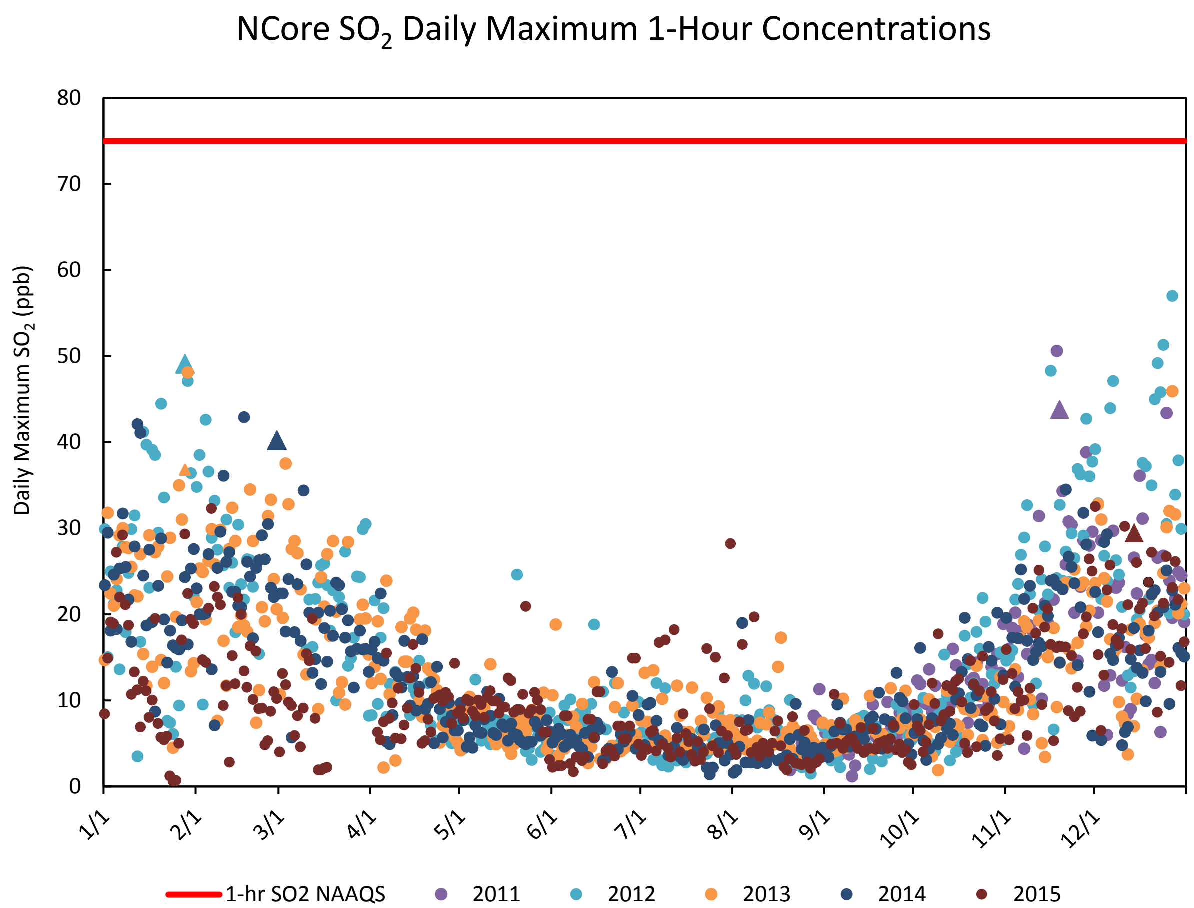

Figure 13. NCore SO_2 daily maximum 1-hour concentrations (99th percentiles are indicated by triangles)

NO_2

The NO_2 analyzer was installed in July 2014 at the NCore site. All daily 1-hour maximum concentrations measured were below the standard of 100 ppb (Figure 14). Highest concentrations are in January and lowest concentrations are in July.

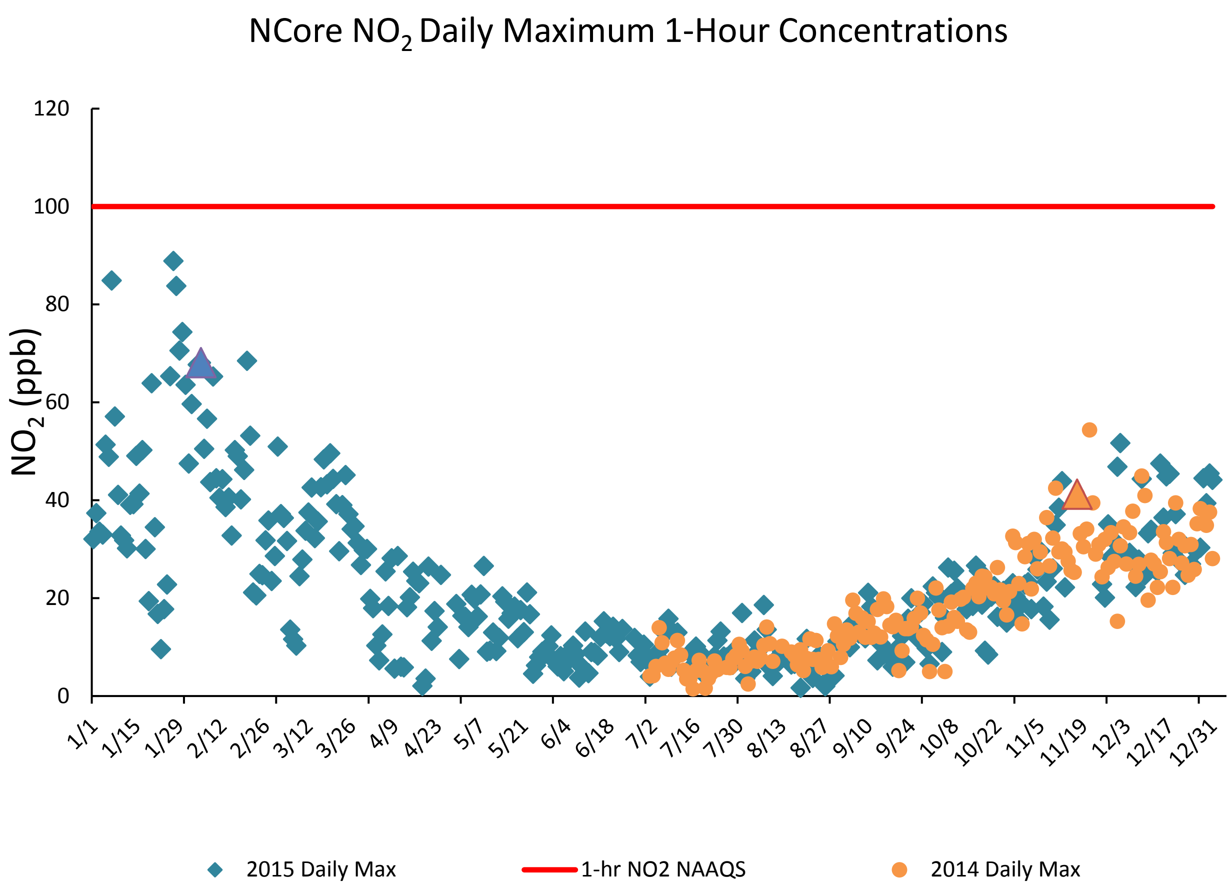

Figure 14. NCore NO_2 Daily Maximum Concentrations (98th percentile is indicated with a triangle)

Alaska Pollutant Specific Summaries

This section details pollutant specific information for the last five years by monitoring location.

$PM_{2.5}$

Tables 5 through 12 summarize $PM_{2.5}$ data from monitoring sites in the four major areas around the state. These data exclude measurements of exceptional events. Additional site details are contained in the 2015 Network Plan.

Table 5. $PM_{2.5}$ data summary from Garden site

Municipality of Anchorage	2011	2012	2013	2014	2015	NAAQS
Max 24-hr concentration (µg/m^3)	23.3	35.2	25.6	22.9	24.2	
Days above 24-hr NAAQS	0	0	0	0	0	
Annual 98th percentile (µg/m^3)	17.3	28.4	15.7	18.5	18.4	
24-hr design value (µg/m^3)	22	23	20	21	18	35
Annual design value (µg/m^3)	6.2	6.0	5.6	5.8	5.7	12

AQS ID: 02-020-0018; equipment: MetOne BAM 1020

Table 6. PM2.5 data summary from Parkgate (Eagle River) site

Municipality of Anchorage	2011	2012	2013	2014	2015	NAAQS
Max 24-hr concentration (µg/m^3)	24.9	23.4	23.1	17.4	24.0	
Days above 24-hr NAAQS	0	0	0	0	017.3	
Annual 98th percentile (µg/m^3)	15.7	17.9	15.0	14.2	17.2	
24-hr design value (µg/m^3)	18	17	16	16	15	35
Annual design value (µg/m^3)	5.4	5.1	5.0	5.2	5.4	12

AQS ID: 02-020-1004; equipment: MetOne BAM 1020

Table 7. PM2.5 data summary from Butte site

Matanuska-Susitna Borough	2011	2012	2013	2014	2015	NAAQS
Max 24-hr concentration (µg/m^3)	34.7	40.3	40.8	56.4	61.5	
Days above 24-hr NAAQS	0	4	4	8	9	
Annual 98th percentile (µg/m^3)	30.2	33.4	27.9	38.1	37.9	
24-hr design value (µg/m^3)	32	34	31	33	35	35
Annual design value (µg/m^3)	7.3	6.6	6.2	6.7	7.0	12

Table 8. PM2.5 data summary from Palmer site

Matanuska-Susitna Borough	2011	2012	2013	2014	2015	NAAQS
Max 24-hr concentration ($\mu g/m^3$)	21.1	21.4	15.7	15.5	15.1	
Days above 24-hr NAAQS	0	0	0	0	0	
Annual 98th percentile ($\mu g/m^3$)	9.1	13.7	11.1	9.3	9.9	
24-hr design value ($\mu g/m^3$)	10	11	11	11	10	35
Annual design value ($\mu g/m^3$)	3.6	3.8	3.8	3.1	2.6	12

AQS ID: 02-170-0012; equipment: MetOne BAM 1020

Table 9. PM2.5 data summary from Floyd Dryden site

City and Borough of Juneau	2011	2012	2013	2014	2015	NAAQS
Max 24-hr concentration ($\mu g/m^3$)	29.7	42.0	38.1	45.0	21.4	
Days above 24-hr NAAQS	0	2	1	1	0	
Annual 98th percentile ($\mu g/m^3$)	24.8	23.5	22.7	27.5	21.0	
24-hr design value ($\mu g/m^3$)	27	25	24	25	24	35
Annual design value ($\mu g/m^3$)	7.6	7.4	6.5	6.7	6.8	12

AQS ID: 02-110-0004; equipment: MetOne BAM 1020

Table 10. PM2.5 data summary from SOB site

Fairbanks North Star Borough	2011	2012	2013	2014	2015	NAAQS
Max 24-hr concentration ($\mu g/m^3$)	42.6	55.5	56.0	48.4	40.3	
Days above 24-hr NAAQS	4	7	4	2	3	
Annual 98th percentile ($\mu g/m^3$)	38.0	49.6	36.3	34.5	35.3	
24-hr design value ($\mu g/m^3$)	47	46	41	40	35	35
Annual design value ($\mu g/m^3$)	12.0	11.5	11.2	11.0	10.2	12

AQS ID: 02-090-0010; equipment: Partisol 2000

Table 11. PM2.5 data summary from NCore site

Fairbanks North Star Borough	2011	2012	2013	2014	2015	NAAQS
Max 24-hr concentration (µg/m^3)	39.8	56.9	52.8	44.0	47.6	
Days above 24-hr NAAQS	1	7	4	2	3	
Annual 98th percentile (µg/m^3)	33.1	50.0	36.2	31.6	36.7	
24-hr design value (µg/m^3)	NA*	NA*	40	39	35	35
Annual design value (µg/m^3)	NA*	NA*	11.1	11.3	10.3	12

AQS ID: 02-090-0034; equipment: Thermo Partisol 2000

* Data no available; 3 complete years data required for Design Value``

Table 12. PM2.5 data summary from North Pole Fire Station #3 site

Fairbanks North Star Borough	2011	2012	2013	2014	2015	NAAQS
Max 24-hr concentration (µg/m^3)	NA*	171.3	121.6	155.8	145.1	
Days above 24-hr NAAQS	NA*	10	11	22	21	
Annual 98th percentile (µg/m^3)	NA*	158.4	121.6	138.3	111.6	
24-hr design value (µg/m^3)	NA**	NA**	NA**	139	124	35
Annual design value (µg/m^3)	NAǂ	NAǂ	NAǂ	NAǂ	NA	12

AQS ID: 02-090-0034; equipment: Thermo Partisol 2000

* site not installed

**data not available; 3 complete years data required for Design Value

ǂ seasonal collection

PM_{10}

Tables 13 through 21 summarize PM_{10} data from monitoring sites in the four major areas around the state. These data exclude measurements of exceptional events. Additional site details are contained in the 2015 Network Plan.

Table 13. PM10 data summary from Garden site

Municipality of Anchorage	2011	2012	2013	2014	2015	NAAQS
1st Max 24-hr concentration (µg/m^3)	39	59	65	91	78	150
2nd Max 24-hr concentration (µg/m^3)	36	53	58	87	75	
Days above 24-hr NAAQS	0	0	0	0	0	

AQS ID: 02-020-0018; equipment: MetOne BAM 1020

Table 14. PM10 data summary from Parkgate (Eagle River) site

Municipality of Anchorage	2011	2012	2013	2014	2015	NAAQS
1st Max 24-hr concentration (µg/m^3)	95	81	174	111	90	150
2nd Max 24-hr concentration (µg/m^3)	62	17	78	109	70	
Days above 24-hr NAAQS	0	0	1	0	0	

AQS ID: 02-020-1004; equipment: MetOne BAM 1020

Table 15. PM10 data summary from Tudor site

Municipality of Anchorage	2011	2012	2013	2014	2015	NAAQS
1st Max 24-hr concentration (µg/m^3)	127	120	256	198	NA*	150
2nd Max 24-hr concentration (µg/m^3)	63	115	120	155	NA*	
Days above 24-hr NAAQS	0	0	1	2	NA*	

AQS ID: 02-020-0044; equipment: MetOne BAM 1020

* site moved from Tudor to Laurel

Table 16. PM10 data summary from Laurel site

Municipality of Anchorage	2011	2012	2013	2014	2015	NAAQS
1st Max 24-hr concentration (µg/m^3)	NA*	NA*	NA*	NA*	90	150
2nd Max 24-hr concentration (µg/m^3)	NA*	NA*	NA*	NA*	76	
Days above 24-hr NAAQS	NA*	NA*	NA*	NA*	0	

AQS ID: 02-020-0045; equipment: MetOne BAM 1020

* Tudor site moved to Laurel after the Tudor site building was sold and new landowner not renewing the lease

Table 17. PM10 data summary from Butte site

Matanuska-Susitna Borough	2011	2012	2013	2014	2015	NAAQS
1st Max 24-hr concentration (µg/m³)	138	113	81	117	55	150
2nd Max 24-hr concentration (µg/m³	95	81	72	107	44	
Days above 24-hr NAAQS	0	0	0	0	0	

AQS ID: 02-170-0008; equipment: R & P Partisol, MetOne BAM 1020

Table 18. PM10 data summary from Palmer site

Matanuska-Susitna Borough	2011	2012	2013	2014	2015	NAAQS
1st Max 24-hr concentration (µg/m³)	214	152	113	101	55	150
2nd Max 24-hr concentration (µg/m³	174	121	84	89	44	
Days above 24-hr NAAQS	2	0	0	0	0	

AQS ID: 02-170-0012; equipment: R & P Partisol, MetOne BAM 1020

Table 19. PM10 data summary from Wasilla site

Matanuska-Susitna Borough	2011	2012	2013	2014	2015	NAAQS
1st Max 24-hr concentration (µg/m³)	68	120	78	127	55	150
2nd Max 24-hr concentration (µg/m³	49	109	63	118	44	
Days above 24-hr NAAQS	0	0	0	0	0	

AQS ID: 02-170-0013; equipment: MetOne BAM 1020

Table 20. PM10 data summary from Floyd Dryden site

City and Borough of Juneau	2011	2012	2013	2014	2015	NAAQS
1st Max 24-hr concentration (µg/m³)	24	24	33	38	21	150
2nd Max 24-hr concentration (µg/m³)	21	19	24	31	18	
Days above 24-hr NAAQS	0	0	0	0	0	

AQS ID: 02-110-0004; equipment: R & P Partisol

Table 21. PM10 data summary from NCore site

Fairbanks North Star Borough	2011	2012	2013	2014	2015	NAAQS
1st Max 24-hr concentration (µg/m³)	64*	95	111	94	105	150
2nd Max 24-hr concentration (µg/m³)	52*	83	95	74	89	
Days above 24-hr NAAQS	0*	0	0	0	0	

AQS ID: 02-090-0034; equipment: MetOne BAM 1020
*completeness not met; 2011 partial year

CO

Alaska's two largest communities, the Municipality of Anchorage and the FNSB, were reclassified as *Limited Maintenance Plan* areas for CO in 2004 and second 10 year *Limited Maintenance Plans* again in 2014. Since 2002, there have been no exceedances of the 8-hour or 1-hour CO NAAQS in either community (Table 22, 23).

Table 22. CO data summary from Garden site

Municipality of Anchorage	2012	2013	2014	2015	NAAQS
Max 8-hr average concentration (ppm)	4.4	3.4	2.7	2.8	9
2nd Max 8-hr average concentration (ppm)	4.3	3.1	2.5	2.8	
Days above 8-hr average NAAQS	0	0	0	0	
Max 1-hr average concentration (ppm)	6.9	4.4	5.2	5.2	35
2nd Max1-hr average concentration (ppm)	6.5	4.3	4.5	4.5	
Days above 1-hr average NAAQS	0	0	0	0	

AQS ID: 02-020-0018;equipment:

Table 23. CO data summary from NCore site

Fairbanks North Star Borough	2012	2013	2014	2015	NAAQS
Max 8-hr average concentration (ppm)	2.4	2.8	2.0	3.8	9
2nd Max 8-hr average concentration (ppm)	2.1	2.2	1.9	2.4	
Days above 8-hr average NAAQS	0	0	0	0	
Max 1-hr average concentration (ppm)	4.7	3.8	3.6	3.6	35
2nd Max1-hr average concentration (ppm)	4.4	3.7	3.2	3.2	
Days above 1-hr average NAAQS	0	0	0	0	

AQS ID: 02-090-0034

O_3 Summary Statistics

DEC currently monitors O_3 at the Palmer site in the Mat-Su Valley and the NCore site in FNSB. DEC had previously located the O_3 monitoring equipment at the Wasilla site which is also located in the Matanuska-Susitna Valley. DEC decommissioned the Wasilla site to consolidate operations. DEC has collected three years of O_3 data; however they are not consecutive years as required by EPA. DEC will continue to collect O_3 data at the Palmer site year-round rather than seasonally as it had been at the Wasilla site. O_3 values have, so far, been measured at levels well below the 8-hour NAAQS of 0.075 ppm (Table 24-25). Design values were about 60% of the NAAQS at the NCore site (Table 26).

Table 24. O3 data summary from Wasilla site

Matanuska-Susitna Borough	2012	2013	2014	2015	NAAQS
4th Max 8-hr average concentration (ppm)	0.048	NA*	0.045	NAǂ	0.075
Days above 8-hr average NAAQS	0	NA*	0	NAǂ	

AQS ID: 02-170-0013
*no data available
ǂ monitor moved to Palmer site

Table 25. O3 data summary from Palmer site

Matanuska-Susitna Borough	2012	2013	2014	2015	NAAQS
4th Max 8-hr average concentration (ppm)	NA*	NA*	NA*	0.047	0.075
Days above 8-hr average NAAQS	NA*	NA*	NA*	0	

AQS ID: 02-170-0012
*no data available; monitor moved from Wasilla site

Table 26. O3 data summary from NCore site

Fairbanks North Star Borough	2012	2013	2014	2015	NAAQS
4th Max 8-hr average concentration (ppm)	0.048	0.048	0.044	0.044	0.075
Days above 8-hr average NAAQS	0	0	0	0	
Design Value	NA*	NA*	0.046	0.045	

AQS ID: 02-090-0034

* 3 years data necessary for Design Value

SO_2 Summary Statistics

DEC currently monitors SO_2 at the FNSB NCore site. All concentration measured fall well below the NAAQS of 75 ppb (Table 27). The annual maximum is 57 to 76% of the standard and the 99th percentile is 40 to 65% of the NAAQS.

Table 27. NCore SO2 summary statistics

Fairbanks North Star Borough	2012	2013	2014	2015	NAAQS
99th Percentile (ppb)	49	37	40	30	75
Annual maximum (ppb)	57.0	48.1	42.9	53.5	
Design Value	NA*	NA*	42	36	

AQS ID: 02-090-0034

* 3 years data necessary for Design Value

NO_2 Summary Statistics

DEC currently monitors NO_2 at the NCore site in FNSB. The NO_2 analyzer was installed on July 1, 2014 so a NO_2 design values cannot be calculated until 2017. The 98th percentiles for the two years monitored are well below the 1-hour NO_2 NAAQS; the 2015 98th percentile is 68% of the NAAQS (Table 28). The 2015 annual mean is 24% of the annual NAAQS.

Table 28. NCore NO2 summary statistics

Fairbanks North Star Borough	2012	2013	2014	2015	NAAQS
98th Percentile (ppb)	NA*	NA*	41.2ɫ	68.1	100
Annual maximum (ppb)	NA*	NA*	54.4ɫ	58.9	
Annual mean (ppb)	NA*	NA*	18.7ɫ	12.7	53

AQS ID: 02-090-0034

* NO_2 analyzer not installed

ɫ data capture < 75% (48%); NO_2 analyzer installed 7/1/2014

Alaska's Air Quality Monitoring Network Technology Results & Discussion

TECHNOLOGY

Particulate Matter

Over the past many years, DEC has standardized sampling equipment at SLAMS sites across the State when replacing aged or broken equipment. DEC mostly use the continuous Met One BAM 1020 as the primary monitors for PM_{10} and $PM_{2.5}$. The exceptions are the sites in the Fairbanks North Star Borough, where all $PM_{2.5}$ SLAMS sites use Thermo Scientific Partisols 2000i Federal Reference Method (FRM) monitors as the primary samplers. Additionally DEC uses the Partisol 2000 at the Mendenhall Valley Floyd Dryden site in Juneau as the Primary PM_{10} monitor.

Currently the $PM_{2.5}$ Met One BAM 1020 in Fairbanks and North Pole do not **consistently** meet the Class III Federal Equivalence Method (FEM) performance criteria and therefore are only used for forecasting purposes. A detailed analysis and discussion is provided in the 2015 Annual Network Plan, (http://dec.alaska.gov/air/am/2015_Air_Monitoring_plan.pdf). The state will continue to employ FRM monitors as the primary samplers at any site where the Class III FEM criteria are not met consistently. Table 29 summarizes the particulate matter sampling technology used at the long term SLAMS and SPM sites.

Anderson High Volume PM_{10} and Thermo Scientific Inc. TEOMs or TEOM/FDMS are used at seasonal sites or special projects across the State. The NCore site houses a Met-One Super SASS Speciation Monitor and the URG 300N carbon module.

Calibration and auditing equipment

For calibrating low flow PM equipment, both FRM and continuous, DEC uses Mesa Labs Delta Cals (formerly BGI), which are annually re-certified. The state's air quality auditor maintains separate equipment for the sole purpose of independent quality control checks. The Met One Super SASS speciation sampler is calibrated and audited with either a Mesa Labs Tri Cal or Delta Cal. Our High Volume reference devices are recertified annually by the DEC auditor in our Juneau lab using a primary standard (rootsmeter).

Gaseous Analyzer Equipment

DEC and the local air agencies within the state have consolidated the CO and ozone equipment. The NCore site has a trace level Thermo Scientific 48i and the Anchorage CO site at Garden operates a Thermo Scientific 48C CO analyzers. The Teledyne 403E ozone analyzers are used in Fairbanks (NCore) and Palmer. All other gaseous criteria pollutants are measured with Thermo Scientific analyzers. Table 30 shows a detailed list of the equipment and sites.

Calibration and auditing equipment

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. The DEC QA officer has a separate zero air generator and transfer standard, and uses separate calibration gases for his audits.

Equipment replacement strategy

There are currently eleven $PM_{2.5}$ and PM_{10} FRM in operation in the network. DEC replaced five of the aging Partisols 2000 with the newer i-Series samplers, after DEC was informed in fall 2015 that Thermo Scientific Inc. no longer supports these older models. Thermo Scientific Inc stopped carrying any of the mechanical or electronic parts needed to upkeep the equipment.

Additionally DEC purchased three Thermo Scientific Partisols 2000i for the NCore site to allow for daily sampling at the site without staff having to work on weekends or holidays.

The PM_{10} FRM at NCore already was an i-Series instrument, which means that only the two PM_{10} FRMs at the Floyd Dryden site are the outdated models. Additionally DEC purchased two zero air generator and three air conditioning units for continuous PM analyzer shelters and one continuous PM analyzer pair.

DEC has identified another seven continuous analyzers, which are older than nine years old, three with ages over seven years and two FRM sampler that need replacement in the next year or two. The total amount for these analyzers will be in the range of $135,000. The current plan is to use the one time multipurpose grant to purchase this equipment during the State Fiscal Years 2017 and 2018.

The gravimetric lab in Juneau uses two Mettler balances, one for quartz and glass PM_{10} High Volume FRM filters and the other for $PM_{2.5}$ and PM_{10} low flow Teflon FRM filters. The lab uses a Measurement Technology Laboratories, LLC (MTL) Laboratory Information Management System (LIMS), which was updated in 2012. The balances are annually recertified and according to the auditor are in excellent condition. Purely due to the age of the balances (about 20 years), DEC anticipates that they will need to be replaced within the next 5 years. Periodic updates of the LIMS system are likely and anticipated in the budget. With a new balance, it seems reasonable to look for a new LIMS system, which integrates with the data acquisition system. DEC estimates the cost for a new balance in the range of $20,000- $25,000 and a new LIMS in the range of $10,000 to $15,000.

Table 29. PM Equipment inventory

#	Parameter	Equipment	Manufacturer	Location	Comments
8	PM 2.5	Partisol 2000i	Thermo Scientific	SOB, NCore (4), NPF#3 (2), Floyd Dryden	
1	PM 10	Partisol 2000i	Thermo Scientific	NCore	
2	PM 10	Partisol 2000	Thermo Scientific	Floyd Dryden (2)	
7	PM 2.5	BAM 1020	Met One	NCore, NPF#3, Floyd Dryden, Garden, Parkgate, Palmer, Butte	
1	PM 2.5	Super SASS	Met One	NCore	
1	PM 2.5	3000N	URG	NCore	
6	PM 10	BAM 1020	Met One	NCore, Garden, Parkgate, Laurel, Palmer, Butte	SPM
2	PM 2.5	TEOM/FDMS 1400ab/8500c	Thermo Scientific	Yakutat (2)	Seasonal, winter, multi-year study
2	PM 2.5	TEOM	Thermo Scientific	Ft Yukon, Galena	Seasonally, summer, wildland fire smoke
Not in operation					
10	PM 10	High-volume sampler	Anderson	rural communities	project specific
5	TSP	High-volume sampler	Anderson		project specific
2	PM 10	BAM 1020	Met One	old style, intended for rural projects	not PM2.5 FEM quality

Table 30. Gaseous Equipment inventory

#	Parameter	Equipment	Manufacturer	Location	Comments
			Gaseous		
2	CO	Thermo 48i	Thermo Scientific	NCore, Garden	Ncore year round, Garden, seasonally(Oct-Mar)
1	SO_2	Thermo 43i-TLE	Thermo Scientific	Fairbanks- NCore	
1	NOx	Thermo 42i-TLE	Thermo Scientific	Fairbanks- NCore	
1	NOy	Thermo 42i-Y	Thermo Scientific	Fairbanks- NCore	
2	O_3	Teledyne 403E	Teledyne Model	NCore, Palmer	Year round
3	Relative humidity		Met One	Fairbanks- NCore	
4	Ambient temperature		Met One	Fairbanks- NCore	
1	Wind speed/direction	Windbird+ Vane nanometer	R. M. Young	Fairbanks- NCore	
6	Wind speed/direction	Sonic Anemometer 50.5H	Met One	Fairbanks- NCore, Peger NPF#3	

Data Acquisition and Storage

To keep track of the large datasets that are produced by continuous analyzers, a centralized data logger system and database are necessary. DEC has contracted with DR DAS, the US distributor of Enviteck data acquisition software. DEC now uses the Envista Ultimate software at all the long term sites around the state. (See Figure 15.) The sites report data back to a state owned server, which houses the database. The data acquisition system (DAS) consists of a central database that collects semi-continuous and continuous data from DEC's monitoring sites, an Air Resource Manager (Envista ARM) that allows for Quality Assurance/Quality Control (QA/QC) of the data, and a program that translates that data to XML format for submittal to the EPA's AQS database. The data acquisition system 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. Error and diagnostic checks on gaseous monitors can also be performed remotely and automatically result in reduced travel time to the sites that are away from the DEC offices. With some particulate monitors, like the Thermo Scientific TEOM, DR DAS allows for remote control of the instruments. The Met One BAM, however still requires onsite programming should an error be recorded by the data acquisition system. DEC is transitioning to conducting the bulk of data processing, manipulation, and analysis within the DR DAS system. Particulate FRM data still are handled separately, since some of the QC requirements are not yet accommodated in the DR DAS set-up.

The Envista DAS sends the data to two real-time websites: EPA's AirNow website (https://www.airnow.gov/) and DEC's real-time website (http://dec.alaska.gov/Applications/Air/airtoolsweb/Aq). DEC created its own data warehouse, which regularly copies the DR DAS database, but also houses data and meta data from projects that are not connected to the DR DAS database. DEC designed and developed its own Air Quality Index website. It displays the AQI color codes and levels for all sites and all pollutants connected to the database on one page. The public can access 72 hour time series graphs and site information, like location and site photos. Recently DEC added a query function, which allows individuals to download preliminary, raw data.

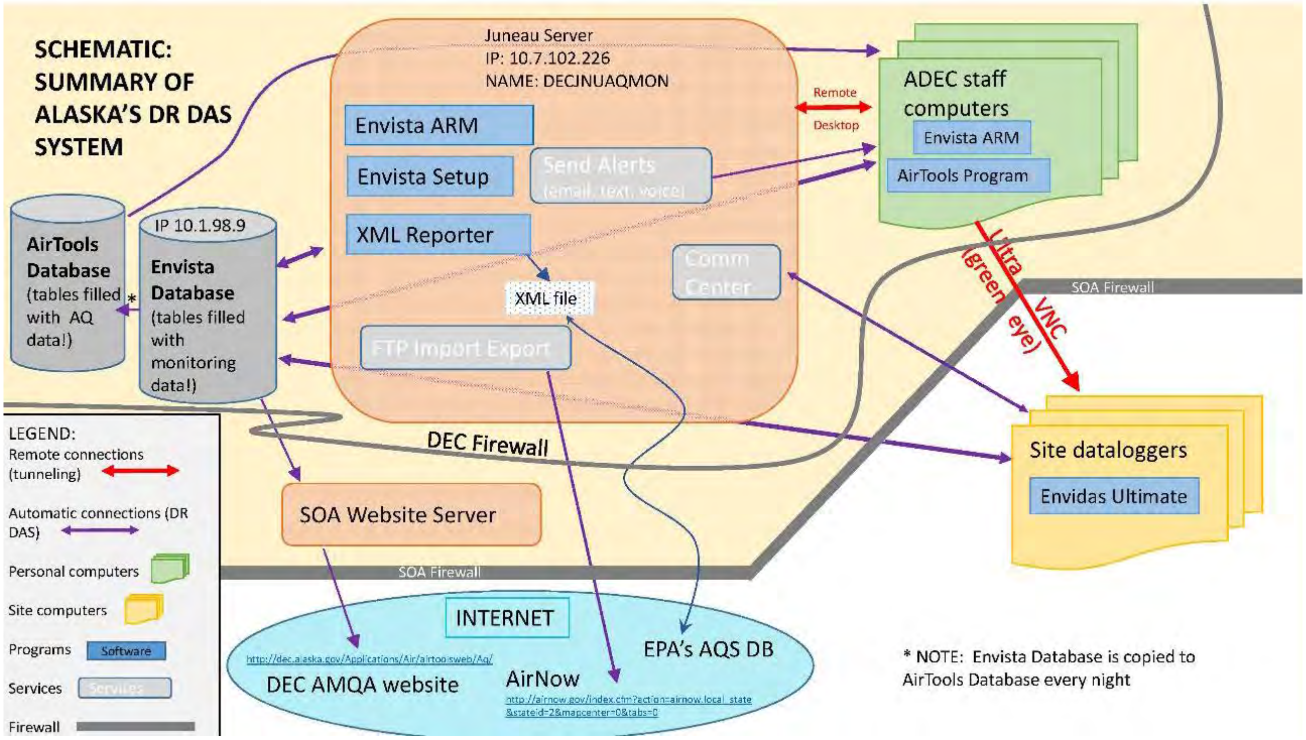

Figure 15. Schematic of Alaska's DAS

PROPOSED NETWORK CHANGES

Most of the DEC's air monitoring activities are focused around population centers and areas that have shown in the past to have air quality problems. The Alaska Department of Labor and Workforce Development projects the highest growth rate within the state to occur in the Mat-Su Borough (12% increase between 2017 and 2022). The Mat-Su Borough population has been the consistently growing over the past several decades. That was the reason DEC enlarged its monitoring network to three monitoring sites in this area in 2010. However, due to budget cuts and reduced staffing, DEC consolidate some of its operations by decommissioning the Wasilla site in March 2015. The Wasilla site had recorded low values for PM_{10} and $PM_{2.5}$. The sites in Palmer ($PM_{2.5}$, PM_{10}, O_3) and the Butte ($PM_{2.5}$, PM_{10}) remain operational and are intended to remain in the monitoring network for the long term. The current statewide ambient monitoring network now consists mostly of only regulatory required sites. Looking ahead, DEC does not expect to be expanding the network significantly during the next 5 years. Below are the specific recommendations:

Potential Network Reductions

PM10

DEC would like to eliminate 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. DEC is proposing to remove the PM_{10} samplers from the Juneau Mendenhall Floyd Dryden site and use the $PM_{2.5}$ concentration measured at the site as a surrogate for PM_{10}. A detailed analysis will be submitted in the 2016 Annual Network Plan.

Ozone

Ozone monitoring is federally required for any CBSA with more than 350,000 residents. In the meteorological summary section we discussed that the concept of a CBSA for the Anchorage, Wasilla and Palmer area does not make sense from an air quality perspective. Due to the complex topography within this CBSA, these communities and even many areas within the Municipality of Anchorage alone experience very different weather on a daily basis. In this regard, there is no single downwind location monitoring location that could be used to monitor secondary formation of ozone. DEC believes that while operating the ozone monitor in Palmer meets the letter of the law, it does not make sense from a scientific standpoint. Ozone concentrations that have been measured in the past at the Garden site in Anchorage, the Parkgate site in Eagle River and the Wasilla site in the Mat-Su Valley have all shown ozone concentrations well below the NAAQS. Indeed, ozone concentrations measured in Denali National Park north of the CBSA 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. DEC believes that valuable staff time and resources could be dedicated to higher priorities if most ozone monitoring were terminated. DEC will continue monitoring at the Palmer site for three consecutive years and then submit a waiver request to EPA to discontinue ozone monitoring in the CBSA. Ozone monitoring will continue at the NCore site in Fairbanks.

New Pollutant Monitoring Needed

At this point DEC does not foresee the need to expand the existing network of long term sites. Due to reduced state and federal funding, DEC has reduced the network to only include regulatory required sites. The only new site DEC anticipates to establish is a Special Purpose Monitoring (SPM) site for $PM_{2.5}$ and PM_{10} in Bethel. DEC will continue as staff and funding allow to conduct special monitoring studies in rural Alaska. Cost and logistics for these short term projects require close coordination with the local tribal and city governments. DEC regularly receives requests to monitor in small communities throughout the state and needs to strike a balance of investigating community complaints with the need to spread monitoring sites into areas not previously covered.

Replace:

Where continuous $PM_{2.5}$ Federal Equivalence Method (FEM) meet the class III performance criteria, DEC will continue to replace existing Federal Reference Method (FRM) sampler with FEM analyzers and update aging FEM monitors. In the Fairbanks non-attainment area, DEC will replace the aging $PM_{2.5}$ FRM monitors with newer models and continue to look for continuous analyzers which perform better in that harsh environment. In the coming years, DEC will have to replace aging gaseous analyzers at the NCore and at the Anchorage Garden CO monitoring sites.

Update:

DEC is looking into adding digital video cameras to all sites reporting to the State's AQI website. As this technology has improved and become more economical, DEC wants to use real time video to assist in diagnosing site issues to determine if instrument responses are due to real localized smoke or dust events or instrument malfunctions.

Emerging Technologies

With the increased public interested in citizen monitoring, DEC may invest and in low cost $PM_{2.5}$ monitors which can be used for special studies or outreach purposes. Due to the harsh winter conditions in the areas of the state that experience poor air quality, additional work is needed to develop suitable applications for these types of equipment or modifications so that the data that are collected are meaningful and comparable.

Air Toxics

Although this monitoring assessment does not address air toxics specifically, it should be noted that a number of air toxic pollutants are of concern. Monitoring data from Anchorage 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.[6] Any air toxics monitoring in the state would require federal funding.

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[6] 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.

Discretionary samplers

Emergency 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 Air Quality staff with assistance from the National Weather Service 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 (MetOne 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.

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 operated by the Alaska Department of Health and Social Services, and the DEC Air Monitoring and Quality Assurance Program operates the sites in Fairbanks and Juneau. After the 2011 Fukushima Dai-Ichi Nuclear Power Plant incident, the question was brought up again whether the existing sites are intended as early warning stations or rather 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. No decision has been reached yet.

FUNDING AND BUDGETARY CONSIDERATIONS

Alaska's Air Monitoring and Quality Assurance Program has a staff of eleven full time positions to cover a large state. Recently the Fairbanks North Star Borough handed back all regulatory monitoring responsibilities and duties to DEC. At the same time the Municipality of Anchorage announced that as of January 1, 2017 all monitoring tasks would revert back to the State. As of 2017, DEC will be responsible for all site operations, data review and analysis, and data submission and reporting for all regulatory ambient monitoring sites in Alaska.

Automation of sampling technologies as well as the use of a data acquisition system have reduced some of the burden on staff resources. However, the increasing number of parameters, data, and meta data required for proper QA/QC shift the focus from site operations to data display, reduction and reporting. The seemingly 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. The relatively level funding from EPA contrasts with the greatly increased workload resulting from online data reporting and analysis, the move from 24 hour averages for PM monitoring to hourly averages, and added gaseous pollutant monitoring. Federally required 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.

Capital Funding Needs

Many of the gaseous instruments in use, listed in Table 30, were purchased in 2011 and 2012. Assuming an average lifetime of about seven years before instruments either become technological obsolete or require extensive maintenance and replacement parts, these samplers will have to be replace within the next two to four years. Transfer standards and calibrators will also have to be replaced within the same timeframe. We expect that the replacement cost for the NCore gaseous analyzers and calibrations equipment will cost in the range of $100,000 to $120,000.

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. However, maintenance is more complex in these locations 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

NCore

The State received capital funding from EPA for the establishment of the NCore site in Fairbanks, but no specific operational funding was provided. In the past few years, DEC has used one time funding to support operation of the NCore site. 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. Therefore DEC has not been able to provide any additional data analysis and reporting outside of data submittal to AQS of the data collected in the Fairbanks North Star Borough non-attainment area. DEC provided limited funding to the FNSB for staff to operate the NCore site, which the FNSB supplemented with other special project funds to cover staff time. Now that DEC had to absorb the NCore site operations and reporting other tasks will have to drop to the bottom of the list.

Due to current budgets and staffing levels, DEC will not be able to conduct any special purpose monitoring in the non-attainment area. Over the past two to three years, DEC has reduced the monitoring network to include only regulatory required monitoring sites. The only exception is the site in Palmer only a few miles from the Butte monitoring site. $PM_{2.5}$ monitoring at the Butte site has shown an increase in winter time 24-hour $PM_{2.5}$ concentration, which are close to violating the NAAQS (2015 design values of 35 µg/m^3). The site in Palmer shows much lower concentrations and is needed to demonstrate the special limit of the higher concentrations in the Butte.

Fiscal Health

Level federal funding 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. Due to budget constraint, DEC had to focus on maintaining the core monitoring site operations and reporting data to AQS, at the cost of providing more extensive data analysis, reduction and reporting for public consumption. Any additional special studies, special projects, or emergency monitoring for wildfires or volcanic eruptions have been put aside in recent years due to limited staff , funding or both. Staff do not have time to keep up with new emerging technology like low cost monitors or hand held sensors, even though the public consistently expresses an interest in using and comping these technologies to data collected at the regulatory monitoring sites.

Summary

Alaska's air monitoring network is faced with higher costs than encountered in most other locations nationwide as a result 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 infrastructure. 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 DEC 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 effects 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 an 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. The fast growing sector of new and cheaper monitoring technology that supports a ‘citizen scientist’ movement will require states to spend time communicating challenges of the new technology and will divert staff time from the grant required tasks.

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.

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Appendix A: EPA Lead Monitoring Waiver

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

AUG 11 2016

OFFICE OF
AIR AND WASTE

Ms. Denise Koch
Director, Division of Air Quality
Alaska Department of Environmental Conservation
410 Willoughby Avenue, Suite 303
Juneau, Alaska 99811-1800

Dear Ms. Koch:

In your letter dated April 14, 2016, Alaska Department of Environmental Conservation requested a waiver of the lead monitoring requirements at the Red Dog Mine based on the results of dispersion modeling conducted by your staff. The Red Dog Mine is a source of lead emissions exceeding 0.5 tons/year which requires lead monitoring as specified in 40 C.F.R. Part 58, Appendix D, section 4.5(a).

According to 40 C.F.R. Part 58, Appendix D, section 4.5(a)(ii), the Regional Administrator may waive the requirement for lead source monitoring if the state can demonstrate that the source will not contribute to a maximum lead concentration in ambient air in excess of 50 percent of the lead National Ambient Air Quality Standards (NAAQS). The modeling approach and protocol for the Red Dog Mine conducted by ADEC were consistent with the EPA's guidance, and were approved by the EPA. The results of this modeling demonstrates that the maximum ambient air 3-month rolling average lead concentration at the mine does not exceed 50 percent of the lead NAAQS. This satisfies the requirement of remaining below 50 percent of the NAAQS and, therefore, I approve a waiver for lead monitoring at the Red Dog Mine.

The approval and existence of this lead source-monitoring waiver for the Red Dog Mine should be identified in the next Alaska Annual Ambient Air Monitoring Network Plan submitted to the EPA, after public review and comment, and shall be identified in all future Alaska Annual Ambient Air Monitoring Network Plans and the Alaska 5-year Air Monitoring Network Assessment Reports submitted to the EPA.

Pursuant to 40 C.F.R. Part 58, Appendix D, section 4.5(a)(ii), this waiver must be renewed every 5 years as part of the Alaska 5-year Air Monitoring Network Assessment. Therefore, if ADEC elects to renew the lead source-monitoring waiver, a formal written request for renewal must be submitted to EPA 120 days prior to the expiration of this waiver. The formal request to renew the lead source-monitoring waiver must demonstrate that the site conditions for which the previous modeling was conducted are still appropriate. If site conditions have changed such that the previous modeling is no longer appropriate, then ADEC must update the modeling based on the current conditions.

If you have any questions on this subject, please have your staff contact Mr. Keith Rose at (206) 553-1949 or rose.keith@epa.gov.

Sincerely,

Timothy B. Hamlin
Director

cc: Ms. Barbara Trost
ADEC

Ms. Deanna Huff
ADEC