

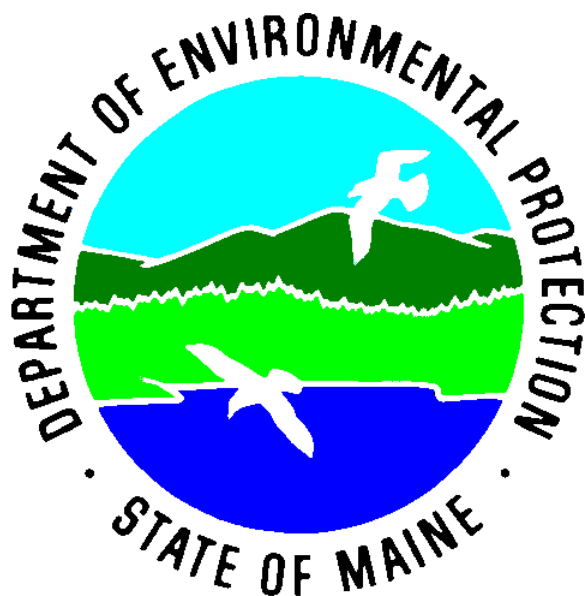
# MAINE STATE LEGISLATURE

The following document is provided by the  
**LAW AND LEGISLATIVE DIGITAL LIBRARY**  
at the Maine State Law and Legislative Reference Library  
<http://legislature.maine.gov/lawlib>



Reproduced from electronic originals  
(may include minor formatting differences from printed original)

# **FIVE YEAR ASSESSMENT OF AMBIENT AIR MONITORING NETWORK**



**MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION  
BUREAU OF AIR QUALITY**

**September 23, 2010**

## **Table of Contents**

Table of Contents .....	2
EXECUTIVE SUMMARY .....	3
OVERALL OBJECTIVES .....	3
BACKGROUND AND OVERVIEW .....	4
POPULATION ANALYSIS.....	6
<i>Health Data</i> .....	7
<i>Asthma</i> .....	9
<i>Heart Attacks</i> .....	9
<i>Low Birth Weights</i> .....	10
MOBILE SOURCE DISCUSSION.....	10
EMISSIONS INVENTORY SUMMARY .....	10
NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS).....	14
POLLUTANT BASED REVIEW/ANALYSES .....	17
Ozone .....	17
<i>Health Effects</i> .....	18
<i>Environmental Effects</i> .....	18
Ozone and PAMS Monitoring Networks.....	19
<i>Ozone Network</i> .....	19
<i>PAMS Monitoring Network</i> .....	21
<i>Future Ozone and PAMS Networks</i> .....	21
Particle Pollution.....	22
<i>Health Effects</i> .....	22
<i>Environmental Effects</i> .....	22
<i>Visibility reduction</i> .....	23
<i>Environmental damage</i> .....	23
<i>Aesthetic damage</i> .....	23
PM <sub>10</sub> , PM <sub>2.5</sub> and Visibility/Speciation Monitoring Networks .....	23
<i>PM<sub>2.5</sub> Network</i> .....	23
PM <sub>10</sub> Network .....	26
Visibility/Speciation Monitoring Network .....	27
PM COARSE.....	28
Lead.....	29
Air Toxics .....	29
Sulfur Dioxide.....	34
Nitrogen Dioxide .....	35
Carbon Monoxide .....	37
Atmospheric Deposition Monitoring .....	37
<i>Background</i> .....	37
<i>History</i> .....	38
<i>Trends:</i> .....	41
<i>Future Monitoring Plans:</i> .....	47
METEOROLOGICAL MONITORING.....	49
MONITORING EQUIPMENT.....	50
QUALITY ASSURANCE.....	51

# **Five Year Network Assessment for the State of Maine**

## **September 23, 2010**

### ***EXECUTIVE SUMMARY***

The Department is pleased to provide a comprehensive review of the ambient air monitoring network operated by the Bureau of Air Quality. Staff of the Bureau has reviewed data from around the state including population statistics, health data, present and past air quality data, inventory information and traffic patterns. The Bureau of Health has provided data and participated in the review. The review has concluded that ozone has been and remains one of the top pollutants impacting the citizens of Maine. In addition, staff has been focusing more on air toxics in recent years and has been gathering data that will allow the state to make more informed decisions on the need and appropriateness of additional controls for those toxics that cause the greatest health risks. Maine will continue to work with other federal and state agencies, tribal governments and industry to ensure that the air quality in the State of Maine will meet national and state standards for all the citizens of Maine.

### ***OVERALL OBJECTIVES***

The State is required to 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 of CFR 58.10, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and where new technologies are appropriate for incorporation in the ambient air monitoring network. The network assessment will 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 PM<sub>2.5</sub>, the assessment will also identify any needed changes to population-oriented sites. The State agency will 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. The assessment should provide a description of the networks and the relative value of each monitor and station. The [annual monitoring network plan](#) will provide for the actual proposed changes to the networks that are consistent with the findings of the five year assessment. The network assessment will cover the National Ambient Air Quality Standards (NAAQS), air toxics and meteorological monitoring networks designed to support the ambient air monitoring program. As part of the assessment this report will

look at population data, traffic changes, emissions inventory data and the current and proposed air quality standards.

## **BACKGROUND AND OVERVIEW**

Maine makes up over half the geographic area of Region I and has always faced unique challenges for determining air quality and pollution impacts. The population centers are primarily along the coast in the south and south central area and that is where most of the air monitoring has taken place. Maine's northeast location in the continental United States makes it particularly vulnerable to pollution generated elsewhere along the eastern sea-board and central U.S as well as eastern Canada. Maine emits a relatively small amount of air pollution in comparison to the states located upwind and with controls installed on Maine sources since the 1970 Clean Air Act, and aggressive adoption of air emission regulations, much of the concern is now with transport from the upwind states. Maine based emissions that continue to cause concern include air toxics from local sources including mobile sources and emissions from numerous small heating sources burning wood and wood chips/pellets. PM from mineral/concrete/asphalt manufacturing and traffic related fugitive PM continues to be a periodic problem. Haze impact on Maine's Class I areas from Maine sources is also a concern.

Transport is a very large portion of Maine's air pollution and assessment of that transport is extremely complicated. Most of the higher concentrations caused by transport enter southern Maine after crossing the Gulf of Maine. Ozone transport at lower elevation from the S and SW travels over the ocean where the pollutants and precursors undergo reactions and stratification quite unlike overland transport and are subject to land/sea winds that are inconsistent with overland air flow. Models do a poor job of predicting the concentrations or the locations of the impacts once they enter the Gulf. Early EPA models were highly inaccurate and assumed emissions and chemical reactions over the ocean were similar to those over the land. It was not until Maine placed a monitor on board the Scotia Prince, a ferry that made 24-hour round trips between Portland, ME and Yarmouth, N.S., did EPA realize the models were not acceptable for predicting impacts on Maine's coastline. The study identified multiple plumes that were just offshore and capable of causing violations when they turned inland with wind changes. Often the winds will parallel the coast line and cause violations at some sites and completely skip over other sites that are in direct line with each other. Models used in 2009 still could not properly predict Maine's concentrations and monitors were the only certain means to assess standards and trends and allow forecasts for unhealthy air. Often ozone concentrations along Maine's coast are the highest in Region I. Along with the transport of ozone and its precursors are the many other pollutants associated with emission sources found within that air shed including air toxics, pollutants causing acid and heavy metals deposition, sulfates, nitrates, and PM.

Transport is also common in the air from the W and SW that enters Maine's western border with New Hampshire and with the Province of Quebec. Ozone monitoring in this area is very limited with some coverage from the line of inland sites set back from the coast to determine how far in the coastal problem extends. The Lovell site was

instrumental in disproving earlier EPA models that showed the ozone plume going up along Maine's western border. The extreme SW portion of Maine was earlier covered by a New Hampshire site used to monitor the Rochester/Durham urban and traffic area impacts. When that site was discontinued Maine was concerned and placed an ozone monitor in Shapleigh, Maine where the Rochester/Durham and transport impacts could be better measured and the reaction time of the plume would cause higher values. An exceedence of the expected 70 ppm standard was measured on May 2, 2010. With the new lower ozone standard, the existing coastal sites and the line of monitors set inland need to be augmented with additional monitors even further inland to determine how far the problem goes. The high population center of Auburn/Lewiston was considered covered by the Gardiner site, but recent high values in the Durham area raise doubt about what could be reaching Auburn/Lewiston at the new standard level.

Transport further up the western border has not been evaluated; however, measurements on Mount Washington in New Hampshire and in Province of Quebec show exceedences of the expected 70 ppm standard close to Maine and similar values can be expected to impact Maine; especially at higher elevations. Although the area is of low population density, people do live in and frequent those areas for work and recreation purposes and there is concern for the standards in the higher elevations in western Maine and along the Longfellow Mountain chain. Again, Maine makes up more than half of the geographic area of Region I and there are many areas where standards could be violated or the moderate level reached with no warning available to the more susceptible population.

Transport of PM in the upper atmosphere is also of concern to Maine. Forest fires in western Quebec and Ontario Provinces often impact Maine, coming from NW and N winds and in very narrow bands across the state and impacting with an obvious ground level haze and odor. Maine has one of the highest adult asthma prevalences in the US and particulate monitors that provide data to forecasters help warn susceptible citizens of these unexpected unhealthy occurrences.

Transport into northern Maine from the Montreal/Quebec corridor is a problem that is not very well documented. Arsenic from Ontario smelters was measured in the 1980s, in the Presque Isle area, probably from the continuation of the plumes documented in northern Vermont around the same time. New monitoring for mercury in Caribou started in 2006 after water quality studies showed high levels of mercury in northeastern Maine; the monitoring will further evaluate possible mercury and metals transport and deposition from that corridor. Heavy metals are known to be in Maine soils and vegetation and at different concentrations depending on where in Maine the sample is taken. This raises questions that need answers as to what is naturally occurring, what is from earlier deposition, and what is still being deposited. An example of heavy metal concern is differing cadmium concentrations found in moose and deer liver throughout the state rendering those organs in some areas unhealthy to eat although they are still consumed by many people.

Transport of air toxics is well documented by two PAMS sites and the trends from these sites help track the results of new control strategies in upwind states. The Cape Elizabeth

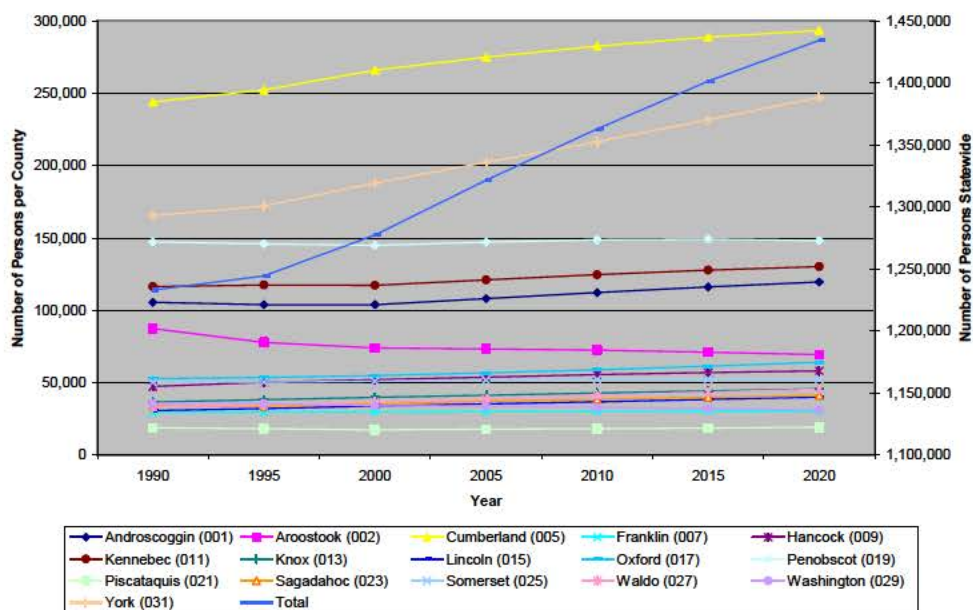


site measures the Boston plume and plumes associated with typical SW ozone episodes. The Cadillac Mountain site is impacted by several different plumes that turn in from the Gulf of Maine or are associated with high elevation transport; of special concern are the high ozone concentrations that continue to keep the area in nonattainment and are expected to do so for many more years. The more stringent ozone standard to be in place in 2010 will be much more difficult to resolve making this PAMS location even more critical for determining where the ozone and precursors originated, what compounds are involved, and what additional controls are needed. The new standard involves concentrations considerably below what the original PAMS system was designed to resolve and raises the question of what compounds should now be measured when taking into account controls that have been phased in over the last 25 years and the significance that other compounds, including biogenic ones, now have on these lower concentrations.

## POPULATION ANALYSIS

In order to look at the impact of air quality on populations around the state this report looks at the historical changes in population and the projected future changes. Figure 1

Figure 1: State of Maine and County Population Changes and Projections



depicts the total population in the state and the breakdown by County since 1990. While Cumberland and York Counties in southern Maine have experienced considerable growth over the last twenty years the rest of the state experienced relatively flat growth with the exception of Aroostook County which has shown a fairly steady decline in population. Overall the state has shown a 10.5% increase in population over the last 20 years with a gain of about 130,000. Nearly 90,000 of that gain has been in York and Cumberland Counties. The more susceptible populations such as the young (age 19 and younger) and the elderly (age 65 and older) have shown different changes as depicted in Figures 2 and 3. Young children are included in the sensitive groups because on a per-body-weight basis they tend to inhale relatively more air than adults. Their elevated metabolic rate and

young immune systems make them more susceptible to air pollution. The elderly also are more likely to be affected by air pollution, due to generally weaker lungs, heart and immune systems, or undiagnosed respiratory or cardiovascular health conditions. The population of young in the state has decreased over the last 20 years and the trend is not expected to change significantly in the future. Cumberland and York Counties showed a slight growth in the young from 1990 to 2000 but all counties in the state have shown a decrease since 2000. The elderly population in the state has been steadily increasing and that trend is expected to continue as the present population ages and more retirees choose to live in Maine.

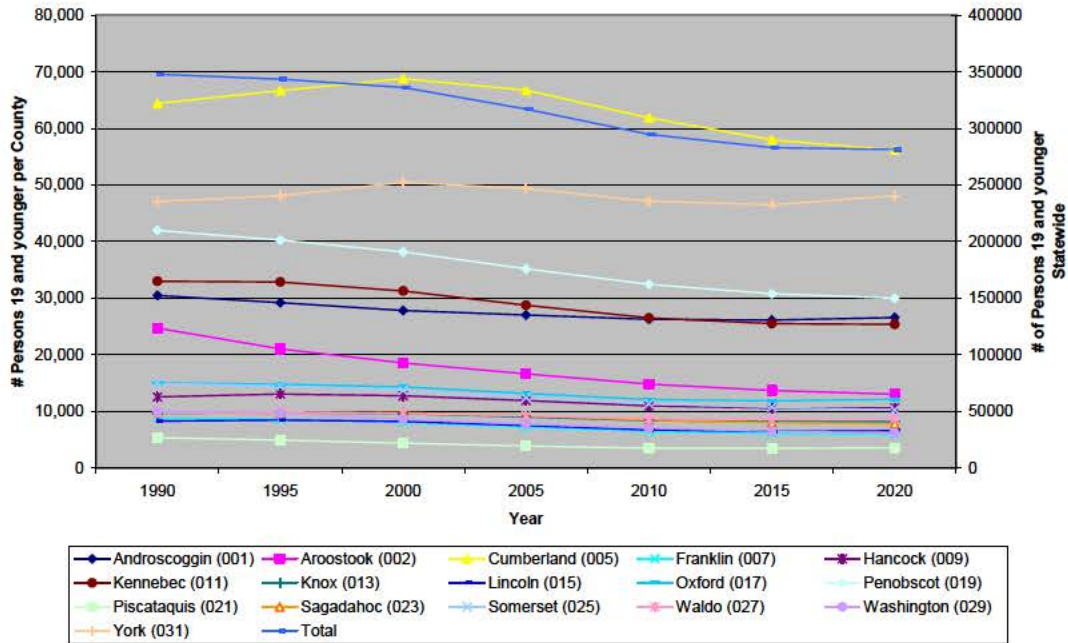
### ***Health Data***

There are several public health problems that have been at least partially linked to air pollution. Any individuals with chronic cardiovascular or lung health problems may be impacted by high levels of air pollution. Even healthy individuals need to be aware that they too can be affected and should adjust their activity accordingly.

This report emphasized three particular health conditions that have been linked to air pollution. Asthma has been studied extensively and there are a lot of data that can be analyzed. Myocardial infarctions or heart attack statistics have also been compiled and can be reviewed for possible links to air pollution. More recently birth weights have been reviewed for possible links to air pollution. Data indicating the prevalence of these health problems in Maine are summarized in Table 1. Cancer prevalence may also be linked to air pollution. About 20 chemicals found in the environment, including arsenic, asbestos, benzene, cadmium, chromium, radon, and vinyl chloride, have been identified as known human carcinogens by national and international agencies. Many additional chemicals have been identified as being potential human carcinogens. The cancer burden posed by specific environmental carcinogens (aside from occupational exposure) has not been well defined. Despite the fact that the contribution of environmental carcinogens to the cancer burden is not as well understood as some of the other major causes of cancer, such as tobacco use, preventive measures should be initiated. Such measures are largely based on what is known at the present and include the reduction of exposure to hazardous chemicals in the workplace and the reduction of environmental pollution. Should any “cancer clusters” be identified by the Maine CDC that could possibly be linked to air pollution, additional monitoring may be needed.



**Figure 2: State of Maine and County Population Changes and Projections  
Ages 19 Years and Younger**



**Figure 3: State of Maine and County Population Changes and Projections  
Ages 65 years and Older**

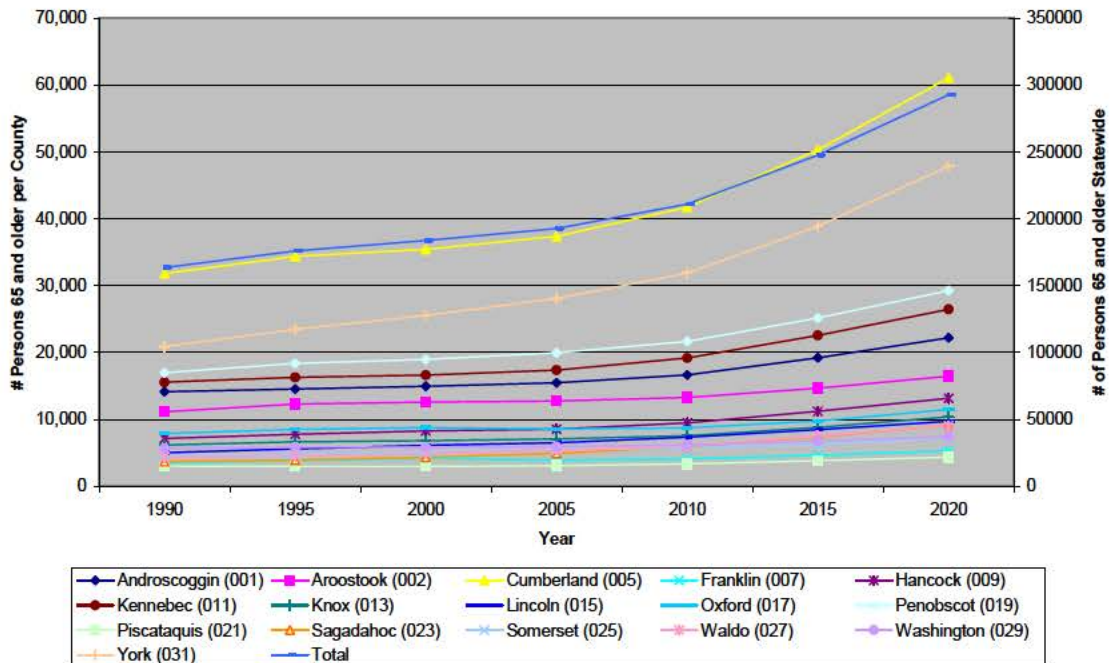


Table 1: At Risk Population Statistics by County

	Heart Attack Hospitalizations, age adjusted rate per 10,000 (2008)	Asthma Hospitalizations (per 10,000) 2002-2006 combined	Asthma Emergency Department Visits, age-adjusted rate per 10,000 [2007]	Adults with Asthma, percent [2008]	Low Birth Weight % <2500 grams, percent of live births (2008)	0-19 YRS (2010 estimate)	% of County Population	65 YRS and older (2010 estimate)	% of County Population
Androscoggin	22.4	11.0	76	11.6	7.0	26,277	23.4	16,647	14.8
Aroostook	46.1	11.2	92.5	10.6	5.9	14,838	20.5	13,263	18.3
Cumberland	16.2	6.4	52.5	9.3	6.8	61,865	21.9	41,720	14.8
Franklin	22.4	9.1	11.6	11.6	7.0	6,452	21.4	4,144	13.8
Hancock	38.1	9.2	73.3	10.3	5.7	10,952	19.8	9,480	17.1
Kennebec	32.9	7.5	88.8	11.3	6.0	26,527	21.3	19,201	15.4
Knox	23	8.8	57.5	7.6	6.6	8,389	19.7	7,577	17.8
Lincoln	23	8.7	57.5	7.6	6.6	6,736	18.4	7,368	20.1
Oxford	22.4	6.4	76	11.6	7.0	12,087	20.6	8,746	14.9
Penobscot	33.2	12.6	60.1	12.6	7.4	32,455	21.8	21,662	14.6
Piscataquis	33.2	6.1	60.1	12	7.4	3,474	19.3	3,334	18.5
Sagadahoc	23	9.6	57.5	6	6.6	8,460	22.0	5,928	15.4
Somerset	32.9	10.3	88.8	11.3	6.0	11,354	21.8	5,697	10.9
Waldo	23	10.9	57.5	7.6	6.6	8,747	21.3	6,039	14.7
Washington	38.1	12.7	73.3	10.3	5.7	7,035	21.4	6,172	18.8
York	22	6.8	53.3	9.4	7.4	47,174	21.8	31,898	14.7
Maine	26.3	8.8	65.9	10.3	6.7	292,823	21.5	208,877	15.3
New England				9.7	7.5				
US				8.8	8.2				

Heart Attack Data: 2008, Maine Health Data Organization (MHDO) provided the data

Asthma Data: 2002-2006, Maine Health Data Organization (MHDO) provided the data.

Low Birth Weight rate data: 2008; The Office of Data, Research, and Vital Statistics (ODRVS), Maine DHHS provided the data.

Population data provided by the Maine State Planning Office, from US Census Data.

New England asthma rate from Living with Asthma in New England - Asthma Regional Council of New England, February, 2010

## Asthma

Asthma continues to be a serious public health problem. The prevalence of asthma has increased significantly since the 1980's. Research by EPA and others has shown that ozone and particle pollution can cause or contribute to asthma attacks. Current asthma rates in New England are significantly higher than elsewhere in the US and Maine has consistently been found to have one of the highest asthma prevalences in New England. Data from 2008 indicates over 10 percent of adults in Maine have asthma with individual counties ranging from a low of 6 percent in Sagadahoc County to a high of 12.6 percent in Penobscot County. There are a variety of factors that can contribute to the high rates such as gender, age, race/ethnicity, income, education level, marital status, weight, and smoking. Consequently, as we look towards the future it will be important to maintain an adequate network of ozone and particulate monitors around the state to be able to provide data that can lead to accurate forecasts of air quality. Those with asthma can then limit their activity during periods when high levels of ozone and/or particulates are forecast and hopefully prevent an attack.

## Heart Attacks

Heart disease is still the leading cause of death in the United States. People with heart disease can be affected by increased levels of air pollution. Particle pollution or ozone can cause serious problems in a short period of time and can lead to heart attacks with no warning signs. In Maine, Aroostook, Washington and Hancock counties have a higher than average rate of heart attacks even after adjusting for the older population present in those counties. There are a variety of factors that contribute to higher rates of heart attacks and while there has been demonstrated links between elevated air pollution and

increased heart attack rates there is no specific data that establishes that link in those three counties.

### ***Low Birth Weights***

A body of evidence is emerging from several countries on the adverse consequences of ambient air pollution on fetal/birth outcomes, including preterm birth and fetal growth restriction.<sup>1</sup> The percent of low birth weight rates in Maine is lower than the New England rate which is lower than the national average. Additional factors also influence the birth weights so establishing a link in Maine may be very difficult.

### ***Chronic Health Problems***

Although not identified as a specific susceptible population any individuals with chronic health problems may be impacted by high levels of air pollution and even healthy individuals need to be aware that they too can be affected and should adjust their activity accordingly.

## ***MOBILE SOURCE DISCUSSION***

Most of Maine is rural and traffic is relatively light. Only a few locations in the state have annual average daily traffic counts that exceed 50,000 vehicles. The Maine Turnpike and a few of the more heavily traveled roads in the Portland area have the most traffic. The volume of traffic has changed very little over the last ten years. The majority of roads including those in most of the larger cities in Maine have increases of less than 2 percent. One factor that could lead to increased air pollution impacts is the amount of congestion or traffic slow down on a road where the volume is beginning to exceed the capacity of the road. Data from the Maine DOT does not appear to indicate any significant congestion in Cumberland County where traffic volume would be most likely to cause an impact.

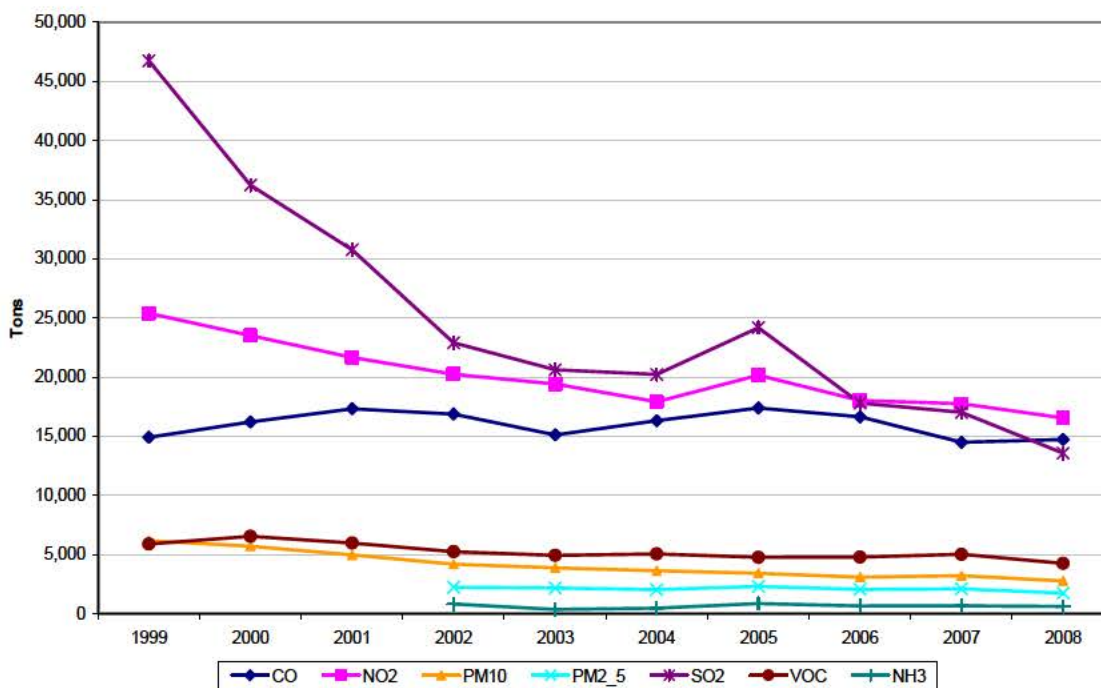
## ***EMISSIONS INVENTORY SUMMARY***

Since 1993, the Department has required facilities (“point sources”) with emissions above certain thresholds to annually report their emissions of criteria air pollutants (Figure 4), and to triennially report their emissions of hazardous air pollutants (HAPs). The largest point sources of emissions in Maine are the paper products industry and electric power producers, although several large contributors have reduced or ceased operations in the last several years.

---

<sup>1</sup> DQ Rich, et al, 2009, “Ambient air pollutant concentrations during pregnancy and the risk of fetal growth restriction,” [Journal of Epidemiology and Community Health](#), Vol. 63, pp. 488-496

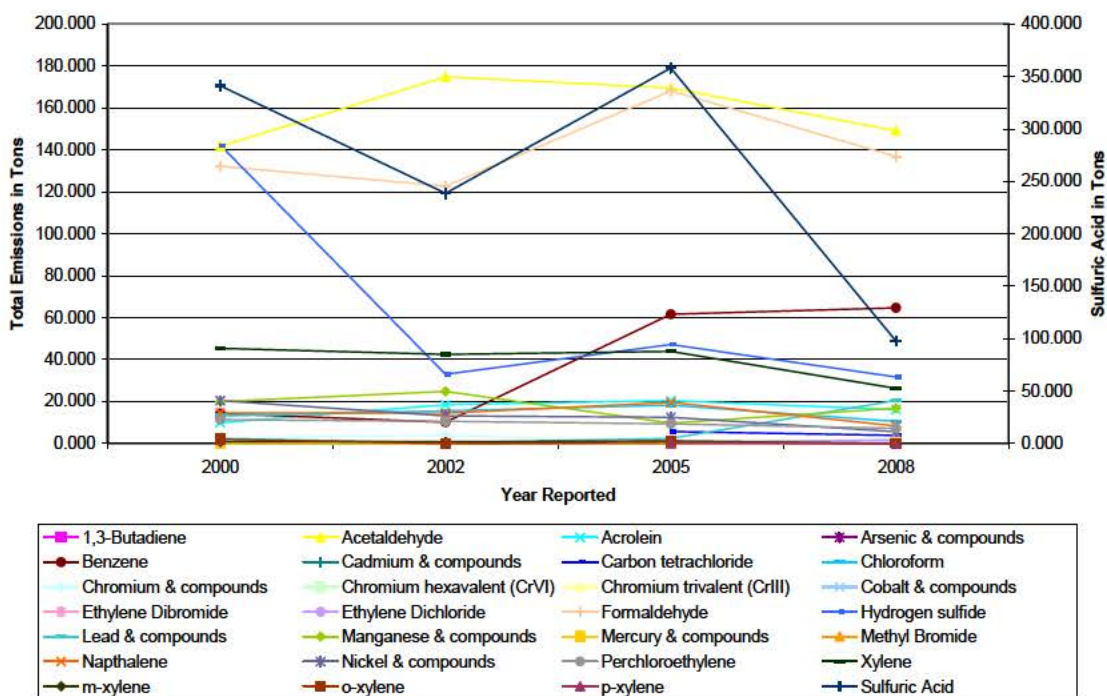
Figure 4: Maine Point Source Emissions



The list of more than 700 reportable HAPs has changed over the years, as well as facilities' methods for estimating their emissions, making it very difficult to assess long-term trends. Figure 5 illustrates 2000, 2002, 2005 and 2008 reported emissions by point sources for 23 of the HAPs on the Maine Air Toxics Initiative's Air Toxics Priority List.



Figure 5: Reported Point Source Emissions of HAPS

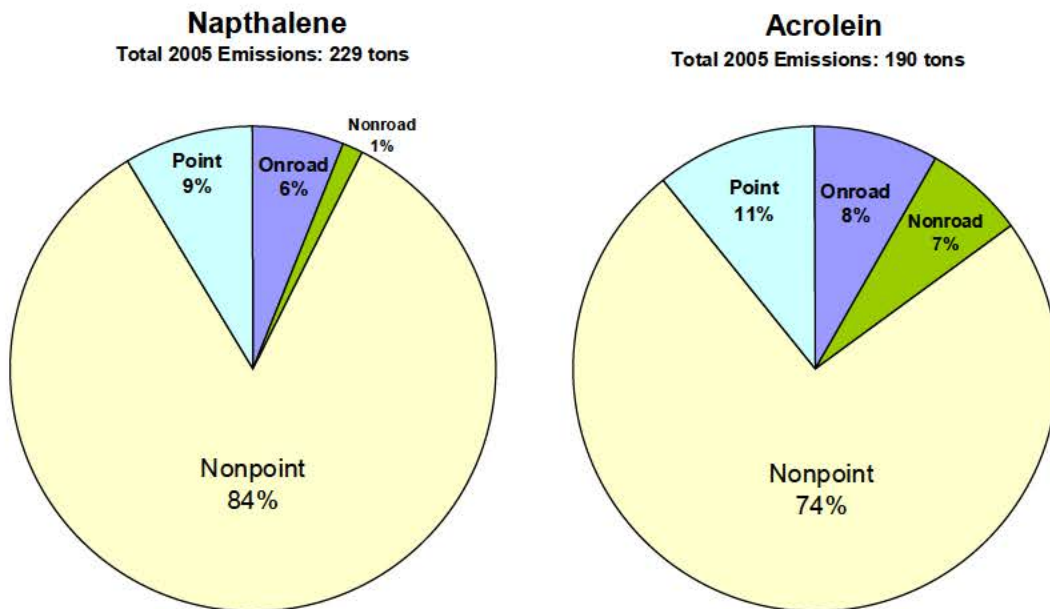


In 2003, the Department began requiring facilities to also report emissions of six greenhouse gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Facilities reported 21,276,016 short tons (19.3 million metric tons) of carbon dioxide equivalent emissions for 2008; 10,143,805 tons from biomass. Facilities also reported almost 7,000 tons of methane and over 800 tons of nitrous oxide. The Department publishes reported estimates of point source greenhouse gas emissions for 2003 through 2007 on our [“How Do I Find Out About Air Emissions Near My Home” website](#).

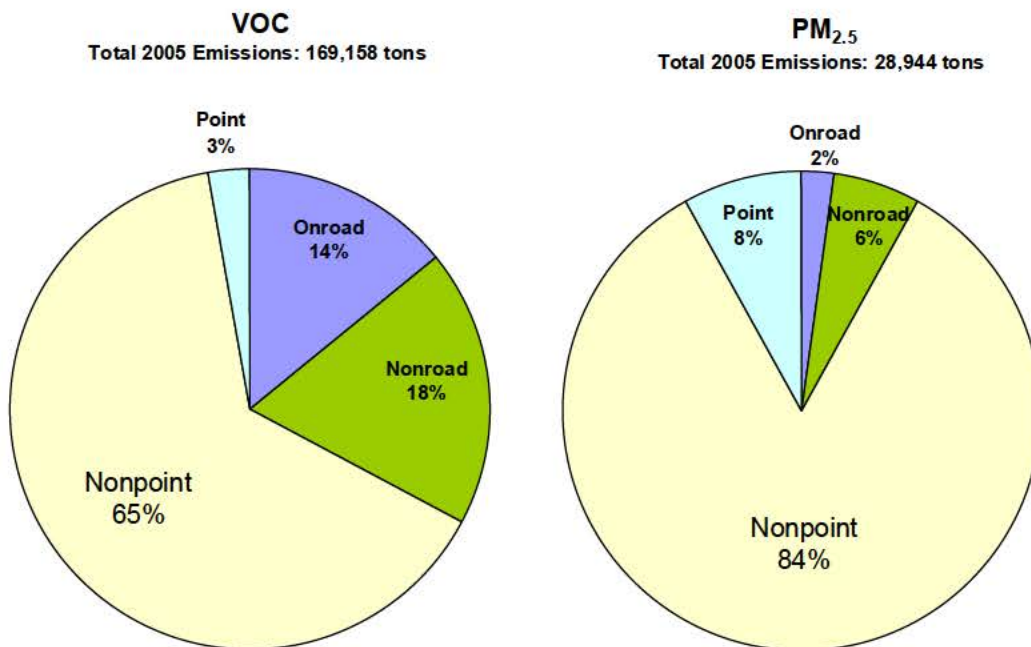
The Department also complies with the Consolidated Emissions Reporting Rule and Air Emissions Reporting Requirements under 40 CFR Part 51 by submitting a comprehensive inventory for point, nonpoint, and mobile sources to EPA for inclusion in the National Emissions Inventory (NEI) every three years. Maine’s comprehensive inventory includes criteria and hazardous air pollutants, and some greenhouse gas (GHG) estimates. Maine plans to incorporate estimates of GHGs for all source categories in future NEI cycles.

Evaluating trends between NEI datasets is also difficult due to changes in estimation methods, compound grouping and reported source classifications. Maine’s comprehensive triennial inventories for 2002 and 2005 as augmented by EPA are available at [EPA’s Emission Inventories website](#). Figures 6 and 7 illustrate the relative contribution of the major source categories to overall emissions of selected pollutants.

**Figure 6: Origin of Source Emissions for Two HAPs in Maine**



**Figure 7: Origin of Source Emissions for Two Criteria Air Pollutants in Maine**

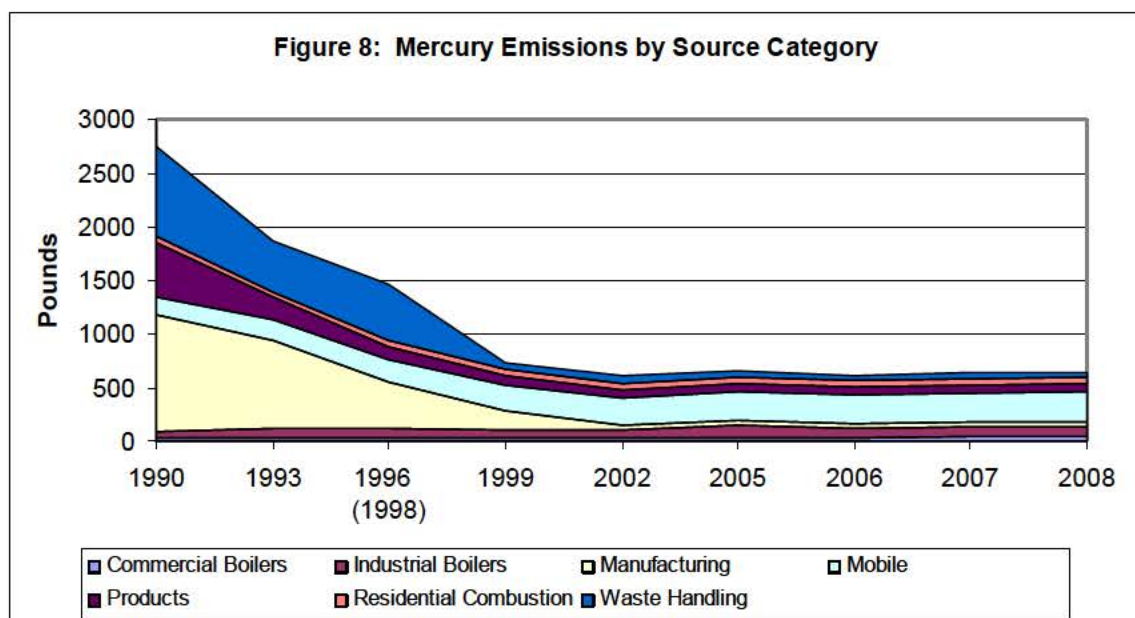


Nonpoint sources are those that are not required to report their emissions and include sources such as gas stations, residential wood stoves and dry cleaners. The Department is currently reviewing estimates of 2008 emissions submitted to the NEI. In general,



estimated emissions of all criteria pollutants increased from 2002 to 2005, and initial estimates show a decrease from 2005 to 2008.

Maine also maintains a separate inventory of mercury emission sources. Figure 8 illustrates Maine's estimated mercury emissions from 1990 through 2008 by source. The major sources of emissions of mercury have shifted from the manufacturing and waste handling sectors in the 1990s to mobile sources in recent years. The Department estimates mercury emissions in Maine have declined more than 75% since 1990. Despite these reductions, Maine's waters do not meet federal standards and development of a total maximum daily load (TMDL) revealed that long-range transport of mercury emissions from upwind states has contributed significantly to mercury deposition in Maine.



## ***NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)***

The [Clean Air Act](#), which was last amended in 1990, requires EPA to set [National Ambient Air Quality Standards](#) (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act established two types of national air quality standards. **Primary standards** set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. **Secondary standards** set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The EPA Office of Air Quality Planning and Standards (OAQPS) has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria"

pollutants. They are listed in Table 2. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, milligrams per cubic meter of air (mg/m<sup>3</sup>), and micrograms per cubic meter of air (µg/m<sup>3</sup>).

**Table 2: National Ambient Air Quality Standards**

	Primary Standards		Secondary Standards	
Pollutant	Level	Averaging Time	Level	Averaging Time
<a href="#">Carbon Monoxide</a>	9 ppm (10 mg/m <sup>3</sup> )	8-hour <a href="#">(1)</a>	None	
	35 ppm (40 mg/m <sup>3</sup> )	1-hour <a href="#">(1)</a>		
<a href="#">Lead</a>	0.15 µg/m <sup>3</sup> <a href="#">(2)</a>	Rolling 3-Month Average	Same as Primary	
	1.5 µg/m <sup>3</sup>	Quarterly Average	Same as Primary	
<a href="#">Nitrogen Dioxide</a>	0.053 ppm (100 µg/m <sup>3</sup> )	Annual (Arithmetic Mean)	Same as Primary	
	0.100 ppm	1-hour <a href="#">(3)</a>	None	
<a href="#">Particulate Matter (PM<sub>10</sub>)</a>	150 µg/m <sup>3</sup>	24-hour <a href="#">(4)</a>	Same as Primary	
<a href="#">Particulate Matter (PM<sub>2.5</sub>)</a>	15.0 µg/m <sup>3</sup>	Annual <a href="#">(5)</a> (Arithmetic Mean)	Same as Primary	
	35 µg/m <sup>3</sup>	24-hour <a href="#">(6)</a>	Same as Primary	
<a href="#">Ozone</a>	0.075 ppm (2008 std)	8-hour <a href="#">(7)</a>	Same as Primary	
	0.08 ppm (1997 std)	8-hour <a href="#">(8)</a>	Same as Primary	
	0.12 ppm	1-hour <a href="#">(9)</a>	Same as Primary	
<a href="#">Sulfur Dioxide</a>	0.03 ppm	Annual <a href="#">(10)</a> (Arithmetic Mean)	0.5 ppm (1300 µg/m <sup>3</sup> )	3-hour <a href="#">(1)</a>
	0.14 ppm	24-hour <a href="#">(1)(10)</a>		
	75 ppb	1-hour <a href="#">(11)</a>	None	

<sup>(1)</sup> Not to be exceeded more than once per year.

<sup>(2)</sup> Final rule signed October 15, 2008.

<sup>(3)</sup> To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010).

<sup>(4)</sup> Not to be exceeded more than once per year on average over 3 years.

<sup>(5)</sup> To attain this standard, the 3-year average of the weighted annual mean PM<sub>2.5</sub> concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m<sup>3</sup>.

<sup>(6)</sup> To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m<sup>3</sup> (effective December 17, 2006).

<sup>(7)</sup> To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (effective May 27, 2008)

<sup>(8)</sup> (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.

(c) EPA is in the process of reconsidering these standards (set in March 2008).



<sup>(9)</sup> (a) EPA revoked the [1-hour ozone standard](#) in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").

(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is  $\leq 1$ .

<sup>(10)</sup> (a) The [annual](#) and 24-hour standards will remain in effect for one year following the effective date of the initial designations for the new 1-hour standard before they are revoked in most attainment areas.

(b) The [annual](#) and 24-hour standards will remain in place for any current nonattainment area, or any area for which a State has not fulfilled the requirements of a SIP call, until the affected area submits, and EPA approves, a SIP with an attainment, implementation, maintenance and enforcement SIP which fully addresses the attainment and maintenance requirements of the new 1-hour standard ("anti-backsliding").

<sup>(11)</sup> To attain this standard the 3-year average of the 99<sup>th</sup> percentile of the annual distribution of daily maximum 1-hour average concentrations shall not exceed 75 ppb.

A number of the NAAQS are currently under review and a number of changes have been proposed for both the level of the standard and the form of the standard as well as requiring a certain level of monitoring in each state for several of the pollutants. Where applicable those changes will be discussed in the individual pollutant review sections. Historically, Maine had adopted their own standards for pollutants. In some cases those standards were identical to the national standards and in others Maine chose to adopt stricter standards to provide an additional level of protection. With all the changes that have occurred in national standards for ozone and particulates Maine revised their statutes to indicate that the Maine standards for those two pollutants would refer to the NAAQS. With some of the other proposed changes in NAAQS Maine will need to review the existing statutes and make changes where appropriate. Standards for chromium, perchloroethylene and toluene were adopted prior to establishment of Maximum Achievable Control Technology standards, and the Department plans to propose removal of these outdated standards. The present state standards are listed in [Table 3](#).

**Table 3: State of Maine Ambient Air Quality Standards**

POLLUTANT	AVERAGING TIME	CONCENTRATION
Particulates	Refer to NAAQS for all particulate standards	
Lead (Pb)	Twenty-Four Hour <sup>1</sup>	1.5 ug/m <sup>3</sup>
Carbon Monoxide (CO)	One Hour <sup>1</sup>	35 ppm (40 mg/m <sup>3</sup> )
	Eight Hour <sup>1</sup>	9 ppm (10 mg/m <sup>3</sup> )
Ozone (O3)	Refer to NAAQS for ozone standard	
Nitrogen Dioxide (NO2)	Annual Arithmetic Mean	.053 ppm (100 ug/m <sup>3</sup> )
Sulfur Dioxide (SO2)	Annual Arithmetic Mean	.022 ppm (57 ug/m <sup>3</sup> )
	Twenty-Four Hour <sup>1</sup>	.088 ppm (230 ug/m <sup>3</sup> )
	Three Hour <sup>1</sup>	.439 ppm (1150 ug/m <sup>3</sup> )
Chromium (Total)	Twenty-Four Hour <sup>1</sup>	0.3 ug/m <sup>3</sup>
	Annual Geometric Mean	0.05 ug/m <sup>3</sup>
Perchloroethylene	Annual Arithmetic Mean	0.01 ug/m <sup>3</sup>
Toluene	Instantaneous	15,000 ug/m <sup>3</sup>
	Twenty-Four Hour	260 ug/m <sup>3</sup>
	Annual Arithmetic Mean	180 ug/m <sup>3</sup>

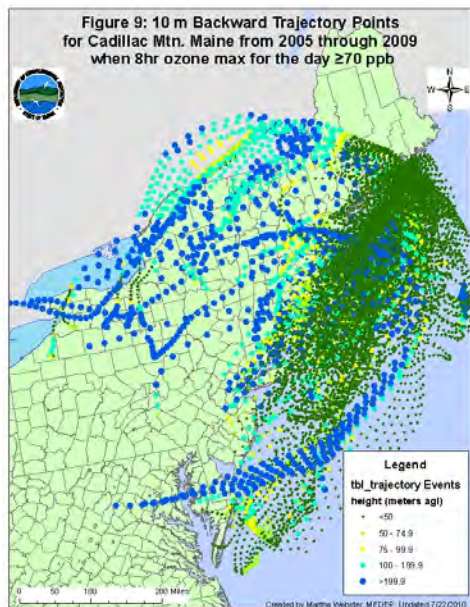
1 = Not to be exceeded more than once per year  
ppm = Parts of pollutant per million parts of air

ug/m<sup>3</sup> = Microgram's of pollutant per cubic meter of air  
mg/m<sup>3</sup> = Milligrams of pollutant per cubic meter of air

## POLLUTANT BASED REVIEW/ANALYSES

### Ozone

**Ozone** ( $O_3$ ) is a gas composed of three oxygen atoms. It is not usually emitted directly into the air, but at ground-level is created by a chemical reaction between oxides of nitrogen ( $NO_x$ ) and volatile organic compounds (VOC) in the presence of sunlight. Ozone has the same chemical structure whether it occurs miles above the earth or at ground-level and can be "good" or "bad," depending on its location in the atmosphere. In the earth's lower atmosphere, ground-level ozone is considered "bad." Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents as well as natural sources emit  $NO_x$  and VOC that help form ozone. Ground-level ozone is the primary constituent of smog. Sunlight and hot weather cause ground-level ozone to form in harmful concentrations in the air. As a result, it is known as a summertime air pollutant. Many urban areas tend to have high levels of "bad" ozone, but even rural areas are also subject to increased ozone levels because wind carries ozone and pollutants that form it hundreds of miles away from their original sources. Figures 9 and 10 illustrate the type of analyses that can be done utilizing back trajectories. The air masses that contain high levels of ozone pollution can be tracked backwards based on wind direction and speed to determine where that air mass may have been and consequently identify possible sources of emissions that generated the high ozone levels. Figure 9 indicates the possible locations that have contributed to all the high ozone levels at the Cadillac Mountain site in Acadia. Figure 10 illustrates the path that the air mass followed prior to impacting the Kennebunkport site. Using the back trajectories for analyzing ozone data as well as other pollutants can identify possible sources that may need further control.



"Good" ozone occurs naturally in the stratosphere approximately 10 to 30 miles above the earth's surface and forms a layer that protects life on earth from the sun's harmful rays.

Breathing ozone, a primary component of smog, can trigger a variety of health problems including chest pain, coughing, throat irritation, and congestion. It can worsen bronchitis, emphysema, and asthma. Ground-level ozone also can reduce lung function and inflame the linings of the lungs. Repeated exposure may permanently scar lung tissue. Ground-level ozone also damages vegetation and ecosystems. In the United States alone, ozone is responsible for an estimated \$500 million in reduced crop production each year. Under the Clean Air Act, EPA has set protective health-based standards for ozone in the air we breathe. EPA and others have instituted a variety of multi-faceted programs to meet these health-based standards.

Throughout the country, additional programs are being put into place to cut NO<sub>x</sub> and VOC emissions from vehicles, industrial facilities, and electric utilities. Programs are also aimed at reducing pollution by reformulating fuels and consumer/commercial products, such as paints and chemical solvents that contain VOC. Voluntary and innovative programs also encourage communities to adopt practices, such as carpooling, to reduce harmful emissions. The Clean Air Act requires EPA to set air quality standards to protect both public health and the public welfare (e.g. crops and vegetation). Ground-level ozone affects both.

### ***Health Effects***

People with lung disease, children, older adults, and people who are active can be affected when ozone levels are in the moderate and higher Air Quality Index (AQI) ranges. Numerous scientific studies have linked ground-level ozone exposure to a variety of problems, including:

- airway irritation, coughing, and pain when taking a deep breath;
- wheezing and breathing difficulties during exercise or outdoor activities;
- inflammation, which is much like a sunburn on the skin;
- aggravation of asthma and increased susceptibility to respiratory illnesses like pneumonia and bronchitis; and,
- permanent lung damage with repeated exposures.

### ***Environmental Effects***

Ground-level ozone can have detrimental effects on plants and ecosystems. These effects include:

- interfering with the ability of sensitive plants to produce and store food, making them more susceptible to certain diseases, insects, other pollutants, competition and harsh weather;
- damaging the leaves of trees and other plants, negatively impacting the appearance of urban vegetation, as well as vegetation in national parks and recreation areas; and
- reducing forest growth and crop yields, potentially impacting species diversity in ecosystems.



## Ozone and PAMS Monitoring Networks

### Ozone Network

Ozone monitoring was first conducted in the state in 1975. Since that time the program has been greatly expanded to monitor ambient levels, identify and delineate non-attainment areas and to provide data for forecasting and mapping of ozone levels throughout the state. Sites have been added, moved and deleted throughout this process. Maine is currently operating a network of 14 sites with an additional three sites operated by Maine tribes and two sites being operated by EPA. The locations of the sites in Maine are shown in Figure 11. The current NAAQS for ozone is the three year average of the fourth high maximum daily eight hour average not to exceed .075 ppm. Graphs indicating the NAAQS status at several sites in and near Maine are shown in Figure 12. The only monitoring site in the state that exceeds that standard, based on the 2007-2009 data, is the monitor on Cadillac Mountain in Acadia National Park. However, there are several sites in the state with data just below the standard. EPA has proposed a new standard for ozone in the range of .060 to .070 ppm as well as a new secondary standard. The final standards were to be issued by August 31, 2010 but have been delayed until November. As shown in Figure 12 there are several monitors in Maine that would be close to non-attainment with a lowering of the standard to .07 ppm. EPA had also issued revised ozone monitoring network design requirements on July 8, 2009. Those changes required monitoring in urban areas with populations of

Figure 11: Ozone Monitor Network

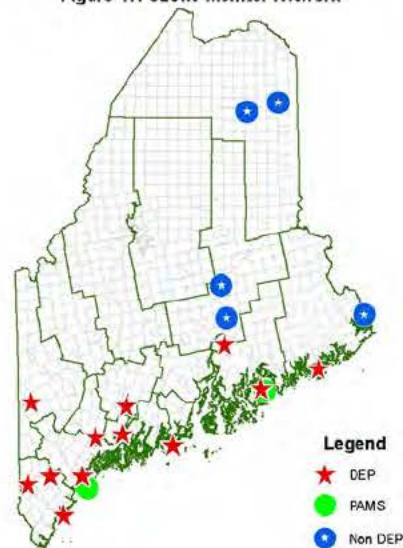
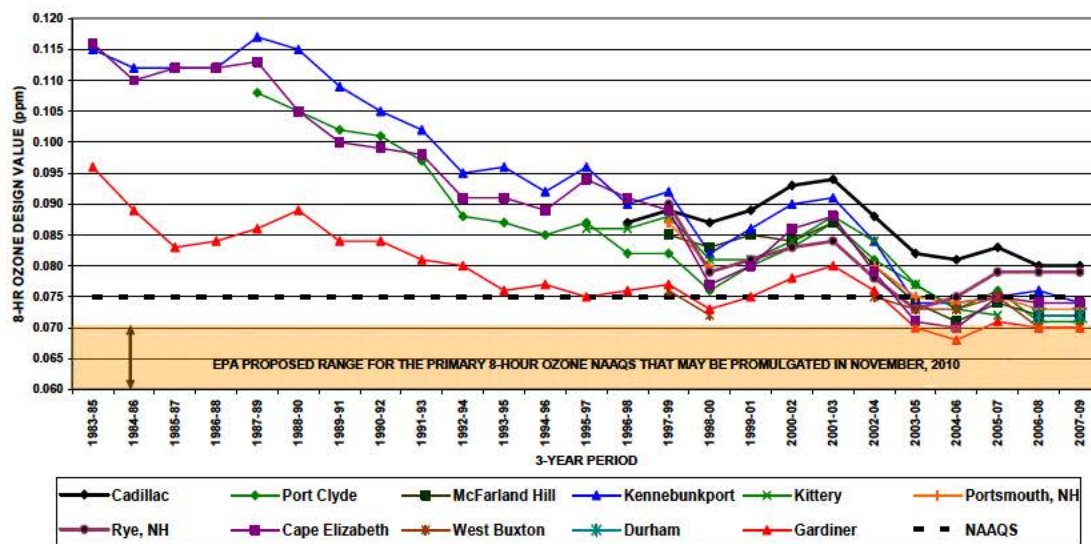


Figure 12 8-HOUR OZONE DESIGN VALUE TRENDS FOR CRITICAL SITES IN AND BORDERING MAINE





50,000 to 350,000 people and required a minimum of three monitors in non-urban areas within each state. EPA plans to issue a final rule on the proposed network design changes in conjunction with the final ozone standards in August. Maine has three Metropolitan Statistical Areas (MSA's) that meet the urban area population requirements, Portland-South Portland-Biddeford, Bangor, and Lewiston-Auburn. The Portland-South Portland-Biddeford MSA includes York, Cumberland and Sagadahoc Counties and currently there are five monitors operating within those counties. The Bangor MSA includes Penobscot County with three ozone monitors currently operating within the county. The Lewiston-Auburn MSA includes Androscoggin County with one monitor currently operating in the county, in Durham. The majority of ozone monitors operating in Maine would be classified as in non-urban areas so that requirement is currently being met.

The current Maine DEP ozone monitoring network is essentially a three tiered network as depicted in Figure 13. The first tier is located along the southwest and mid-coastline where historically the worst ozone events and nonattainment have and currently occur. Monitors are located at Kennebunkport, Cape Elizabeth, Port Clyde, McFarland Hill, and the summit of Cadillac Mountain in Acadia National Park. Since a number of coastal monitoring sites in Maine are recording concentrations just below the current standard it is important to continue operating those monitors to show continued compliance (requirement in existing maintenance plans for the 1997 ozone standard) and/or a return to non-attainment based on a lower standard. This tier contains the more populated areas in the Portland-South Portland-Biddeford MSA and also includes the Rockland Micropolitan Statistical Area. It is important to note that the southern coastal area of Maine is one of the most densely populated areas of the state and has shown the greatest growth over the last 20 years.

Figure 13: Ozone Monitor Tiered Network



The second tier of ozone monitors is located just inland in southwest and central Maine to downeast of Acadia National Park. Monitors are located at Shapleigh, West Buxton, Durham, Bowdoinham, Gardiner, Holden and Jonesport. The importance of this tier is how it has and will continue to be used to determine the attainment/nonattainment boundary and in forecasting how far inland moderate and higher AQI concentrations will occur with a more stringent standard. Shapleigh, Bowdoinham and Jonesport monitors were specifically added to the network within the past five years because of the more stringent 2008 standard. This tier also contains the most densely populated areas away from the coastline including the Bangor and Lewiston-Auburn MSA's, part of the Portland-South Portland-Biddeford MSA and the Augusta-Waterville Micropolitan Statistical Area.

The third tier of ozone monitors is located in the rural western and northern areas of the State. Maine DEP currently operates a monitor at North Lovell, EPA operates sites at

Howland and Ashland and the Micmac, Penobscot Nation and Passamaquoddy Tribes also operate sites in this tier. The importance of this tier is for ozone mapping and forecasting purposes especially during the spring months and may be needed to determine the extent of nonattainment when a lower standard is promulgated.

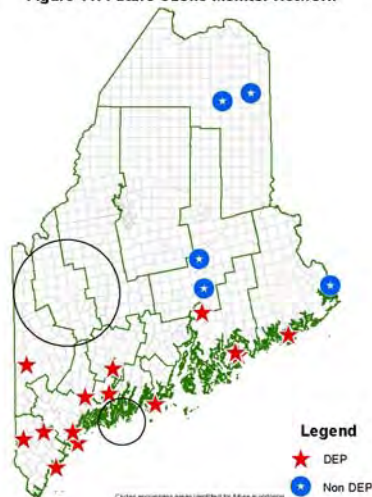
### *PAMS Monitoring Network*

The Photochemical Assessment Monitoring Stations (PAMS) network was originally established in 1993. The monitoring regulations for PAMS provide for the collection of an “enhanced” ambient air quality database which can be used to better characterize the nature and extent of the ozone problem, aid in tracking Volatile Organic Compounds (VOC) and Nitrogen Oxides (NO<sub>x</sub>) emission inventory reductions, assess air quality trends, make attainment/non-attainment decisions, and evaluate photochemical grid-model performance. The ME DEP operates two PAMS in Maine. These sites are required to be operational for the June – August period but generally operate for May and September also. PAMS are designed to measure the precursors responsible for the development of ozone and were initially required for serious or greater non-attainment areas. Both of the sites in Maine were required as a result of serious non-attainment areas in other states. The site in Cape Elizabeth is considered an extreme downwind site for the Greater Connecticut non-attainment area and the Cadillac Mountain site in Acadia National Park is considered an extreme downwind site for the Boston non-attainment area. As additional controls have been implemented and air quality has improved the serious non-attainment areas have been reduced or eliminated. However, with a lowering of the standard the status of some of these areas may change and continued monitoring of the precursors remains important.

### *Future Ozone and PAMS Networks*

As justified in the previous section, all monitors in the current ozone network are important for the current and more stringent future ozone standards. There are two areas of the state that may need additional monitoring as indicated in Figure 14. The area around Phippsburg along the coast had recorded some of the higher hourly concentrations in the state but the monitor was removed after the 1999 season at the request of the property owner. A site was established in Reid State Park for a few years but the site did not have good exposure as it was situated in a wooded area which may have resulted in lower ozone concentrations. That monitor was then relocated to a site further inland (Bowdoinham) to see if the higher concentrations were forming or being transported further inland. Whether the standard is lowered or not it may be important to find a site in the Phippsburg area to adequately document the levels of ozone impacting that area of the coast. However, obtaining permission to install monitoring sites on coastal property in Maine is very difficult. There may also be a need to establish a site in the mountains of western Maine. The highest background ozone concentrations during the year occur

Figure 14: Future Ozone Monitor Network



in the spring months before leaf-out. Maine has recently experienced some high spring ozone concentrations at inland sites as a result of the high background, long range transport, weather patterns and the lack of vegetation to absorb ozone. A high elevation site in the Bethel/Rangely area or possibly the Carrabassett/Greenville area may be needed to help document transport and forecast spring ozone events. Whether or not there is a non-attainment area in Maine, there will be a need for data to provide accurate forecasting capability for ozone concentrations as the effects of ozone are felt by healthy individuals at concentrations as low as 60 ppb.

National and regional discussions are currently in progress to determine the PAMS monitoring network for the future more stringent ozone standards. The current PAMS network in Maine is very useful in tracking historical VOC and NO<sub>x</sub> control programs through trends analyses, and in documenting transport patterns. Future uses of the data and data analyses from this network other than trends analyses include State Implementation Plan requirements for a Section 126 of the Clean Air Act Petition, Attainment Demonstration Ozone Conceptual Model and inputs for the Attainment Demonstration Modeling analyses.

### ***Particle Pollution***

Particle Pollution (particulate matter or PM) consists of coarse particles (PM<sub>2.5-10</sub>) with a diameter between 2.5 and 10 micrometers and fine particles (PM<sub>2.5</sub>) that have a diameter 2.5 micrometers or smaller. The current PM<sub>10</sub> standard includes both coarse and fine particles. Examples of coarse particle pollution include smoke, soot, dust and dirt. Examples of fine particle pollution include sulfates and nitrates that are formed in complicated chemical reactions when sulfur oxides and nitrogen oxides are emitted into the atmosphere from power plants, industries and mobile sources.

### ***Health Effects***

Particle pollution, especially fine particles, can get deep into the lungs and into the blood stream causing serious health problems. Numerous scientific studies have linked particle pollution inhalation to a variety of ailments including:

- increased respiratory symptoms including irritation of the airways, coughing or difficulty breathing;
- decreased lung function;
- aggravated asthma;
- development of chronic bronchitis;
- irregular heartbeat;
- nonfatal heart attacks; and
- premature death for people with heart or lung disease.

### ***Environmental Effects***

Fine particle pollution (sulfates, organic matter, nitrates, elemental carbon and soil dust) is the primary cause of regional haze (visibility degradation)

### *Visibility reduction*

Fine particles (sulfates, organic matter, nitrates, elemental carbon and soil dust) are the major cause of reduced [visibility \(haze\)](#) in scenic areas such as those located in national parks and wilderness areas.

### *Environmental damage*

Particles can be carried over long distances by wind and then settle on ground or water. The effects of this settling include: making lakes and streams acidic; changing the nutrient balance in coastal waters and large river basins; depleting the nutrients in soil; damaging sensitive forests and farm crops; and affecting the diversity of ecosystems.

### *Aesthetic damage*

Particle pollution can stain and damage stone and other materials, including culturally important objects such as statues and monuments.

## ***PM<sub>10</sub>, PM<sub>2.5</sub> and Visibility/Speciation Monitoring Networks***

### *PM<sub>2.5</sub> Network*

The current PM<sub>2.5</sub> 24-hour filter Federal Reference Method (FRM) monitors in the state of Maine used to track compliance with NAAQS are primarily located in the most densely populated and source regions. Additional PM<sub>2.5</sub> monitors are located in Greenville for a wood smoke study and in Acadia National Park at the McFarland Hill site to help meet the NCORE requirements. Continuous hourly PM<sub>2.5</sub> TEOM monitors used to help inform the public are located in the three largest cities in Maine with additional monitors in Greenville and at the McFarland Hill NCORE site. The types of monitors and their locations are shown in Figure 15.

Figures 16-19 demonstrate that all monitors are showing attainment of the 2006 PM<sub>2.5</sub> NAAQS. Figures 16 and 17 shows the trends in 24 hour data and compares the data with the 24 hour standard. Figures 18 and 19 shows the trends in the annual averages and also compares them with the annual standard.

The following is a list of sites in a relative order of importance:

- HIGHEST POPULATION AREAS  
Portland (FRM and TEOM)  
Lewiston (FRM and TEOM)  
Bangor (FRM and TEOM)
- SOURCE REGIONS OF INTEREST  
Rumford (FRM)  
Madawaska (FRM)
- NCORE SITE  
McFarland Hill (FRM and TEOM)

Figure 15: Maine PM<sub>2.5</sub> Monitor Locations

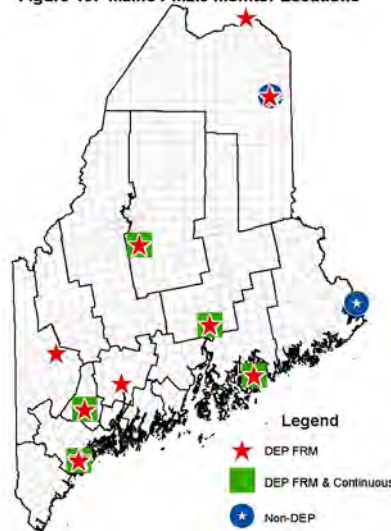


Figure 16: MAINE PM2.5 24-HR 98th PERCENTILE CONCENTRATION TRENDS

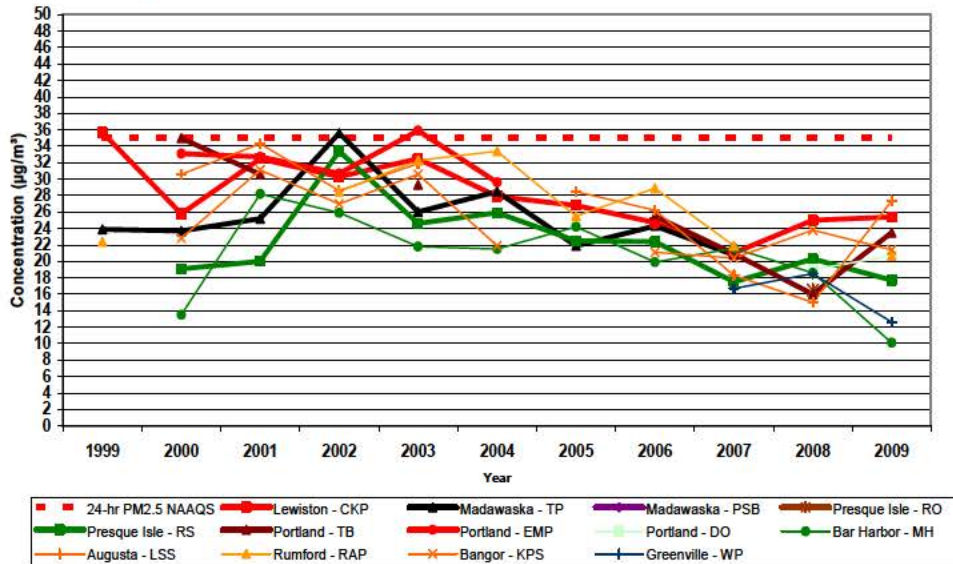


Figure 17: MAINE PM2.5 24-HOUR DESIGN VALUE TRENDS

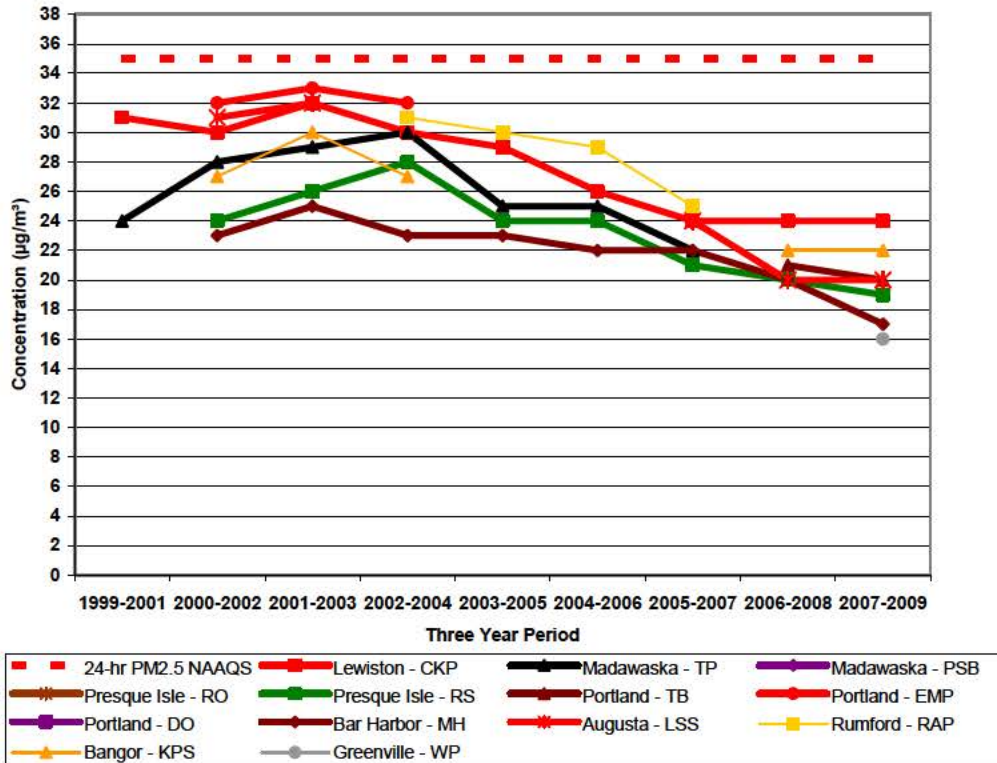




Figure 18: MAINE PM2.5 ANNUAL CONCENTRATION TRENDS

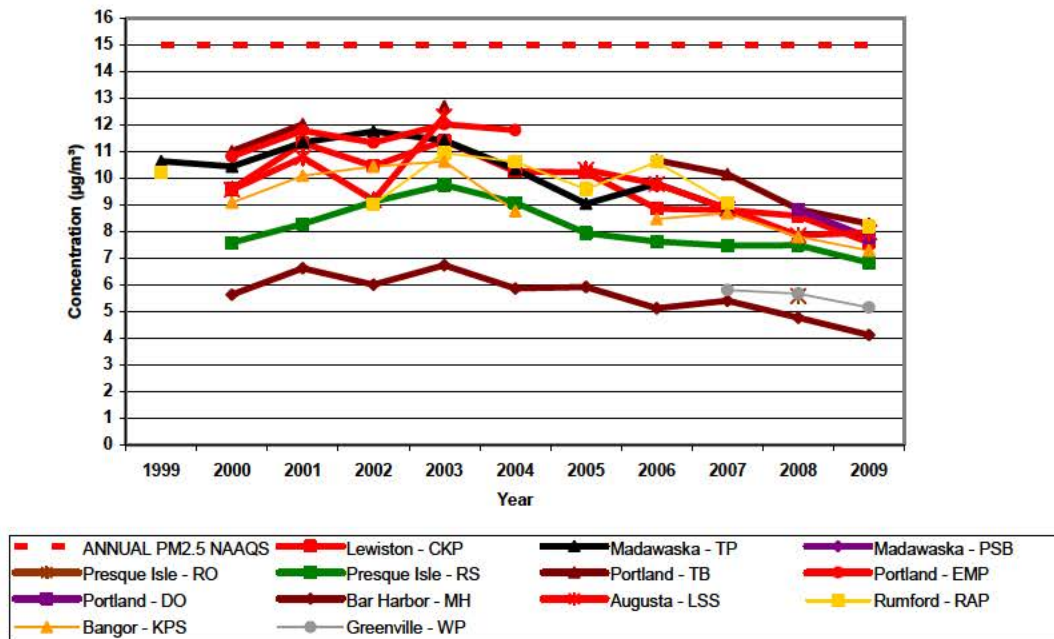
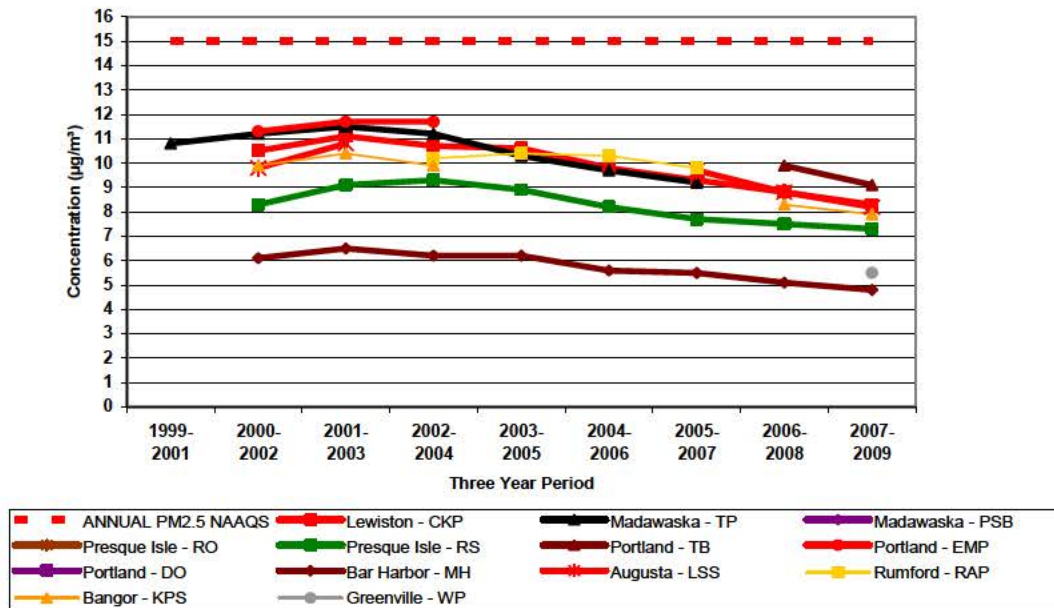


Figure 19: MAINE PM2.5 ANNUAL DESIGN VALUE TRENDS





- OTHER POPULATION CENTERS OF INTEREST

Augusta (FRM)

Presque Isle (FRM)

- WOOD SMOKE STUDY

Greenville (FRM and TEOM)

At this time and until the PM<sub>2.5</sub> NAAQS is revised the only possible change in the network would be to move the Greenville site, when the smoke study is completed, to a site in a river or mountain valley that has a significant number of wood burning sources to document compliance and to provide data for more accurate forecasting in complex mountain valley areas.

### ***PM<sub>10</sub> Network***

The current PM<sub>10</sub> 24-hour filter and continuous TEOM FRM monitors in the State of Maine used to track compliance with NAAQS are located in the more populated areas, at a source of interest and in a region that has historically experienced exceedances of the standard. The types of monitors and their locations are shown in Figure 20.

The graph in Figure 21 shows that all sites are showing attainment of the current PM<sub>10</sub> NAAQS. The last exceedance of the 24-hour standard occurred in Madawaska in 2006. More frequent monitoring was initiated in Madawaska in order to document the attainment status of the area and during that period of daily sampling there were no additional exceedances recorded.

The following is a list of sites in a relative order of importance.

- HIGHEST POPULATION AREAS

Portland (FRM)

Lewiston (FRM)

Bangor (FRM)

- REGIONS WITH HISTORICAL EXCEEDANCES

Presque Isle (FRM and TEOM) (maintenance plan)

Madawaska (FRM)

- OTHER POPULATION CENTER OF INTEREST

Augusta (FRM)

Van Buren (FRM)

- SOURCE OF INTEREST

Bradley (FRM)

Figure: 20 Maine PM<sub>10</sub> Monitor Locations

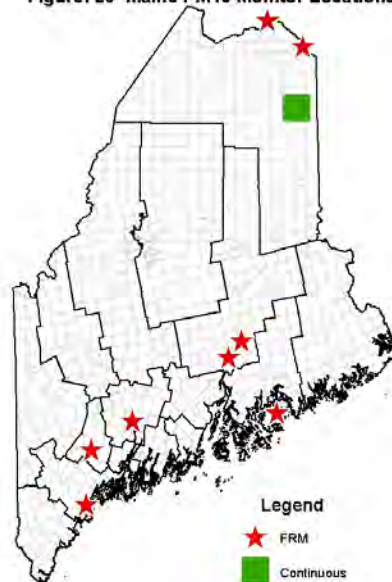
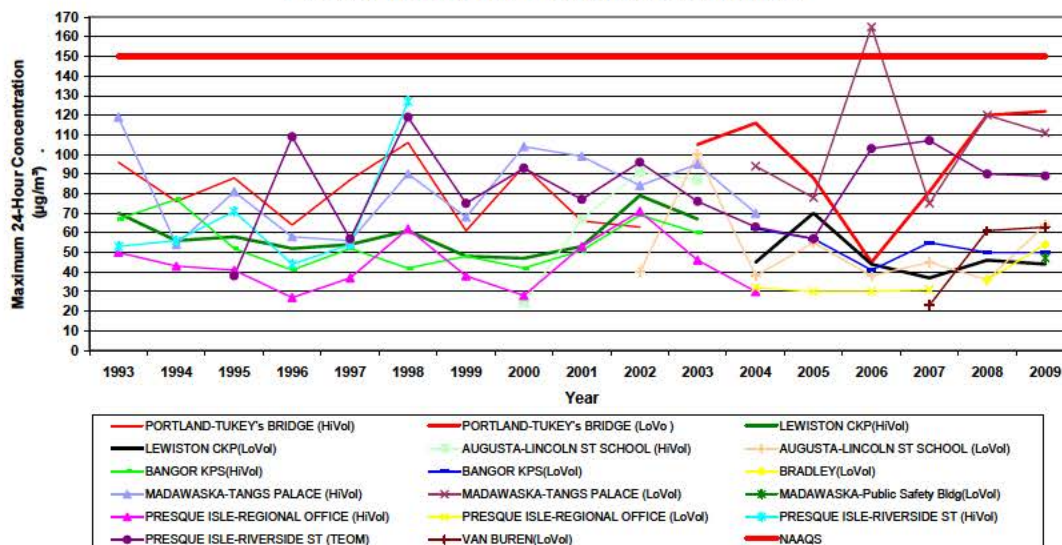


FIGURE 21 PM<sub>10</sub> 24-HOUR CONCENTRATION TRENDS IN MAINE



The PM<sub>10</sub> network is adequate monitoring the highest population centers and maintenance areas of the state. The Van Buren site will have three years of data next year and will be reviewed for possible relocation. The monitor in Bradley, in place for a special study of emissions from a nearby source, will also be available for possible relocation when the study is completed.

## Visibility/Speciation Monitoring Network

Maine operates a PM speciation network by participating in the Interagency Monitoring of Protected Visual Environments or IMPROVE program. Monitors are currently located in Bridgton and Freeport. Sites are also operated by the National Park Service in the Acadia National Park Class I Area, the Fish and Wildlife Service in the Moosehorn Wilderness Class I area and the Penobscot and Micmac tribes. The map in Figure 22 indicates the location of the IMPROVE monitors in the state.

Figure 22: Maine IMPROVE Monitor Locations

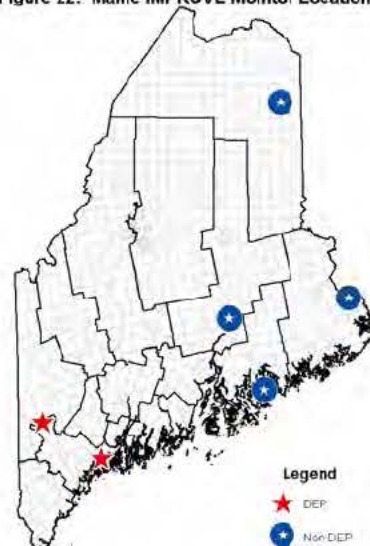
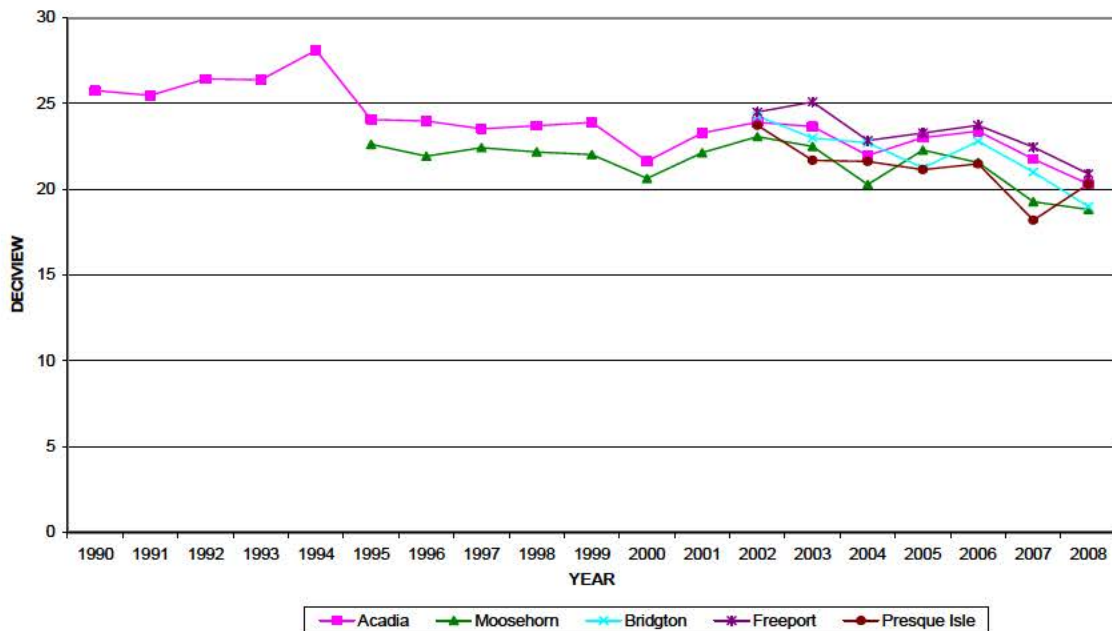


Figure 23 shows visibility impacts through trends in deciviews from sites in Maine for the 20% worst visibility days monitored. Data from the Penobscot tribe site had not been compiled to show the trend in deciviews at the time this report was prepared. Deciview is a visibility metric based on the light extinction coefficient that expresses incremental changes in perceived visibility.



FIGURE 23: IMPROVE MONITORS DECIVIEW TRENDS



The visibility/speciation network is adequate for monitoring requirements at all three Class I areas in and near Maine. The Moosehorn Wilderness visibility/speciation monitoring is representative of conditions at the nearby Roosevelt-Campobello International Park (RCIP) Class I area so no monitor is needed at RCIP. It is critical to continue monitoring for the three Class I areas to track visibility conditions as required in the Regional Haze Rule and committed to in Maine's draft State Implementation Plan (SIP). As shown in Figure 23, impacts at the Bridgton and Freeport monitors are different than at the Class I areas. This is due in part because EPA's PM<sub>2.5</sub> network design criteria for Maine required the establishment of two speciation sites. The Department opted to use IMPROVE Protocol samplers to meet this requirement so that all PM speciation data in the state would be generated by using the same equipment and collected filters would be analyzed by the same lab. Another reason is because these two sites are located in a Class II area – not Class I.

## PM COARSE

PM Coarse is the fraction of particles that fall in the size range from 2.5 up to 10 microns in size. There is currently no standard for this size range but EPA has proposed a standard in the past but opted to do more research rather than promulgate a standard. The only monitoring requirement is for PM Coarse to be monitored at all NCore sites. The monitoring will be required at the NCore sites as of January 1, 2011. Maine is currently monitoring PM Coarse at the NCore site in Acadia National Park using the difference method. The monitors measure PM<sub>10</sub> and PM<sub>2.5</sub> and PM Coarse is calculated by subtracting the PM<sub>2.5</sub> from the PM<sub>10</sub>. Should EPA propose a standard the PM Coarse component of particulates could be calculated at several other sites in the state using the difference method. Lewiston, Augusta, Bangor and Madawaska sites have both PM<sub>10</sub> and PM<sub>2.5</sub> monitors and can report PM Coarse data if necessary.

## **Lead**

In 2008 EPA promulgated a new lead standard and issued some minimum monitoring requirements. At that time the only requirement applicable to Maine would have meant one monitor in the Portland CBSA (Core-based statistical area). They have since reconsidered the monitoring requirement and may require a monitor at the NCore site in Bar Harbor instead of the Portland area. A final decision is expected later this year. In the interim Maine will be analyzing selected filters collected over the last eight years from all of the PM10 sites in the state for lead levels and based on those results will decide whether the monitoring network will need more than the minimum requirements.

## **Air Toxics**

Information compiled by Maine's Environmental Public Health Tracking Network indicates that asthma and cancer rates in Maine exceed the national average in several counties. Washington County's cancer death rate exceeds the national rate and rose from 2005 to 2006. No counties in Maine are below the national cancer death rate.

Under a Healthy Communities grant from EPA, the Department undertook the Maine Air Toxics Initiative with a broad stakeholder group that formed the Air Toxics Advisory Committee (ATAC) to evaluate the results of the 1999 National Air Toxics Assessment (NATA) and identify which air toxics are the most responsible for creating health risks in Maine. The Department and ATAC evaluated emissions inventories, chemical toxicity databases, national air modeling, and ambient air monitoring programs and ultimately agreed air toxics driving the potential risk are primarily combustion byproducts. The Maine Air Toxics Priority List (ATPL) identifies 27 air pollutants that create unacceptable risks to public health. Those pollutants and the basis for their ranking are listed in Table 4.

The ATAC recommended that the Department pursue no cost or low-cost approaches to reducing emissions of air toxics, focusing primarily on energy efficiency, residential wood combustion, mobile sources, and continuing scientific investigation.

[NATA results for 2002](#) (released June 2009) indicated that nonpoint combustion sources are primary risk drivers statewide, mobile source emissions remain a secondary risk driver for citizens in more urban areas and carbon tetrachloride background levels drive risk in rural areas. These results suggest that current monitoring sites located in developed areas with significant traffic flow continue to provide valuable information for public health protection. The Department will evaluate 2005 NATA results, 2008 emission estimates, and the last five years of monitoring results to determine if revisions to the ATPL may be appropriate.

The Department monitors year-round for toxic air pollutants in twelve Maine cities and towns, including photochemical organics, metals, and particulate. Figure 24 indicates the locations and the type of monitoring done at these sites.



Table 4: Maine Air Toxics Priority List

Rank	MEDEP Pollutant CATEGORY NAME	Basis for addition to Air Toxics Priority List
1	Polycyclic Organic Matter	Toxicity-Weighted Emissions <sup>2</sup> and NATA risk
2	Naphthalene	Toxicity-Weighted Emissions and NATA risk
3	Acrolein	Toxicity-Weighted Emissions and NATA risk
4	Formaldehyde	Toxicity-Weighted Emissions and NATA risk
5	Benzene	Toxicity-Weighted Emissions and NATA risk
6	Chromium Compounds	Toxicity-Weighted Emissions and NATA risk
7	Cobalt Compounds	Toxicity-Weighted Emissions and NATA risk
8	1,3-Butadiene	Toxicity-Weighted Emissions and NATA risk
9	Sulfuric Acid	Toxicity-Weighted Emissions and NATA risk
10	Diesel Particulate Matter	Qualitative estimate of Toxicity-Weighted emissions and risk
11	Nickel Compounds	Toxicity-Weighted Emissions and NATA risk
12	Arsenic Compounds	Toxicity-Weighted Emissions and NATA risk
13	Particulate Matter from Nanotechnology	Qualitative estimate of emerging risk
14	Brominated Flame Retardants	Persistence & bioaccumulation
15	Acetaldehyde	Toxicity-Weighted Emissions and NATA risk
16	Lead Compounds	Toxicity-Weighted Emissions and NATA risk
17	Cadmium Compounds	Toxicity-Weighted Emissions and NATA risk
18	Chloroform	Toxicity-Weighted Emissions and NATA risk
19	Manganese Compounds	Emerging risk update & persistence
20	Tetrachloroethylene (Perchloroethylene)	Monitoring exceeds ME Ambient Air Standard
21	Methyl Bromide (Bromomethane)	Persistence
22	Carbon Tetrachloride	Persistence
23	Dioxins and Furans	Persistence & bioaccumulation
24	Hydrogen Sulfide	Acute Risk incidents
25	Ethylene Dichloride (1,2-Dichloroethane)	Persistence
26	Ethylene Dibromide (Dibromomethane)	Persistence
27	Mercury Compounds	Persistence & bioaccumulation

<sup>1</sup> The air toxics inventory is “Toxicity-Weighted” to allow quick “apples-to-apples” comparisons between pollutants with widely varying potencies and health effects. The risk posed by an air toxic depends upon exposure concentration (the amount of air toxic in the air), the amount breathed, and the toxicity of the pollutant. Toxicity-factors for air toxics are based on the toxicity of each pollutant and constants that help determine air toxic intake. Pollutant emissions are a significant factor in determining exposure concentration. Therefore, the toxicity-factor is multiplied by air toxic emissions, to derive a relative ranking of air toxics. Emission personnel can then focus QA reviews on those air toxics that have a high toxicity ranking, and those air toxics whose relative rankings would change significantly when emissions change. Thus, a high quality inventory is available for fate and transport modeling, which ultimately calculates actual risk. Toxicity-factors and their technical basis are available on MEDEP’s website at: [www.maine.gov/dep/air/toxics/mati-docs.htm](http://www.maine.gov/dep/air/toxics/mati-docs.htm). See: David W. Wright, *Toxicity-Weighting: A Prioritization Tool for Quality Assurance of Air Toxics Inventories* (Bureau of Air Quality, Maine Department of Environmental Protection, 17 SHS, Augusta, ME 04333-0017) April 19, 2007

The Department employs the TO-15 method to analyze 25 compounds listed in Table 5, including nine of the priority toxic pollutants (highlighted in red). These monitors play an important role in ground-truthing estimates of toxic emissions. The Department's estimates guide which toxics are selected for monitoring, and monitoring results may indicate the need to evaluate emission factors for estimates. In 2011, the Department will re-evaluate which toxic pollutants should be monitored with TO-15 using historical monitoring data, 2008 emission estimates currently under development, comprehensive 2005 emission estimates, 2005 NATA results, and 2010 revised Ambient Air Guidelines from Maine's Centers for Disease Control (CDC). CDC's 2010 revisions include 10-fold increases in the guidelines for toluene and acrolein, and a 1,000-fold decrease in the guidelines for ethylbenzene.

Figure 24: Air Toxics Monitoring Network

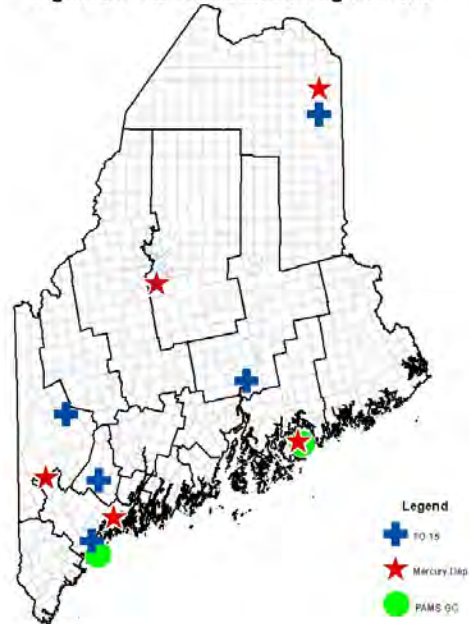


Table 5: List of TO-15 Compounds

	CAS Number	Compound
1	74-87-3	Methyl Chloride
2	75-01-4	Vinyl Chloride
3	106-99-0	1,3-Butadiene
4	74-83-9	Methyl Bromide
5	75-00-3	Ethyl Chloride
6	75-09-2	Methylene Chloride
7	75-34-3	Ethylidene Dichloride
8	1634-04-4	MTBE
9	107-02-8	Acrolein
10	67-66-3	Chloroform
11	107-06-2	Ethylene Dichloride
12	71-43-2	Benzene
13	56-23-5	Carbon Tetrachloride
14	79-01-6	Trichloroethylene
15	108-10-1	Methyl Isobutyl Ketone
16	542-75-6	1,3-Dichloropropene
17	79-00-5	1,1,2-Trichloroethane
18	108-88-3	Toluene
19	106-93-4	Ethylene Dibromide
20	127-18-4	Tetrachloroethylene
21	100-41-4	Ethylbenzene
22	1330-20-7	m,p Xylenes
23	79-34-5	1,1,2,2-Tetrachloroethane
24	106-46-7	1,4-Dichlorobenzene
25	120-82-1	1,2,4-Trichlorobenzene



The air toxics monitoring that is being conducted in the five cities in Maine will provide background and baseline for the various pollutants monitored. These sites will be used to determine impacts and to identify any trends that may be occurring in these compounds. The data from these sites will also be very useful in the analysis of data collected in any areas of the state that may be considered as a “hotspot”, either due to health data or high emissions. The concentrations of the various compounds can be compared to determine whether ambient concentrations are higher than normal and if so may be a contributing factor to any local health problems.

The Department also conducts air toxics monitoring during the ozone season at the two Photochemical Assessment Monitoring Stations (PAMS) in Cape Elizabeth and on Cadillac Mountain. Air toxics measurements from these sites represent out-of-state pollution due to the sites’ locations for assessing long-range transport. The Department measures some of the most prevalent combustion by-products - benzene, toluene, ethylbenzene, and xylenes (BTEX compounds) - at these sites and all other toxics monitoring sites. PAMS measurements can help the Department estimate local versus transported pollutant concentrations of the BTEX compounds at other sites. PAMS data also provides more than a decade of measurements that can be used to evaluate trends. Figures 25 and 26 indicate a significant decline in overall annual average BTEX concentrations at both sites in the late 1990’s, and much smaller variations in recent years. The toxics measurements at the sites do not trend closely with one another, however. The Department can use year-round monitoring in conjunction with PAMS data to perform more in-depth analyses of the patterns in toxics concentrations.

Figure 27 illustrates benzene monitoring results from six of the Department’s year-round toxics monitoring sites. Benzene plots for the individual sites indicate a decline in peak levels at the Lewiston (CKP) and Bangor (KPS) sites, but steady levels in Rumford and Presque Isle. Using the long-term data compiled from the Department’s toxics monitoring sites, the Department can evaluate trends for any of the TO-15 compounds listed in Table 5.

Figure 25: Cadillac PAMS 1997 to 2009 BTEX Compounds

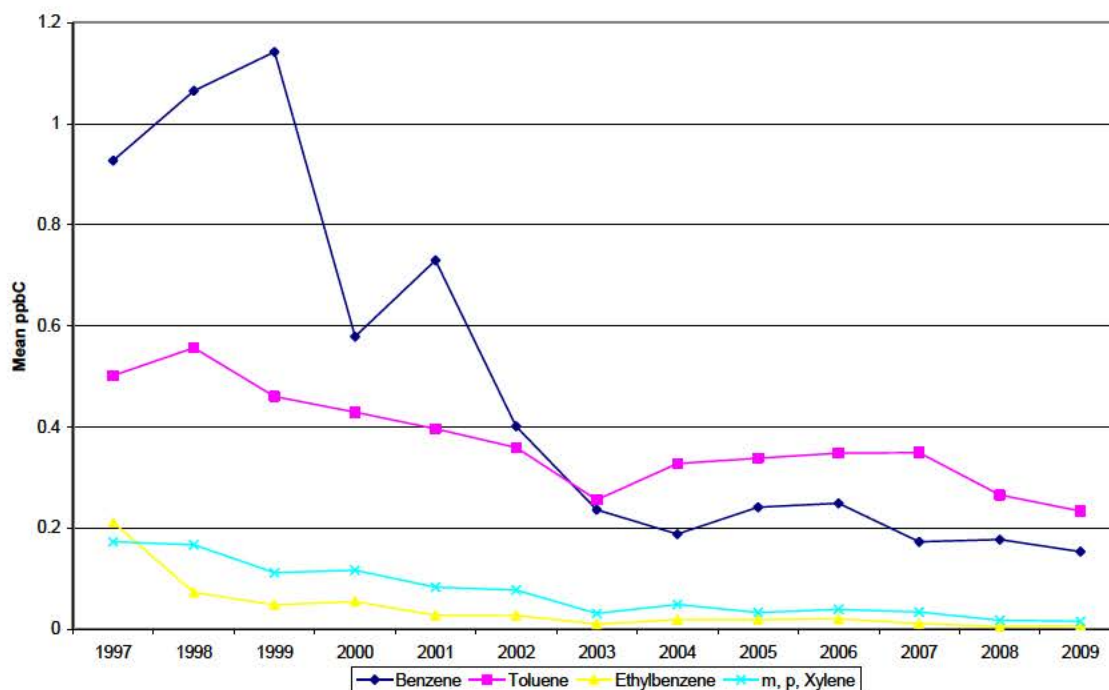
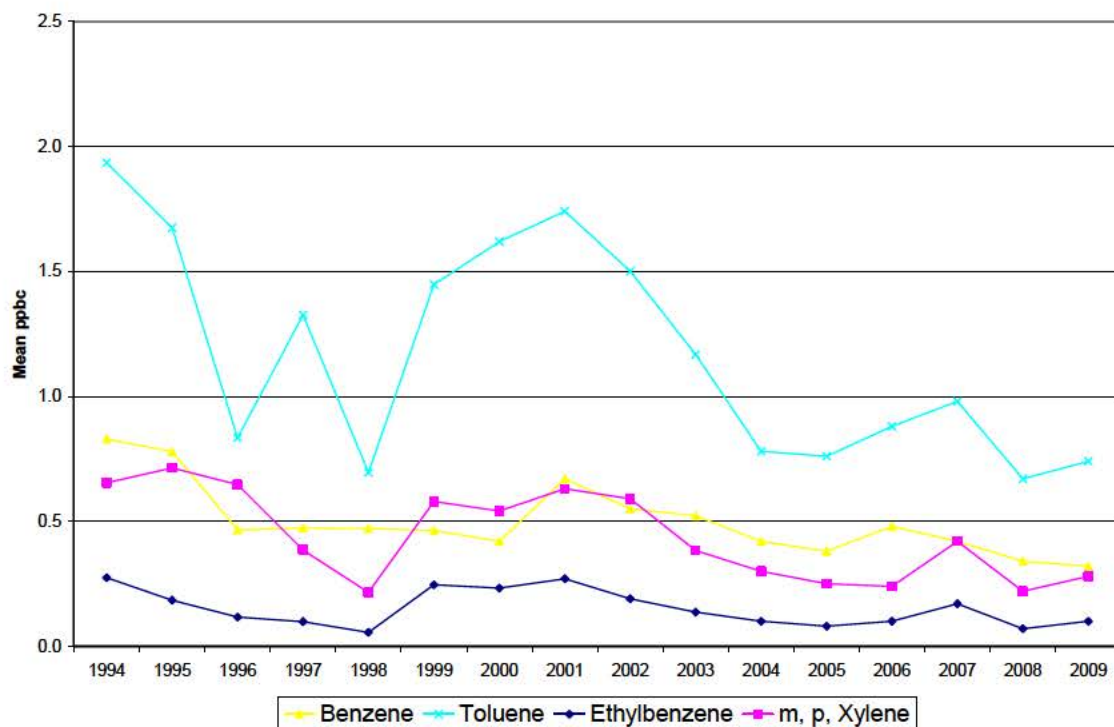
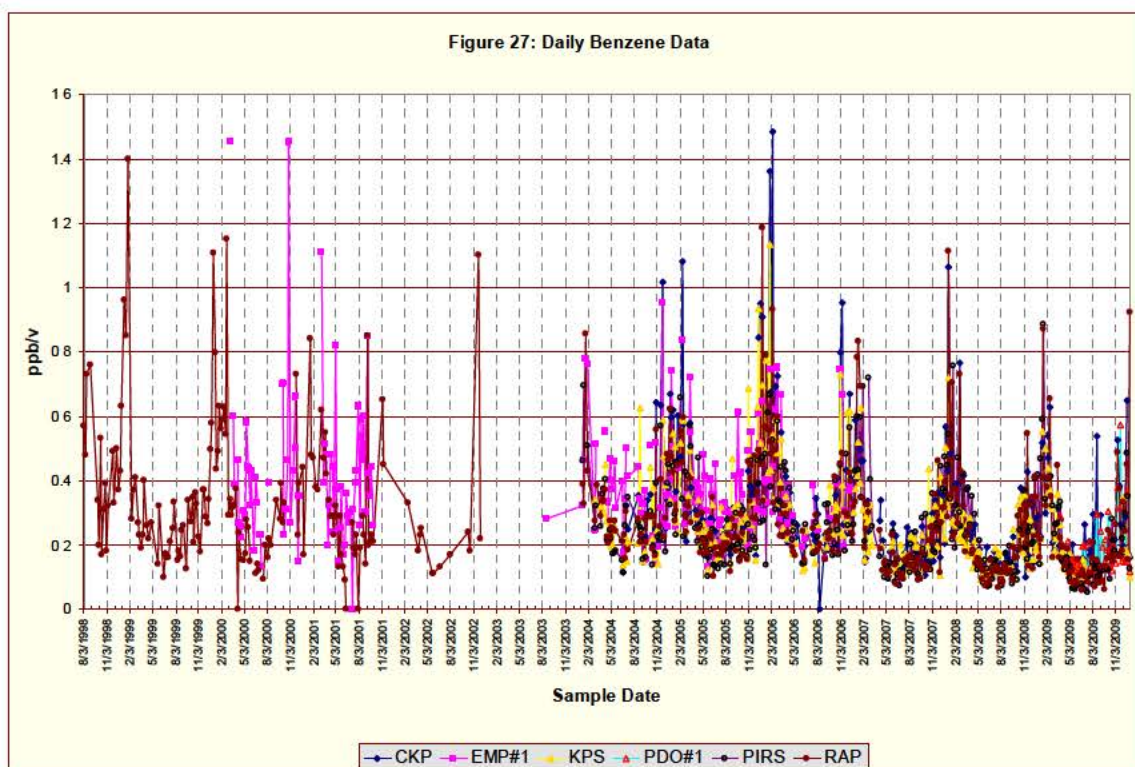


Figure 26: Cape Elizabeth PAMS 1994 thru 2009 BTEX Compounds





[Maine's Air Toxics Strategy](#) includes further investigation into air quality impacts from residential wood combustion. The Department is developing the capability to deploy portable PM<sub>2.5</sub> and TO-15 monitors and employ liquid chromatography to apportion measured pollutants by combustion source (e.g. wood, diesel). This will enable the Department to collect air quality data from areas throughout the western mountains and remote areas of the state where emission estimates and inspections indicate wood smoke impacts may be greatest. The long-term on-going measurements collected from the stationary monitoring sites provide valuable datasets for comparison, especially the mountain sites in Rumford and Greenville. The Department will also analyze historical HAPs monitoring data compared to metals measured on archived particulate filters to identify air quality trends in monitored areas.

Mercury deposition monitoring informs water quality impact analyses and plays a critical role in identifying the contribution of air pollution to water pollution. In 2008 the New England states petitioned EPA to convene a conference with 11 upwind states identified as the most significant contributors to mercury deposition in Maine. Ongoing deposition monitoring will indicate if future emission reduction strategies are effective.

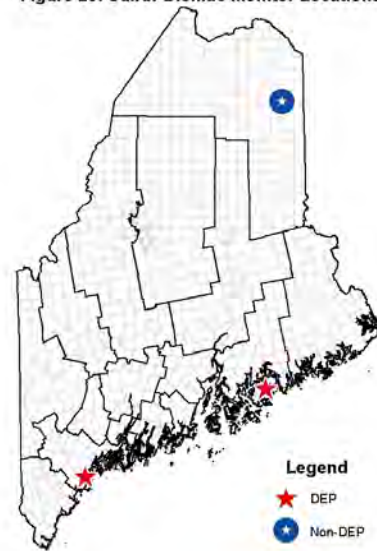
## ***Sulfur Dioxide***

Sulfur Dioxide is a colorless irritating gas having the same pungent odor as a struck match. It is emitted mainly from stationary sources that utilize fossil fuels (coal, oil) such as power plants, ore smelters and refineries. High concentrations can lead to difficulty



breathing and increased asthma symptoms. Sulfur dioxide had been a problem in areas of the state in the 70's and early 80's but additional controls and the reduction of sulfur content in fuels has dramatically reduced the concentrations of sulfur dioxide in the air to well below the standards that were in effect at the beginning of this year. However, as a result of a review of the standard EPA promulgated a new standard at a much lower level than the previous standard. On June 2, 2010 EPA issued a new 1-hour primary standard of 75 ppb that becomes effective on August 23, 2010. The revised standard includes a new "form" which is the 3-year average of the 99<sup>th</sup> percentile of the annual distribution of daily maximum 1-hour average concentrations. In the final review of the standard EPA also required monitoring in Core Based Statistical Areas, based on a population weighted emissions index for the area. Maine does not have any CBSA's that would require a monitor. Maine has continued to operate a sulfur dioxide monitor in the Portland area and for several years has also operated a monitor at the NCore site in Acadia National Park. The Micmac tribe also operates a monitor at their site in Presque Isle. The NCore site in Acadia National Park will be required to have a trace level SO<sub>2</sub> monitor. The locations of monitors are indicated on the map in Figure 28. The maximum 1-hour concentration recorded in Portland in the last two years is 47 ppb with the 99 percentile for the last two years at the current site near the Deering Oaks Park being 15 ppb. Consequently, the only required monitoring in Maine is the monitor for the NCore site and an urban monitor to collect background/baseline data for the licensing program. Figure 29 depicts the 1 hour concentration trends at an urban and rural location as well as concentrations at a site in NH near the Maine border at Kittery.

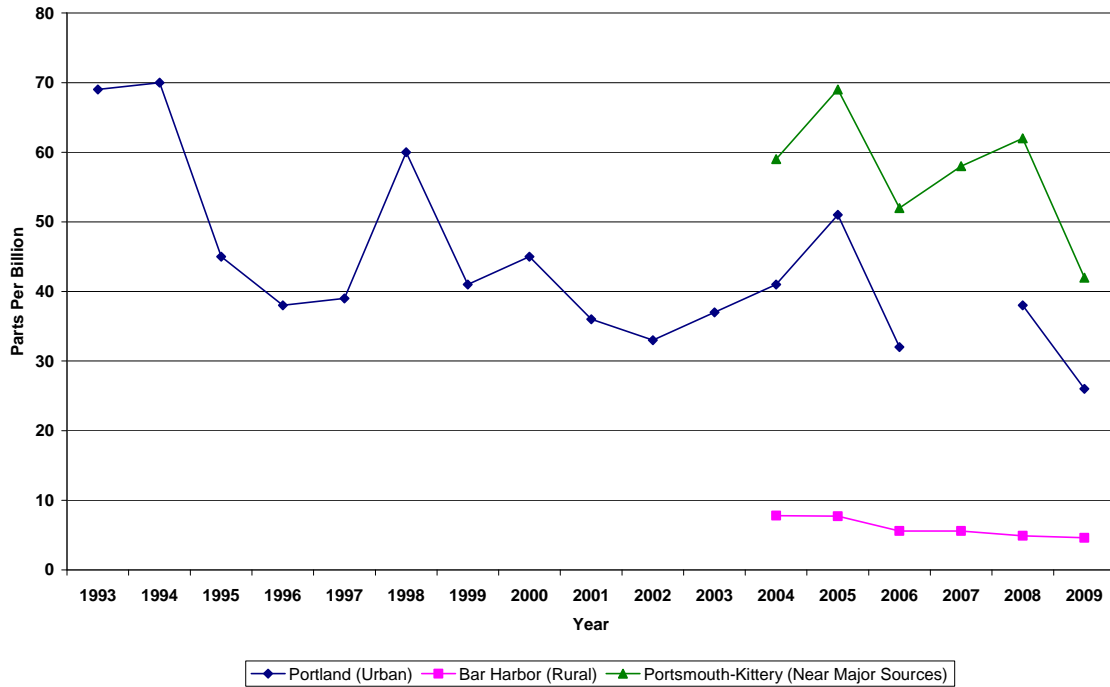
Figure 28: Sulfur Dioxide Monitor Locations



## ***Nitrogen Dioxide***

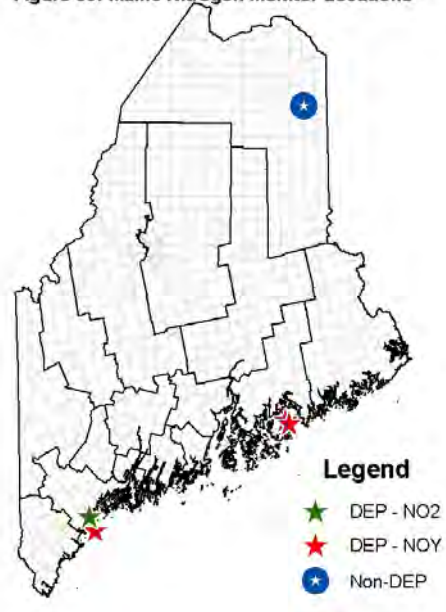
On January 20, 2010 EPA strengthened the primary national ambient air quality standard for nitrogen dioxide by adding a 1-hour standard at 100 parts per billion (ppb) while still retaining the annual average standard of 53 ppb. The form of the 1-hour standard is the 3-year average of the 98<sup>th</sup> percentile of the annual distribution of daily maximum 1-hour average concentrations. In order to determine compliance EPA revised the monitoring network requirements to include at least one monitor near a major road in an urban area with a population greater than or equal to 500,000 people. EPA also required a community-wide monitor in any urban area with a population greater than or equal to 1 million people. Maine will be required to have one near road monitor in the Portland area but will not be required to have any community-wide monitors. The current

**Figure 29: 1-Hour 99th Percentile Sulfur Dioxide Trends**



monitoring site at the Deering Oaks Park in Portland is within 50 meters of Forest Avenue and State Street and is also near I-295. Since Forest Avenue is a major road and carries a large amount of traffic it would appear to meet the siting requirements. This monitor has been in operation for the last two years and based on the data collected it would appear that the monitor is currently about 50% of the standard. In addition to this monitor a low level oxides of nitrogen monitor will be required at the NCore site in Acadia National Park. The Micmac tribe also operates a monitor at their site in Presque Isle. The existing monitors meet EPA monitoring requirements and will provide the data necessary for urban and rural concentrations needed for the licensing program. The locations of nitrogen dioxide and reactive oxides of nitrogen monitors ( $\text{NO}_y$ ) are shown in Figure 30.

**Figure 30: Maine Nitrogen Monitor Locations**



## Carbon Monoxide

The current NAAQS for CO is a 1-hour standard of 35 ppm and an 8-hour standard of 9 ppm. There is currently no secondary standard. These standards were promulgated in 1971. They have undergone several reviews since first promulgated but have not been changed. The CO standards are currently under review again with proposed rulemaking scheduled for October 28, 2010 and a final rulemaking by May 13, 2011. Maine had experienced some non-attainment problems in the 1970's in some of the "street canyon" areas of Bangor, Lewiston and Portland. Traffic pattern changes and newer vehicles resolved those problems and CO concentrations have been dropping ever since. Carbon Monoxide is currently monitored in Portland at the Deering Oaks site and at the NCore site in Acadia National Park. The Micmac tribe also operates a monitor at their site in Presque Isle. The maximum 1-hour concentration recorded over the last two years at the Deering Oaks site in Portland site has been 2.4 ppm and the maximum 8-hour concentration over that same time period has been 1.8 ppm. Given the low concentrations the only required monitoring is the required trace level monitor at the NCore site in Acadia National Park and an urban monitor needed for the licensing program. The locations of carbon monoxide monitors are shown in Figure 31.

Figure 31: Maine Carbon Monoxide Monitor Locations



## Atmospheric Deposition Monitoring

### Background

The importance of collecting environmental data geared toward understanding and addressing the problem of atmospheric deposition was recognized nationally in the early 1970s. The objective was, and still is, to obtain quality assured data and information in support of research on the exposure of managed and natural ecosystems and cultural resources to acidic compounds, nutrients and base cations in precipitation. Mercury was added to the list of compounds of interest by the mid-1990s. These data are then in turn used to support informed policy decisions on related air quality issues.

The National Atmospheric Deposition Program (NADP) was organized in 1977 under the leadership of the State Agricultural Experiment Station (SAES) program to increase the understanding of the causes and effects of acidic precipitation on agricultural crops, forests, rangelands, surface waters and other natural and cultural resources. A long-term precipitation chemistry network of wet-only deposition sites, distant from point source emission influences, began operation in 1978 collecting one-week long bulk precipitation samples. Precipitation chemistry is determined by having the samples analyzed by a Central Analytical Laboratory (the CAL, located at the University of Illinois in Champaign) for the routine parameters listed in Table 6 below, which provides data on amounts, temporal trends and geographic distributions of the atmospheric deposition of acids, nutrients and base cations by precipitation.



Table 6: Wet Deposition Chemistry Parameters

Calcium	Magnesium	Potassium
Sodium	Ammonium	Nitrate
Chloride	Sulfate	Specific conductance
Free acidity (as pH)	Orthophosphate ( for QA purposes)	

Sites that belong to this National Trends Network (NTN) benefit from having identical siting criteria, operating procedures, a common analytical laboratory, as well as a common quality assurance program. Presently, there are approximately 250 sites nationally in the NTN.

Over increasing concerns about mercury in the atmosphere, during the mid-1990s, a Mercury Deposition Network (MDN) was created within NADP to provide data and information on the wet deposition of this pollutant to surface waters, forested watersheds and other receptors. To help illustrate the extent of the mercury problem, 48 states and 8 Canadian provinces have health advisories warning against the consumption of fish with high fish tissue mercury concentrations taken from lakes and other water bodies. The MDN is also a long-term precipitation network of wet-only deposition sites, distant from point source emission influences, which began operation in 1996 by also collecting one-week long bulk precipitation samples. Samples are analyzed by a different central laboratory (Frontier Global Sciences in Seattle, WA) for total mercury (sites can also opt to have samples analyzed for methyl mercury), which provides data on amounts, temporal trends and geographic distributions of the atmospheric deposition of mercury and mercury related compounds by precipitation. Like sites in the NTN, sites that belong to the MDN have the same benefits described previously. Presently, there are approximately 110 sites nationally in the MDN.

## History

**National Trends Network (NTN):** Maine has a long history of operating and maintaining atmospheric deposition monitoring networks. More than three decades ago when concerns about “acid rain” topped many environmental organizations’ agendas and captured the public’s attention in both the United States and Canada, the University of Maine sponsored the first precipitation chemistry site in the state in Greenville (ME09), which began operation in November 1979 as part of the NADP’s National Trends Network (NTN). Being the most forested state in the nation as a percentage of its total land area, both then and now, there was good reason to begin to collect measurements to assess the amount and kinds of acidic compounds, nutrients and base cations that were being delivered to our forest ecosystems through wet deposition. The following year quickly saw three additional NTN sites established: the first in Caribou (ME00) by the National Oceanic and Atmospheric Administration (NOAA) in April, the second in Bridgton (ME02) by Maine DEP (its first) in September, and the third one in Acadia National Park in Bar Harbor at Paradise Hill (ME99) by the National Park Service (NPS) in November 1980. A year later in November 1981, the NPS relocated this site to its current location at McFarland Hill (ME98), which concluded this early phase of NTN network growth in Maine.

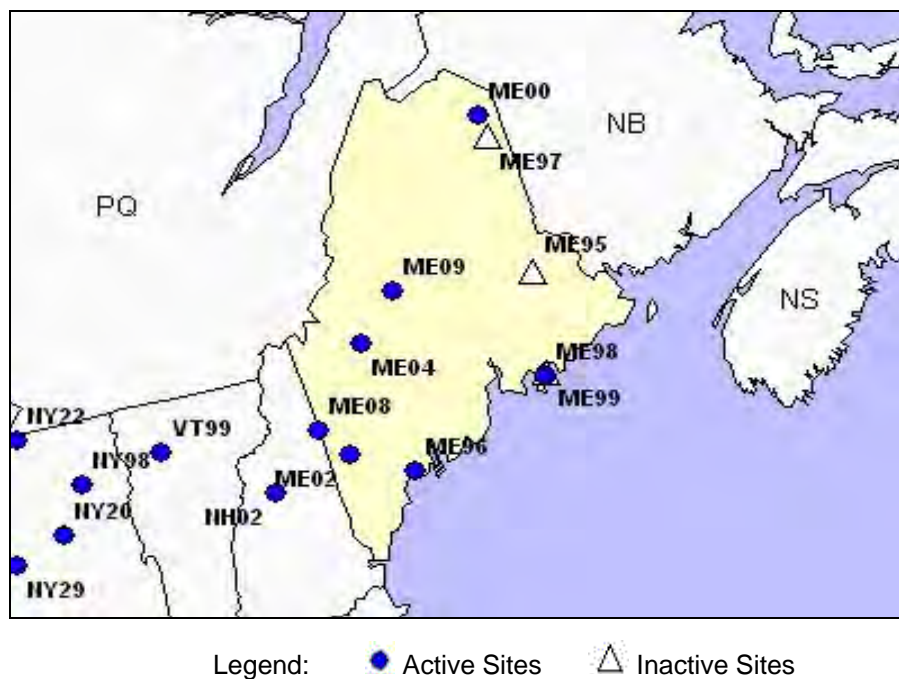
To these sponsoring agencies credit, four of these early sites (ME00, ME02, ME09 and ME98) have remained in continuous operation to the present day, which is a powerful testament to their dedication to the network and their belief in the value and importance that this long-term trend data (30 years  $\pm$ ) provides to many varied outside stakeholders, in addition to their own internal data users. There's no better example of illustrating the "long" in long-term than this!

NOAA established a second site in Presque Isle (ME97) in June 1984, which was operated by the University of Maine. It was discontinued at the end of September 1988.

This four-site network remained very stable for the next 17 years, when the second and most recent phase of network growth occurred, beginning in January 1998. In collaboration with EPA-NE initially, Maine DEP sponsored its second NTN site in Freeport (ME96) as part of the 3-year Casco Bay Estuary Air Deposition Project. After the completion of this project in 2000, Maine DEP has continued to sponsor and operate this site. In September 1999, the US Geological Survey established its site in the White Mountain National Forest in Gilead (ME08). And finally, in 2002 the most recent site additions to the NTN in the state were by two Maine tribes: the Penobscot Indian Nation established a site on some tribal land in Carrabassett Valley (ME04) in March, and the Passamaquoddy Tribe did the same at a location on their land near Scraggly Lake (ME95) in June.

See Figure 32 for a map of Maine's NTN site locations.

Figure 32: NTN sites in Maine

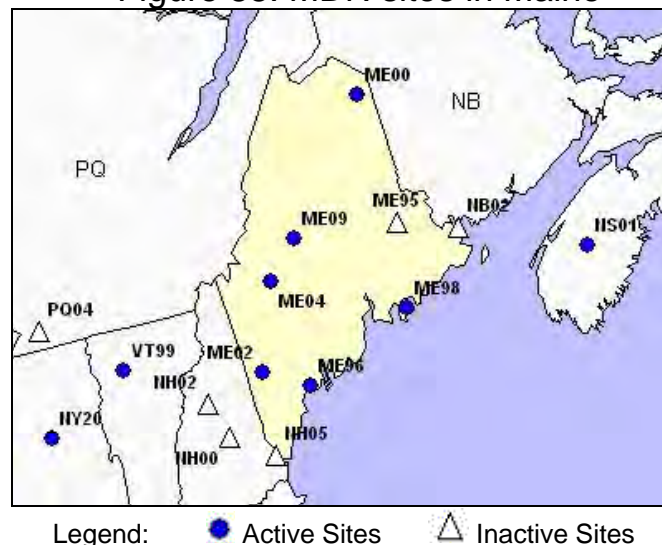


**Mercury Deposition Network (MDN):** Maine DEP has been a leader not only in the Northeast but nationally as well when it comes to measuring and documenting mercury levels in the environment, along with coming up with innovative ways of removing it from its various waste streams. Maine was one of the first seven states nationally to sponsor the first mercury deposition monitoring sites in the MDN in 1996. Maine DEP and the National Park Service combined resources and efforts to establish the state's first site in Acadia National Park in Bar Harbor at McFarland Hill (ME98 and collocated with the NTN sampler) in March 1996. DEP quickly followed up ME98's joint site sponsorship with the establishment of one on its own in Greenville at ME09 (also collocated with the NTN site) in September 1996. Building on these early successes, DEP established the state's third (and its second full) MDN site in Bridgton at ME02 in June 1997. In January 1998, through the same collaborative effort between EPA-NE and the Casco Bay Estuary Program described earlier for the Freeport NTN site (ME96), DEP installed the state's fourth MDN site as part of the Casco Bay Air Deposition Project. As with the NTN site in Freeport, DEP has also continued to fund and operate ME96 for mercury deposition after the study was completed in 2000. All four of these original sites continue in operation today, which now provides a very valuable 12 – 14 year data record.

The most recent addition of sites to the MDN in Maine came nearly 10 years later, to include one in Caribou at ME00 in May 2007, with the newest one in Carrabassett Valley at ME04 in February 2009. The MDN site at ME00 came about as a result of a DEP consent agreement with a facility that contained a provision for the funding of a Supplemental Environmental Project to study mercury deposition in northern Maine. With the DEP acting in a project support role, the University of Maine in Orono was the recipient of the SEP funds and oversees the implementation of the project. The MDN site at ME04 is a result of the Penobscot Indian Nation's desire to collocate a mercury deposition site along with the NTN sampler at this tribal site.

See Figure 33 for a map of Maine's MDN site locations.

Figure 33: MDN sites in Maine





### *Trends:*

One of the principal data products produced by the NADP from the data measured by Maine's NTN and MDN sites, along with the other sites in those networks, are nationally color-shaded contour maps of both concentration and deposition amounts. The different color shades represent defined numeric ranges of the precipitation-weighted mean concentration and annual wet deposition of a map's identified parameter, and depict its spatial variability across the country. Comparing annual maps to one another also provides the ability to look at temporal changes over time. An illustration of these color-shaded contour maps for sulfate ion concentration appears in Figure 34. As can be seen for Maine, as well as the rest of the country when comparing the two maps over the 14-year period represented, there has been an easily noticeable decrease in the concentrations of sulfate ion as measured via precipitation samples. Another example of illustrating this same trend in the data can be seen in the plots for sulfate for two of Maine's longest-term trend sites over an even longer period of time, as shown in Figure 35. By having this long-term trend measurement network in place over 30 years, its data has been able to empirically document the successful implementation of various sulfur emission reduction activities, on the state, regional and national levels, during this time period.

Related to and due in part to sulfate in precipitation creating sulfuric acid (as one example), the resulting pH of precipitation samples (determined from hydrogen ion analyses) is an important ecological parameter measured by the NTN network. The annual maps and plots in Figures 36 and 37, respectively, illustrate a corresponding improving trend in pH levels, although not of the same magnitude as seen with sulfate reductions. This is because there are pollutants, namely nitrates, that also contribute to the acidity found in precipitation. Nitrogen emission reduction activities have also been in place during the last three decades, but have not resulted in the same degree of improvement (as seen in Figure 38) that occurred with sulfur/sulfates. This difference helps to explain only the modest improvement in pH levels.

Figure 34: Sulfate Ion Concentrations

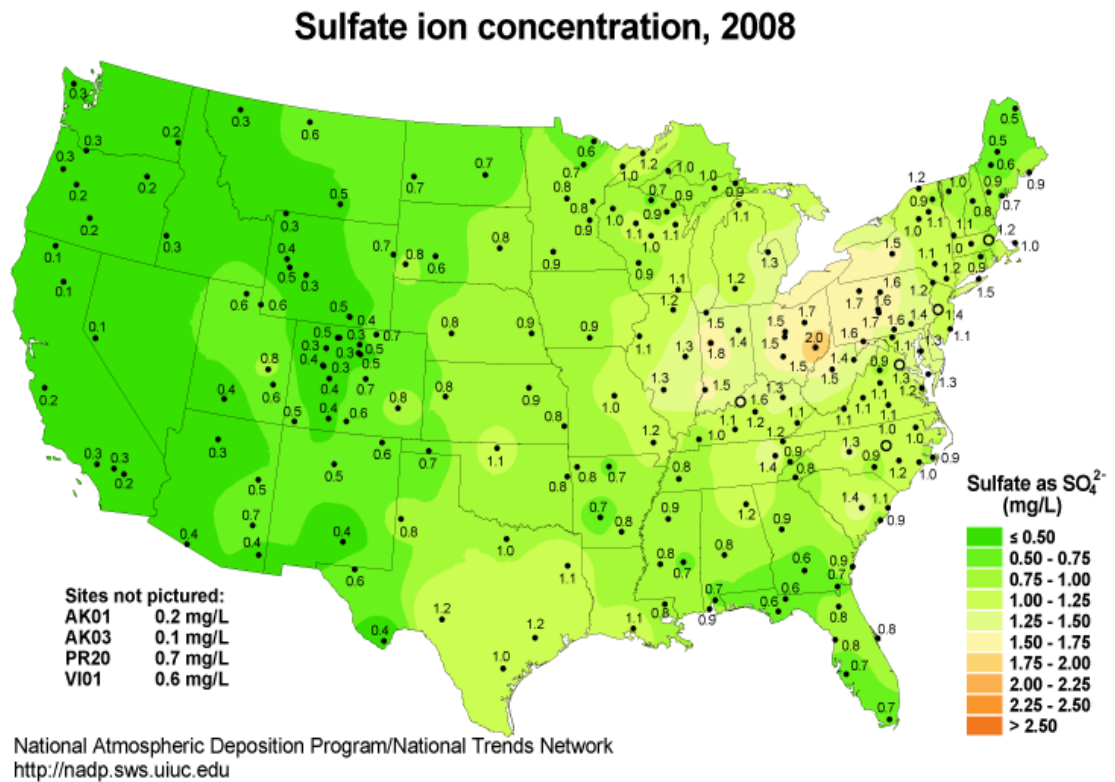
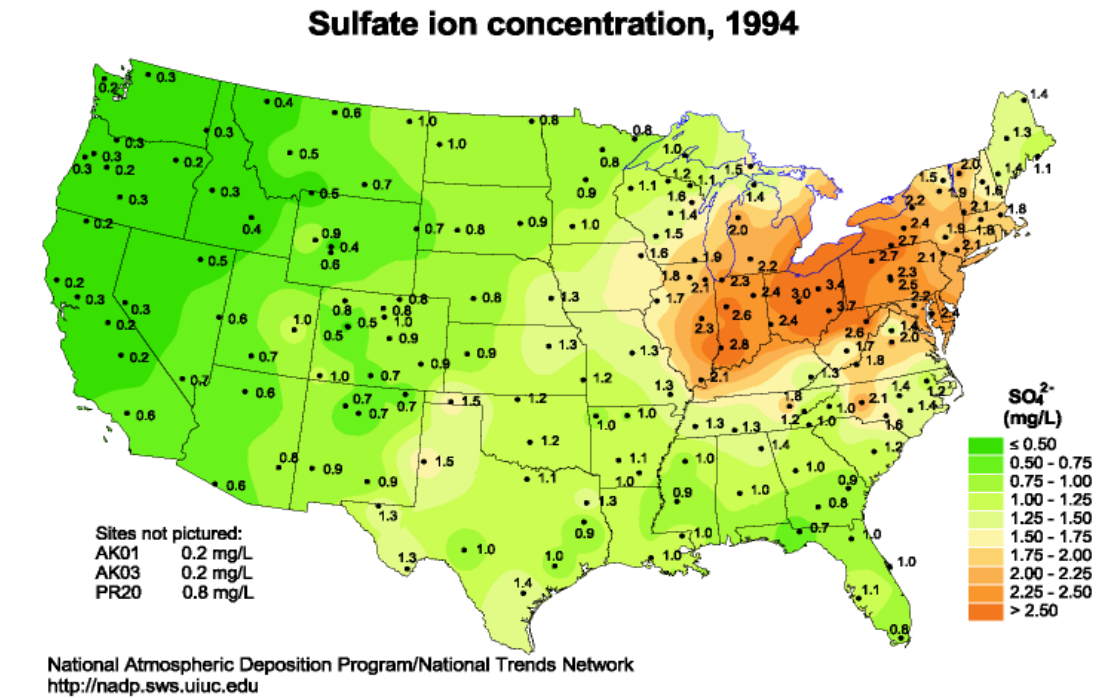


Figure 35: Annual Sulfate Concentrations

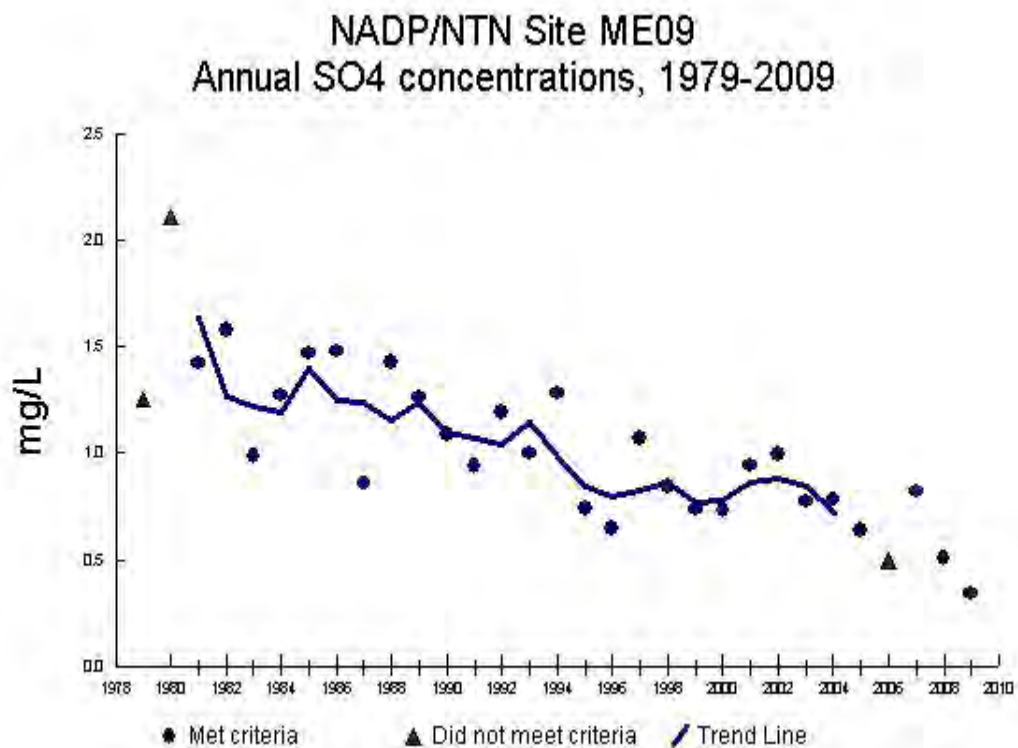
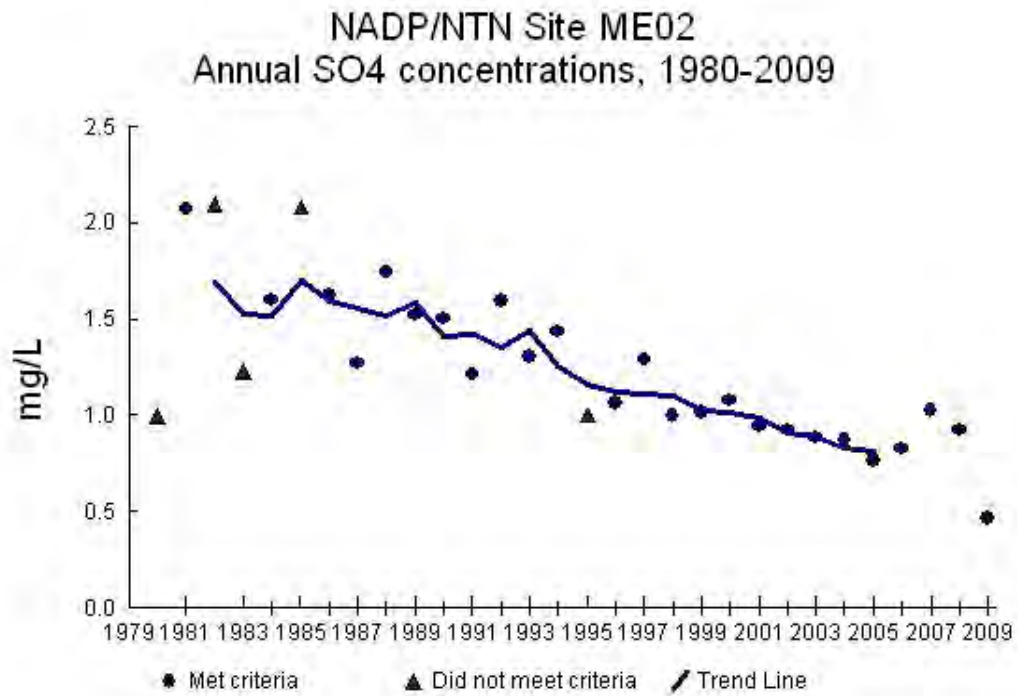
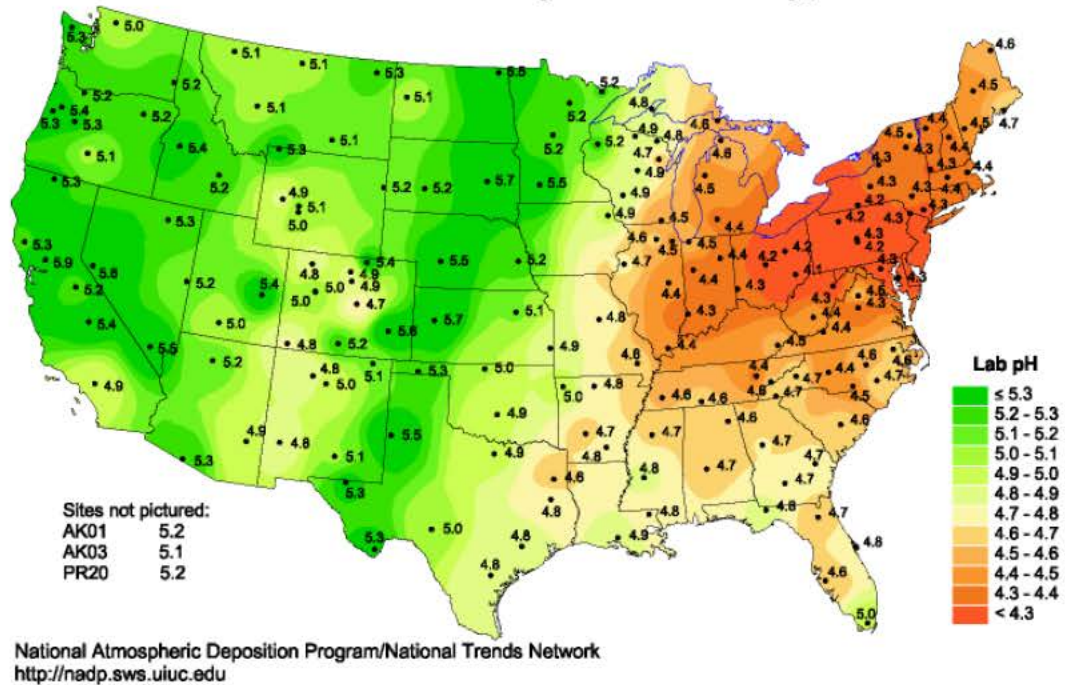




Figure 36: Hydrogen Ion Concentrations

**Hydrogen ion concentration as pH from measurements made at the Central Analytical Laboratory, 1994**



**Hydrogen ion concentration as pH from measurements made at the Central Analytical Laboratory, 2008**

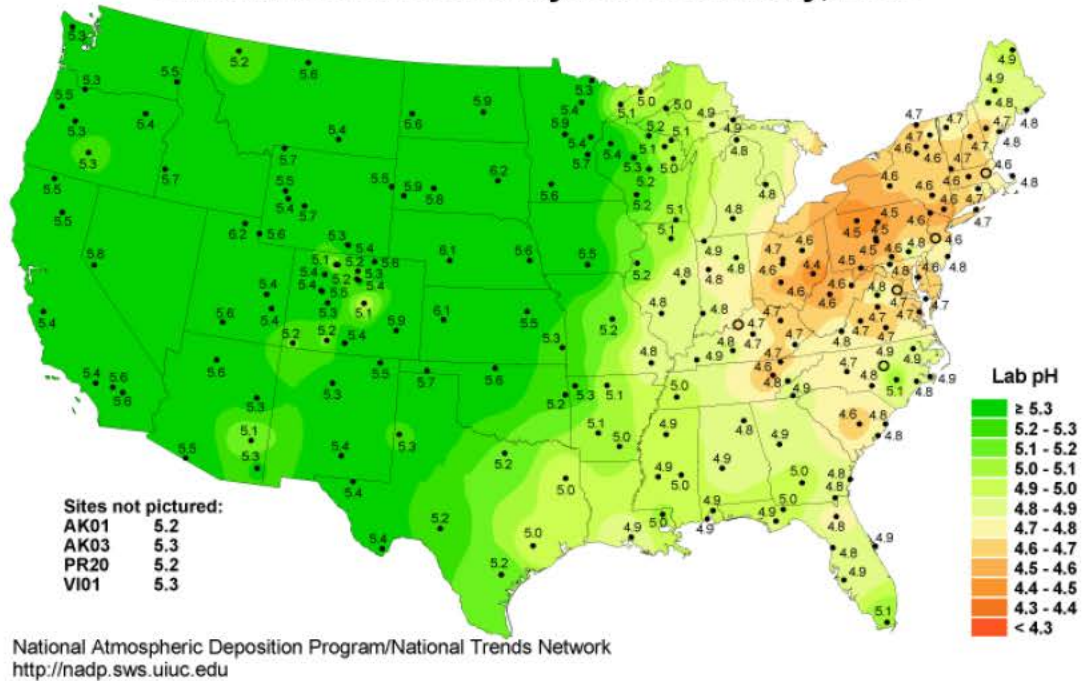


Figure 37: Annual pH Data From Two Maine Sites

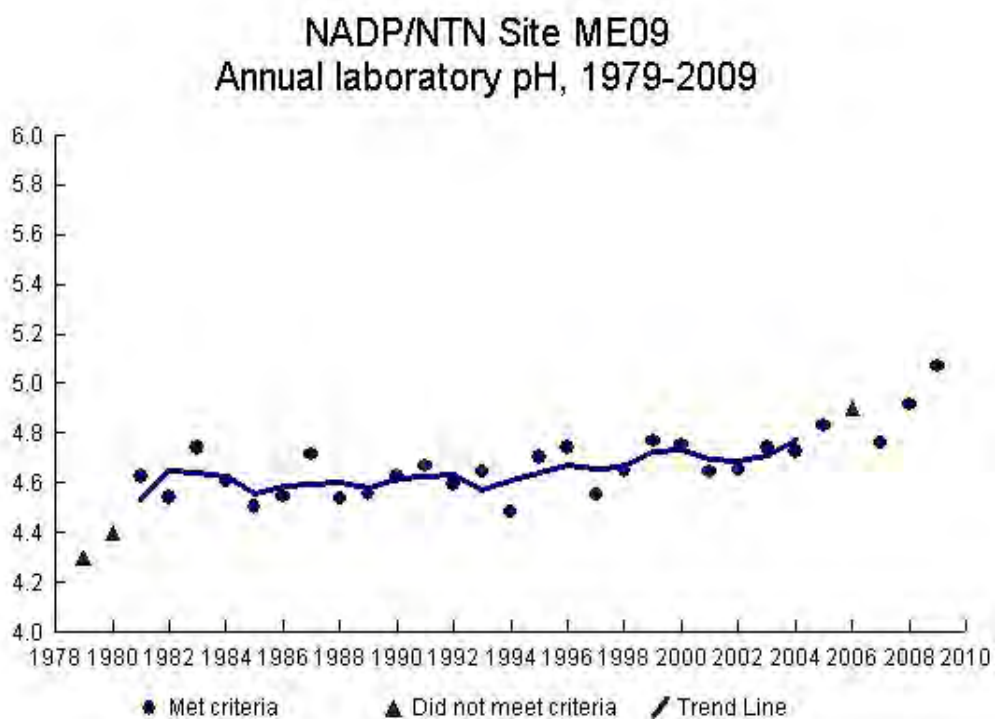
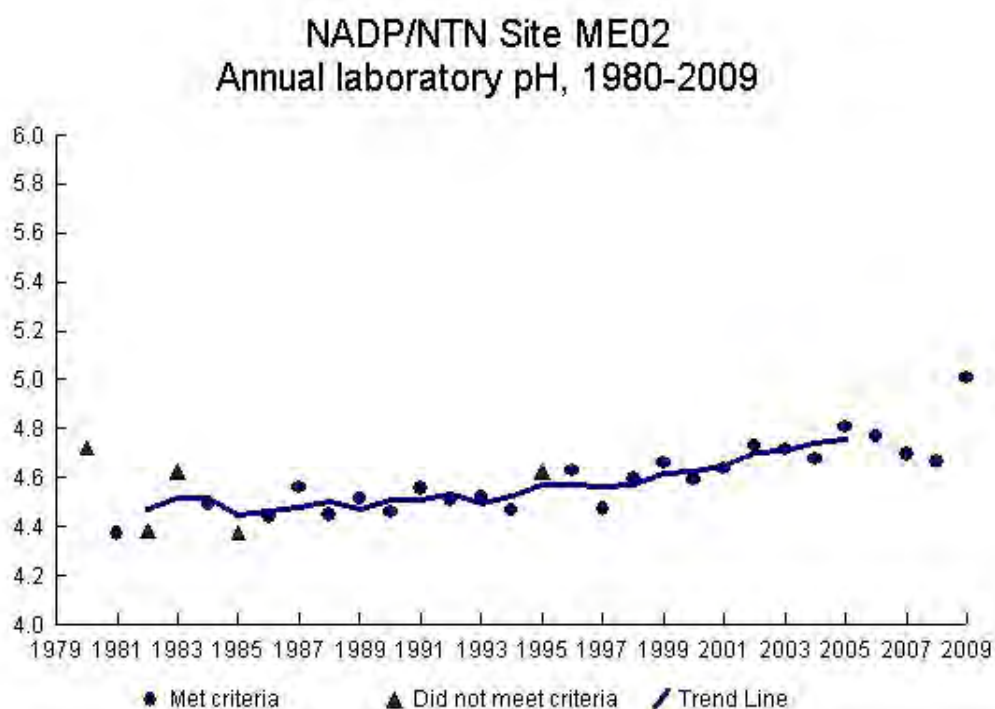
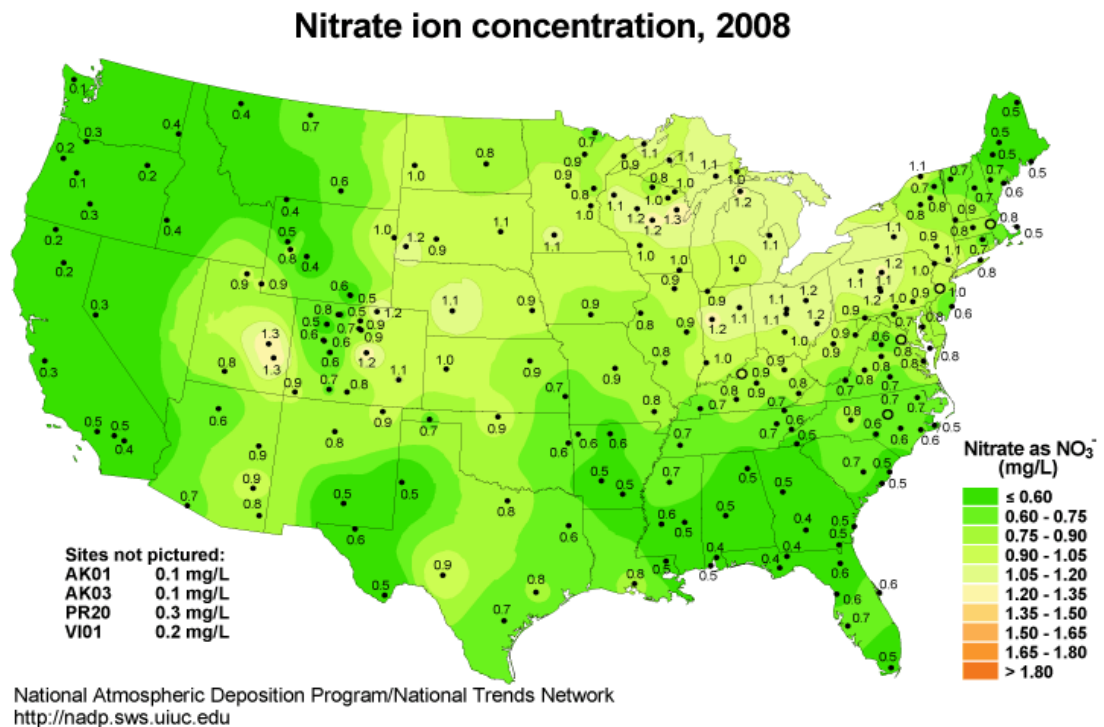
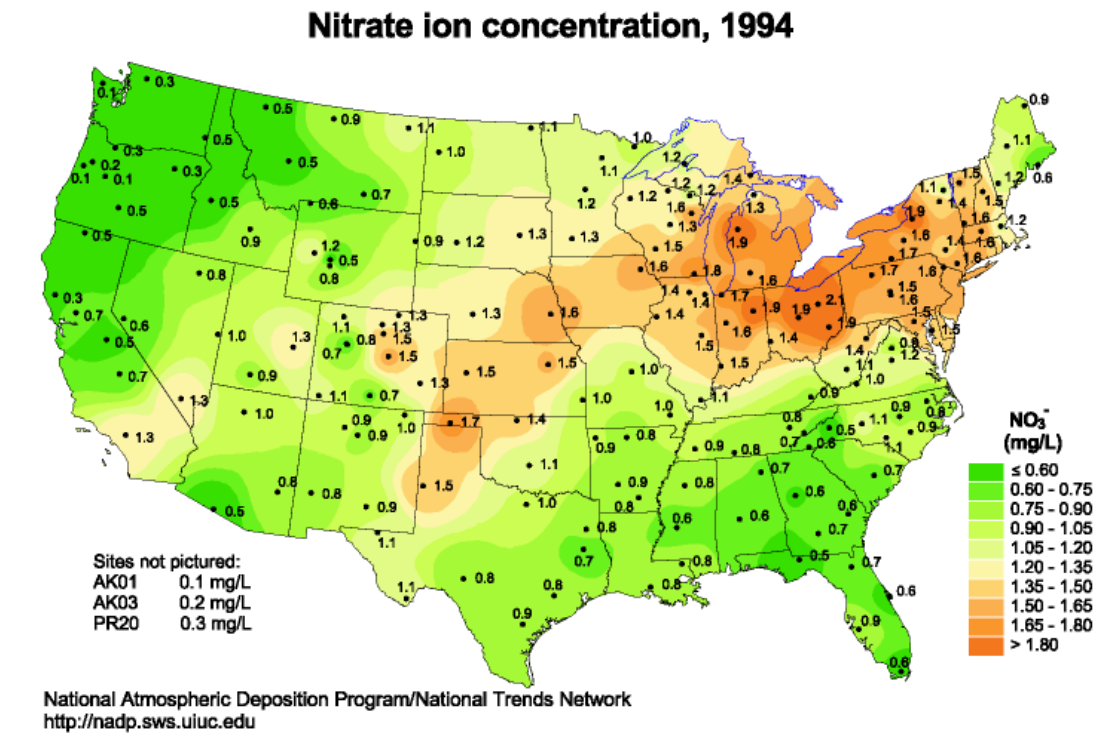


Figure 38: Nitrate Ion Concentrations



Lastly, to help illustrate the advantages and benefits of having a robust and truly long-term trend network and its data, Figure 39 shows the annual color-shaded contour maps of the MDN sites nationally from 2003 and 2008. Because the number and density of sites in this network nationally (along with some other factors) are not as great as that of the NTN, the NADP felt the mapping program it uses to create its maps was not the most appropriate or best way to representatively depict total mercury concentrations (and deposition) until 2003. As one can see, visible discernable (and significant) trends are not as readily apparent over this shorter 5-year time period. Also, because the number and location of MDN sites has been growing since the inception of the network, it doesn't yet have the consistency of a stable network like that of the NTN.

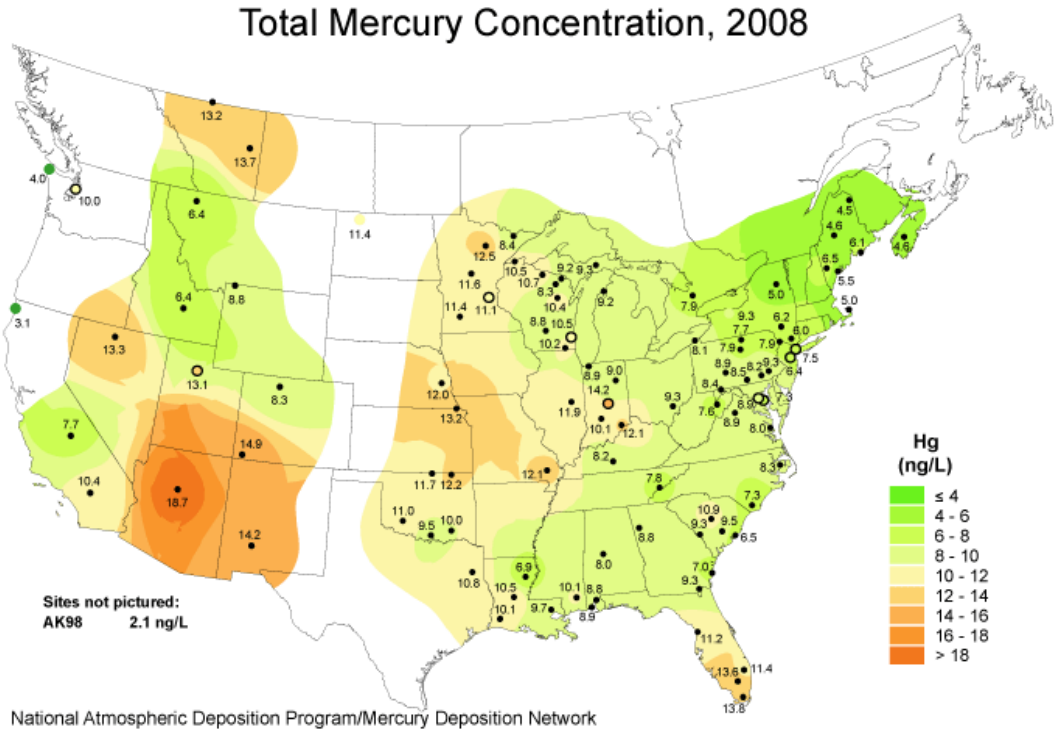
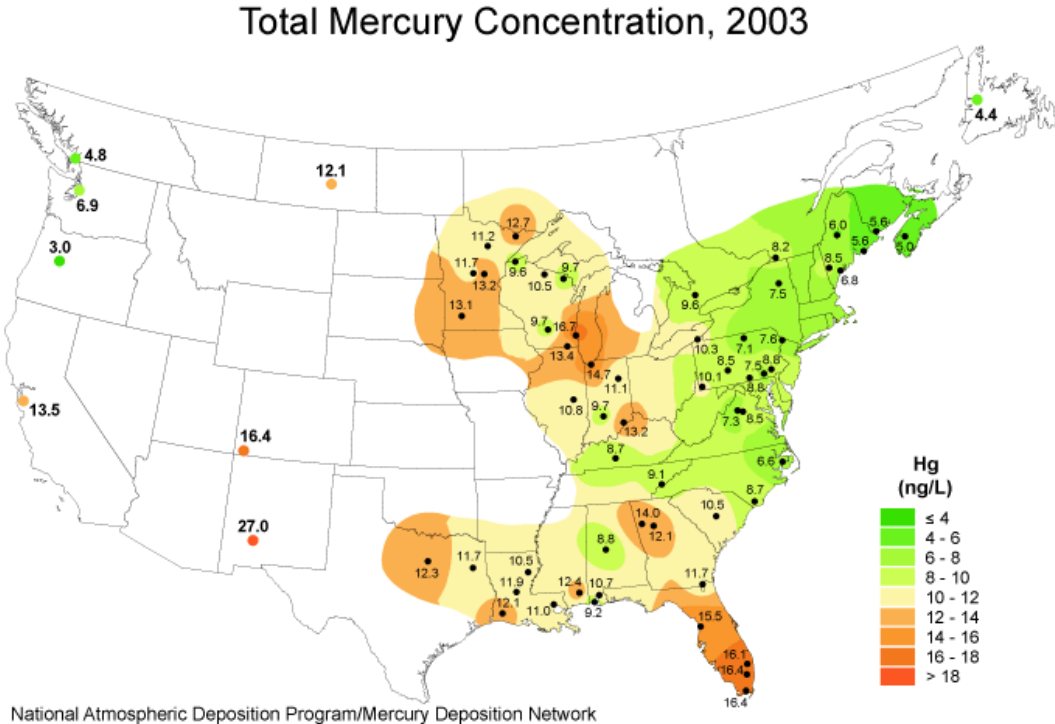
### *Future Monitoring Plans:*

Maine DEP plans to continue its support of the statewide NTN and MDN deposition monitoring networks and its financial sponsorship of the sites it currently is responsible for, because of the many important benefits having such a long-term network provides. Their data are valuable to not only our own internal data users, policy makers and the general public, but also to an amazing variety of other users representing many other scientific disciplines, ranging from wildlife biologists, water quality specialists, and epidemiologists, to atmospheric chemists, government regulators and academic researchers from many different fields. Maine DEP has played a critically important role during the most recent few years of stepping in to provide both funding and operational support to some of the oldest and longest running sites in the state, and the nation, when their original sponsoring organizations were faced with funding cutbacks which would have meant the closing of these sites. Specifically, Maine DEP rescued the NTN sites at Greenville (ME09) and Caribou (ME00) when the University of Maine and NOAA, respectively, had their funding cut for continued operation of these sites. The closing down of these two sites, or any long-term trend site for that matter, at this point in their history would have represented an irreversible loss in being able to continue documenting the long term trends in deposition in Maine and in the country without any confounding interruption in the dataset. As long as resources allow, Maine DEP is committed to preserving the operational status of the sites in the state.

A priority effort for the agency in the immediate near future will be collaborating with EPA-NE and the Passamaquoddy Tribe to re-establish the tribal NTN site (ME95) that was formerly located near Scraggly Lake. This currently is the only area of the state that does not have any wet deposition monitoring and its precipitation chemistry taking place, and represents a major missing piece of the deposition picture in this heavily forested, agricultural and surface water based recreational area.



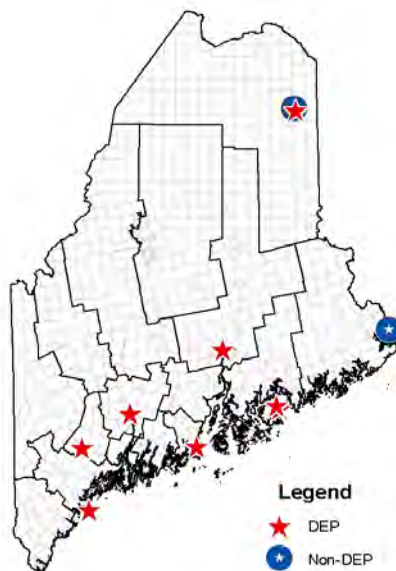
Figure 39: Total Mercury Concentrations



## METEOROLOGICAL MONITORING

Integral to the analysis of air pollution data is the need for meteorological monitoring to provide wind speed and direction data. The wind speed and direction data can then be used to track both where the pollutants may have come from and where they may be going. To ensure the availability of data Maine has operated monitoring sites for wind speed, direction and stability in Presque Isle, Bangor, Augusta, Lewiston, Owls Head and Cape Elizabeth. A monitor is also operated on top of Cadillac Mountain in Acadia National Park during the summer season. In addition to these sites the National Park Service operates a monitor in Bar Harbor and the Passamaquoddy and Micmac tribes operate monitors at their sites. The locations of monitors around the state are shown in Figure 40.

**Figure 40: Meteorology Monitor Network**



The data from these sites can be used to develop annual wind roses or wind roses for varying time periods. The data can also be combined with pollutant data to develop pollution roses. An example of an annual wind rose covering a five year period is shown in Figure 41 and an example of a pollution rose is shown in Figure 42. Annual wind roses from all of the monitors can be found at

<http://www.maine.gov/dep/air/meteorology/Windrosehome.html>. In the past there have been monitors operated at a number of industrial sites around the state either as part of a monitoring program or to gather data to be used in a modeling analysis for a source that needs to show compliance with air quality standards. For most modeling analyses a five year data set is required. A list of those locations that have collected and processed meteorological data for use in modeling can be found on the Bureau's web site at <http://www.maine.gov/dep/air/meteorology/metdata.html>.

**Figure 41: Five Year Annual Wind Rose for Augusta, Maine**

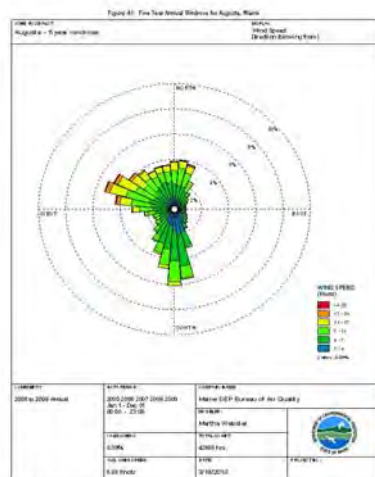
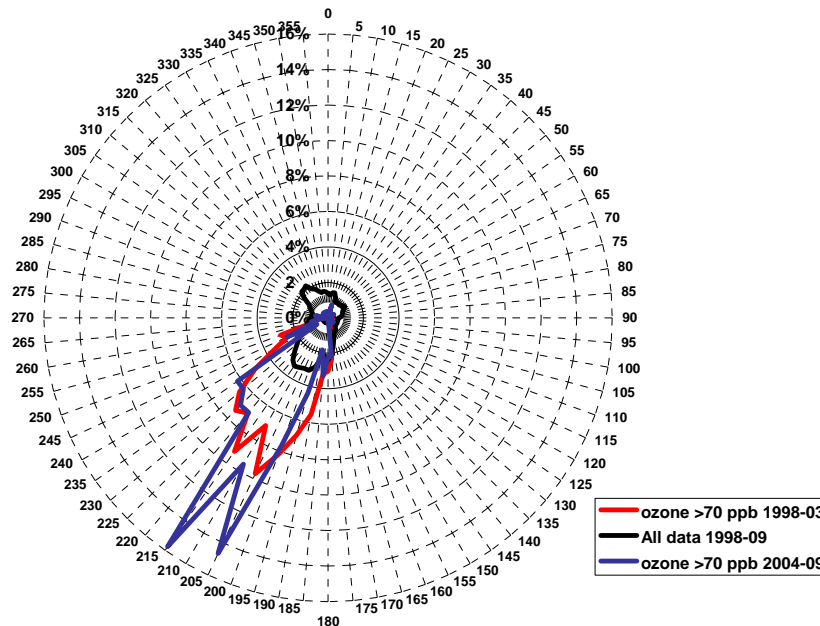


Figure 42: CAPE ELIZABETH OZONE POLLUTION ROSE (wind direction frequency)



## MONITORING EQUIPMENT

Maine has an extensive and expensive inventory of air monitoring equipment to operate the current network. Most monitors in use today cost several thousand dollars for both the monitor and calibrator. Couple that with a data logger and a shelter and even a simple one pollutant site can cost \$45-\$50,000 to put in operation. The current monitoring plan calls for equipment to be replaced after about ten years of use. Depending on available funds the equipment cycle is usually a little longer. In the past year Maine has been able to replace several ozone monitors and calibrators, particulate monitors and trace level carbon monoxide, sulfur dioxide and nitrogen dioxide monitors. The yearly budget for the Bureau continues to allocate \$100,000/year for capital equipment replacement. This amount along with some capital equipment dollars available through EPA grants has enabled the Bureau to maintain the equipment and achieve a high data recovery rate for the monitoring network. However, given the total dollars in monitoring equipment, including both field monitors and laboratory equipment, this amount translates to approximately a 15-20 year replacement cycle for the monitoring equipment.

The current monitoring equipment is adequate to maintain the proposed network. The major area of concern is the lack of any spare continuous particulate monitors. Some of the more expensive repair parts that may be needed are not readily available from the vendors and with a couple of the monitors in use for ten years or more those parts are starting to need replacement and when a monitor fails it may take a few weeks to get the needed part from the vendor. The instruments in use were some of the first continuous particulate monitors developed but do not meet the requirements for an approved method so spending the money to have a spare monitor does not make sense at this time. Should a site in a western Maine mountain valley be deemed necessary than a decision will need

to be made to stay with a new monitor that is not an approved method but could be adequate for forecasting purposes or to start transitioning the continuous particulate network to new monitors which are approved. Also of some concern is the age of the PM<sub>2.5</sub> and PM<sub>10</sub> filter based monitors. Most of these were placed into service over ten years ago. Several replacement monitors have been purchased in the last year but more will need to be acquired in the next year or two in order to maintain the existing network without a lot of lost data due to maintenance problems. One final area of concern is the monitoring and calibration equipment that may cost several thousand dollars apiece but does not reach the capital equipment level of \$5000. This equipment has to compete with the rest of the operating budget for the Bureau and the budget does not always allow for routine replacement of this level of equipment.

## **QUALITY ASSURANCE**

The Environmental Protection Agency has a policy that requires all projects involving the generation, acquisition, and use of environmental data be planned and documented, and have an Agency-approved quality assurance project plan (QAPP) prior to the start of data collection. The primary purpose of the QAPP is to provide an overview of the project, describe the need for the measurements, and define QA/QC activities to be applied to the project, all within a single document. The QAPP should be detailed enough to provide a clear description of every aspect of the project and include information for every member of the project staff, including samplers, lab staff, and data reviewers. The QAPP facilitates communication among clients, data users, project staff, management, and external reviewers. Effective implementation of the QAPP assists project managers in keeping projects on schedule and within the resource budget. The EPA's QA policy is described in the Quality Manual and EPA QA/R-1, *EPA Quality System Requirements for Environmental Programs*.

Maine currently has four QAPP's in place for various air monitoring programs. The Particulate Matter (PM) NAAQS Pollutants QAPP was revised and approved by EPA on May 30, 2007. It is currently undergoing a revision to incorporate all aspects of PM<sub>10</sub> monitoring using low volume manual samplers and continuous PM monitoring using TEOM samplers. The Gaseous NAAQS Pollutants QAPP was revised and approved by EPA on June 23, 2009. It is currently undergoing additional review with additional changes expected later this year. The Photochemical Assessment Monitoring Station (PAMS) QAPP was revised and approved by EPA on October 28, 2005. It is currently under review with additional changes expected later this year. The Air Toxic Volatile Organic Compound (VOC) Pollutants QAPP was revised and approved by EPA on September 28, 2004. It is currently under review with additional changes expected later this year. Additional revisions will be needed to address the trace level monitors required for the NCore site and for the lead monitoring requirements that will be effective next year.

Maine currently operates an extensive quality assurance program that includes auditing of all ambient monitors by staff from the Laboratory and Quality Assurance Section. In order to maintain a high level of confidence in the accuracy of data collected by ambient



monitors the lab and QA staff conduct audits of the instruments each quarter. This program far exceeds the minimum requirements of EPA. This requirement will be relaxed in future revisions based on demonstrated results to date so as to allow for staffing or equipment issues that may preclude this requirement from being met each quarter.