The North Carolina Department of Environment and Natural Resources
Division of Air Quality
Ambient Air Monitoring Section

Public Outreach for Ambient Air Criteria Monitoring in North Carolina

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On October 17, 2006, the Environmental Protection Agency (EPA) promulgated a new rule that requires all State and Local air monitoring organizations to make any changes in their air monitoring networks available for a 30 day public comment period, before submitting their required annual network plans to EPA.

This presentation provides background information on how the North Carolina Division of Air Quality's Ambient Air Monitoring Section oversees the operation of the State's Networks, so that the public may be in a better position to make comment on the Annual Network Design Plan required to be submitted to EPA on June 30th, 2007.

The State of North Carolina is recognized by EPA as having four environmental agencies that collect and report air pollution data.

The North Carolina Division of Air Quality - NC DAQ
The Western North Carolina Regional Air Quality Agency - WNC
The Mecklenburg County Land Use and Environmental Services Agency - MCAQ
The Forsyth County Environmental Affairs Department - FCEAD

There is also a Tribal Agency, the Eastern Band of Cherokee Indians, in Jackson County, which is a separate Primary Quality Assurance Reporting Organization not included in this presentation.

This presentation will discuss the purpose of monitoring the air in NC, what the monitoring involves, where it is done, how locations are determined and how the networks are designed.

This presentation will focus primarily on the operations of the NC DAQ. The three other local county programs operate similarly in accordance with State and Federal regulations.

What is Ambient Air Quality Criteria Monitoring?

"Ambient air" is the outside air that we all breathe. This term is specifically defined by EPA as "that portion of the atmosphere, external to buildings, to which the general public has access."

In the early 1970s, the EPA listed six major air pollutants that affected the quality of ambient air and established concentration limits for these pollutants. These limits are known as the National Ambient Air Quality Standards (NAAQS). Primary limits or standards were established to protect human health and secondary standards were established to protect human welfare and the quality of life. Through the years, the NAAQS have been revised and amended to account for evolving scientific understanding of air pollution and its impacts. Currently, the six criteria pollutants are:

Ozone	O3
Particulate matter	PM 2.5 and PM 10
Carbon Monoxide	CO
Sulfur Dioxide	SO2
Nitrogen Dioxide	NO2
Lead	Pb

These six pollutants can cause serious human health problems (including premature mortality) and damage the environment and property. Common sources of these pollutants are coal-fired power plants, industrial manufacturing sources, and on-road and off-road vehicles. These standards can be viewed on-line at **http://www.epa.gov/ttn/naaqs/.**

The Clean Air Act (CAA) requires the states to set up air monitoring networks to measure these six pollutants. The methods used to sample these pollutants are referred to as either "reference" or "equivalent" methods and must be approved by EPA before being used. The required methods for sampling these six pollutants, and ambient limits themselves are codified in the Code of Federal Regulations at 40 CFR Part 50.

The NC DAQ Air Monitoring program can be broken down into two categories:

1) Ambient Air Criteria Pollutant Monitoring

2) Toxics Air Monitoring

This presentation only addresses the Ambient Air Criteria Pollutant Monitoring in North Carolina. Information on Toxics Air Monitoring in North Carolina can be found on the Division's Website under the Air Toxics Program at http://daq.state.nc.us/**.**

Where can I find Ambient Air Criteria Pollutant Monitoring Data?

The State and three local programs in Buncombe, Forsyth and Mecklenburg counties, maintain over 70 locations of air pollution monitors in 45 counties around the State. There are two types of monitors - those that have data that can be collected by telemetry and those with filters that must be collected manually. The locations for the telemetered monitors, available meteorological parameters and their latest hourly readings can be viewed on-line at: http://daq.state.nc.us/ambient/monitors/**.**

The remaining manual sites are fine particulate (PM2.5) sites and are operated manually. Their data are not available in real time. You can request data from a manually operated PM2.5 site at: http://daq.state.nc.us/ambient/monitors/.

The Air Quality Index

Data from all the criteria pollutants are required to be available to the general public using what EPA calls an Air Quality Index or AQI. For any city of 500,000 people or more, the NC DAQ and the local programs are required to provide the general public with access to this information. Most major cities in NC report this information on the weather pages in their local newspapers. These data also are posted on the NC DAQ and local program websites.

The Air Quality Index compares local pollutant levels with the National and State standards and reports these levels every several hours by translating raw pollution data into a more accessible reporting scale. This scale reports various levels of air quality data on a scale that ranges from Good to Moderate to Unhealthy or Very Unhealthy. These data can be used by the general public to assess how and when to conduct outdoor activities with regards to air pollution levels. That Air Quality Index website for the NC DAQ is found at http://daq.state.nc.us/monitor/aqi/. There is also a National Air Quality Index with nationwide air pollutant levels available at http://airnow.gov/ for EPA's national website called AIRNOW.

Who does Ambient Air Criteria Pollutant Monitoring in NC?

The NC Division of Air Quality's Ambient Monitoring Section consists of the following branches and offices **(**See **http://daq.state.nc.us/about/org/.)**

There are three branches at the NC DAQ Raleigh Headquarters:

- Projects and Procedures Quality Assurance Branch
- Data Management and Statistical Services Branch
- Electronics and Calibration Branch

There are seven NC DENR Division of Air Quality Regional Offices in:

- Wilmington
- Washington
- Fayetteville

- Raleigh
- Winston-Salem
- Mooresville (Iredell County -North of Mecklenburg County and Charlotte)
- Asheville

There are three local programs in Buncombe, Forsyth and Mecklenburg counties that maintain ambient air criteria monitoring for those counties.

The NC DAQ Ambient Monitoring Section's Responsibilities

Projects and Procedures Branch

The Projects and Procedures Branch is responsible for maintaining the overall quality control for all ambient monitors operated by the State and local programs. Electronically polled data is checked daily by the headquarters and several times a week by the regional offices for quality control purposes. These instruments must follow EPA-approved Quality Assurance/Standard Operating Procedures that are updated and reviewed on a regular basis by this branch. Annually, the operations logbooks and maintenance activities are reviewed and reported in an overall Systems Audit Report that is sent to EPA. Electronic continuous monitors are checked at least every 14 days by site operators. Manual particulate monitors must meet monthly flow check and other maintenance requirements. All sites are audited by an independent audit device at least once per year.

Data Management and Statistical Services Branch

The Data Management and Statistical Services Branch maintains daily polling activities of the NC DAQ electronic sites. This branch also forwards NC DAQ's data to EPA' s AIRNOW website which gives the public an up-to-the-hour look at nationwide air monitoring levels.

This branch also submits all final data from the Division of Air Quality to EPA's Air Quality System (AQS) database. This is EPA's database for storing all air monitoring data in the U.S. This branch also provides data to clientele inside and outside the NC DAQ and does statistical analyses on air monitoring data upon request. A request form can be found at http://daq.state.nc.us/monitor/.

Electronics and Calibrations Branch

The Electronics and Calibration Branch provides technical support to the Division of Air Quality and the Ambient Monitoring Section. This is accomplished by performing installations, repairs, maintenance, calibrations, certifications, audits and training on the air monitoring equipment. Various monitor, calibrator, data system interface and controller devices are certified by this branch. The branch purchases supplies, electronic parts and equipment. It services and repairs computer-related equipment. In addition to

direct repair and maintenance, this branch provides remote troubleshooting and repair assistance through telephone communication to minimize travel costs.

The Electronics and Calibration Branch supports NC DAQ Headquarters, seven DAQ regional offices, three local county programs and other air quality related agencies. This is to assure that high quality ambient data are available for decisions about attainment and non-attainment of the air quality standards. These data are collected by continuous and intermittent monitoring systems.

Regional Offices

There are seven regional offices of the Division of Air Quality in the State. Each office has staff dedicated to ambient monitoring operations. These technicians and chemists calibrate the monitors and perform routine maintenance checks and audits at routine intervals to insure continued quality assured performance. These personnel work in close conjunction with the Electronics and Calibration Branch for equipment installation, maintenance and repair and they work closely with the Projects and Procedures Branch to ensure that proper quality assurance is being maintained.

Local Programs

The Local programs operate in much the same manner as the NC DAQ regional offices operate. They are more reliant on their own maintenance activities and work with EPA directly for quality assurance issues. These programs are located in Buncombe, Mecklenburg and Forsyth counties and have extensive networks in those counties due to population size and the amount of industry located there.

How is Ambient Air Criteria Pollutant Monitoring performed?

The Code of Federal Regulations, 40 CFR Parts 50 and 53, establishes the reference and equivalent methods for the sampling of these six criteria pollutants. Many of these older laboratory wet chemistry reference methods are superseded by newer equivalent continuous electronic methods. Carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone and fine particulate all have continuous electronic methods now. The reference method for PM2.5 fine particulate is an intermittent manual filter method. There is a continuous method for reporting fine particulate data, but this is not an approved equivalent method and the data cannot currently be used for comparison with the NAAQS.

<u>Ambient Monitoring Methods</u>

<u>Ozone (O3)</u>

The NC DAQ and the local agencies use an EPA-approved ultraviolet (UV) photometric method to monitor for ozone. Air containing ozone absorbs UV light at a certain frequency which is read by the detector in the monitor. UV light is also the method used to generate ozone for calibration of these monitors. An ozone calibrator known as the

"primary standard" is taken to an EPA laboratory to be certified. This primary standard is then used to calibrate each site's calibrator for field use. These field calibrators are then used to calibrate the ozone monitors at each site.

Fine Particle Pollution (PM2.5)

The NC DAQ and the local agencies measure fine particles (PM 2.5) with two methods. One is a reference intermittent manual method and one is an EPA correlated acceptable continuous method, which is not NAAQS comparable. The continuous method will be a candidate for EPA certification as a stand-alone NAAQS method starting later this year.

The NC DAQ and local programs use a reference method sampler which pulls an air stream through a PM2.5-size selective inlet. This sample of air is then impacted onto a 47 mm width Teflon filter for a 24-hour period. Sampling is every three days at most sites. The technicians check the monitors for an array of temperature, pressure and other maintenance checks weekly. The filters are brought back to a lab and weighed.
The other method the DAQ uses to measure fine particles is a correlated acceptable continuous method that uses a "Tapered Elemental Oscillating Microbalance" (TEOM) to continuously weigh and measure fine particulate. TEOMs will be eligible starting this year to operate as stand-alone units as an Approved Regional Method (ARM) by EPA once EPA has reviewed and certified submitted applications.

Both of these methods are calibrated with a flow transfer standard that contains an orifice that has been manufacturer calibrated. These flow transfer standards are re-certified by the manufacturer on a semi-annual basis. These units are used to check flows for the manual monitors at least once per month and at least every 14 days for the "TEOM" method.

Carbon Monoxide (CO)

The NC DAQ and local programs use an equivalent method instrument that uses a divided infrared light source that alternates reading between the CO channel and the pure air channel. An infrared light wavelength enters the optical bench where it is absorbed by the carbon monoxide sample gas. This infrared radiation then exits the optical bench and is read by the infrared detector. This method is known as non-dispersion infrared light method or NDIR.

NC DAQ also uses a "trace level" method at some sites to measure very small levels of carbon monoxide. These small levels are precursors to ozone and fine particulate and these data can be used for modeling purposes. While the normal CO measured is in the 0-50 parts per million (ppm) range, trace level monitoring takes place at the 0-5 ppm range.

Sulfur Dioxide (SO2)

The State and Local monitoring agencies use an EPA-approved equivalent method continuous instrument to monitor sulfur dioxide (SO2). This monitor uses a "pulsed UV fluorescence" method to absorb SO2 at a certain wavelength to be read by a detector. The normal sampling range is 500 parts per billion (ppb). Trace level monitoring to measure for fine particulate precursors has a range of 200 ppb.

Nitrogen Dioxide (NO2)

The NC DAQ does not monitor for nitrogen dioxide as this criteria pollutant is at such low levels. The Charlotte-Mecklenburg county and the Winston-Salem Forsyth county local programs do monitor for this pollutant and their data represent a "worst case" monitoring data set for the State of NC. Since the NC DAQ does not continue to monitor for nitrogen dioxide, the EPA recommends that State and local programs monitor for oxides of nitrogen (NOy). NOy includes all the chemical variations of nitrogen oxide compounds, not just nitric oxide (NO) and nitrogen dioxide (NO2) which combine to form the compound known as nitrogen oxides (NOx). The State and local programs use a trace level instrument that uses a chem-illuminescence method measurement. These instruments are also used to measure "precursor" components for ozone and fine particulate.

The NOy chem-illuminescence method uses a light emitting reaction and a modified sample stream with the converter upstream of its normal placement to allow for more accurate monitoring of total reactive oxides of nitrogen. This stream may include the ozone precursors nitric acid (HNO3) and peroxy-acetyl nitrate (PAN).

All three trace level instruments (CO, SO2 and NOy) are used to monitor for ozone precursors as well as to corroborate monitoring for nitrate, sulfate and carbon elements now found in continuous fine-particle sampling.

Lead

Lead levels fell to low levels in North Carolina once the EPA banned the use of leaded fuel in most vehicles. North Carolina still monitors for lead but as a subset of the fine-particle pollution network with PM2.5 monitoring data.

What determines where air monitoring sites are located?

Types of Monitoring Sites

There are three types of monitoring sites: National Core Sites (NCore), State and Local Monitoring Stations (SLAMS) and Special Purpose Monitors (SPM)

NCore sites

NCore sites are National Core Sites. Each State is required to have at least one of these sites. These sites will monitor for many pollutants at one site. This will give an overall look at how various pollutants are affecting urban and rural locations that represent a large area of each state. North Carolina is designated to have two sites because of its large population. One site will be in Charlotte and the other in Raleigh, as these are the two largest urban populations in the State. The NC DAQ has proposed a NCore rural station at an existing site in Rowan County in Rockwell, North Carolina, located about 30 miles northeast of Charlotte.

SLAMS sites

SLAMS sites are State and Local Air Monitoring sites. These will comprise the majority of sites for State and local programs. These sites are made up primarily of the sites required by EPA based on previously measured pollution levels and population size in the Metropolitan Statistical Areas (MSA).

SPM sites

SPM sites are Special Purpose Monitoring sites. These sites are established by the NC DAQ for various reasons. For example, an SPM site may be helpful in an area to better understand the air pollution characteristics of that area. These sites can also provide background air quality data required prior to the siting of a major emission source at certain locations in the state.

Additional sites

The Ambient Monitoring Section also monitors non-criteria pollutants such as :

- Ammonia at three sites in Martin, Lenoir and Sampson counties
- Pollen, to represent the Raleigh area
- meteorological monitoring to accompany PM2.5 and other precursor pollutants
- special purpose monitoring, such as hydrogen sulfide, as needed.

National Monitoring Strategy

The requirements promulgated on October 17, 2006, and codified in the Code of Federal Regulations, 40 CFR Part 58, which EPA has termed a new National Air Monitoring Strategy, determine the placement of criteria pollutant ambient air monitors in North Carolina.

EPA requirements are:
1) Data will be provided to the general public in a timely manner. The NC DAQ and local programs provide these data through posting near real-time daily data on their

websites - for NC DAQ at http://daq.state.nc.us/ambient/monitors/; for Forsyth County at http://www.co.forsyth.nc.us/envaffairs/ and for Mecklenburg County at http://www.charmeck.org/Departments/LUESA/Air+Quality/Home.htm**.**

2) Multi-pollutant sites (those with fine-particle, ozone monitors and trace level monitors) will be established to better understand the impact of regional and local sources at two sites in North Carolina. These sites are Raleigh and Charlotte. These sites will be North Carolina's NCore sites.

3) Support meeting the National Ambient Air Quality Standards (NAAQS) with appropriate compliance strategy.

4) States will assess their networks and update them to address current air pollution problems.

5) Support air quality research studies.

Objectives of Designing an Air Monitoring Network

The EPA requires six monitoring objectives for measuring air quality required by State Criteria Networks:

1) Measure the highest concentrations or worst-case scenarios;
2) Determine representative concentrations in areas of high population density;

3) Measure impact on ambient pollution levels from significant sources;

4) Measure background concentrations;

5) Measure transport concentrations and

6) Measure for welfare-related impacts.

Network Design

Network Design is the process of determining where the various criteria pollutant monitors will be located in and around North Carolina.

In order to fulfill a proper network design for a State, sites must meet certain EPA requirements:

1) Develop a network for each individual criteria pollutant based on the nature of how each criteria pollutant forms and interacts in the atmosphere.

For example, carbon monoxide (CO) tends to remain close to a source and is best measured near the source. Thus CO is best sampled at sites that are close to major roads

in cities where the traffic is stop and go. Slower speeds cause more inefficient vehicular combustion and urban areas tend to have higher CO pollution than major freeway areas. Setbacks from intersections are required to keep vehicles stopped at intersections from biasing the samples collected.

2) For each pollutant site chosen, determine which of the six EPA monitoring objectives will be fulfilled.

3) For the objectives chosen, the proper Spatial Scales of Representation requirements must be met.

Spatial Scales of Representation

Monitoring sites are classified by Spatial Scales of Representation. These scales show what distance away from the monitor the measured air pollution levels are representing. The different spatial scales represent areas with similar populations and geographical and physical characteristics in and around the State.

1) Micro Scale - 300 foot diameter circle with monitor in the center

2) Middle Scale - 1500 foot diameter circle with monitor in center

3) Neighborhood Scale - 2.5 mile diameter circle with monitor in center

4) Urban Scale - 30 mile circle with monitor in center

5) Regional Scale - 100-300 miles - circle with monitor in center

6) National Scale - 300 miles - circle with monitor in center (not used by NC DAQ).

These scales are applied to the six objectives (Table 1):

a) To measure the highest concentrations or worst case scenarios - the smaller Micro, Middle, Neighborhood or sometimes Urban scales are used.

b) To determine representative concentrations in areas of high population density – the Neighborhood or Urban scales are used.

c) To measure the impact on ambient pollution levels from significant sources - the smaller Micro, Middle or Neighborhood scales are used.

d) To measure Background concentrations – the larger Neighborhood, Urban or Regional scales are used.

e) To measure Transport concentrations – the larger Urban or Regional scales are used.

f) To measure for welfare-related impacts – the larger Urban or Regional scales are used.

Table 1: Monitoring Objectives versus Spatial Scales of Representation

Objective/Diameter	Micro 300'	Middle- 1500'	Neighbor -2.5 mi	Urban - 30 mi	Region- 180 mi
High Concentration.	X- CO	X	X - PM, O3,Criteria.	X- O3	
Source Impact	X	X	X - PM, O3, Criteria.		
Pop. Exposure			X - PM, O3, Criteria.	X - PM, O3, Crit.	
Background			X - PM , O3, Criteria.	X- PM, O3, Crit.	X
Transport				X - PM, O3, Crit.	X
Welfare-Related				X - PM , O3, Crit.	X

Other Monitoring Design Considerations

Ozone monitors are sited for neighborhood, population exposure, background, transport, welfare and highest concentration objectives and the appropriate scales of representation.

Particulate Matter monitors are sited for measuring the highest concentrations or worst case scenarios. They are also sited for determining representative concentrations in areas of high population density and as reasonably homogeneous geographical sites in accordance with wind pattern trends to measure impact from significant sources.

Monitoring for ozone, particulate matter and the other criteria pollutants must meet geographic and physical site characteristics. For example, ozone monitors should be sited downwind of major source areas to capture the highest concentrations. Monitors have to be sited at certain distances from roadways and industrial sources. PM2.5 monitors are normally sited in areas where people live, work and have recreational activities.

The requirements for physically siting criteria monitors are found in the Code of Federal Regulations 40 CFR 58 Appendices D and E. These include distances sites must be from traffic roadways, intersections, trees, flues, and items obstructing air flow patterns.

Other Considerations for siting monitors are:

- traffic count information
- geographical considerations, such as hills mountains and valleys

- meteorological and climatological data, coastal versus mountain conditions
- housing density
- emission inventories
- modeling results.

Other information used in the siting of monitors involves the use of:

- Regional and traffic pattern maps
- Emission inventories and existing air quality data for NOx and hydrocarbons
- Meteorological and climatological data - to determine down wind areas
- Geographical considerations

Individual Criteria Pollutant Networks

Ozone Network

Ozone historically has been the air pollutant of most concern in the North Carolina. The NC DAQ and the local programs have spent a significant portion of their efforts over the last 15 years to decrease the levels of ozone across the state.

The NC DAQ expanded the ozone network in the late 1990s using EPA's Urban Air shed Modeling protocol to find the worst case locations for ozone monitoring. The State then used data from this expanded network to develop and improve its forecast modeling. All of these data were ultimately audited by an outside contractor at the request of the NC DAQ in 1998. This audit gave NC DAQ better insight into how well the State Implementation Plan was working to lower ozone levels and it offered needed suggestions on how to improve modeling and forecasting efforts.

Ozone is not directly emitted into the atmosphere, but is formed by oxides of nitrogen and volatile organic compounds (or hydrocarbons) in the presence of sunlight. Ozone is a warm-weather pollutant and is formed "photo-chemically" in the atmosphere near and up to several miles downwind from the sources involved. It also may be transported over significant distances, therefore ozone sites are normally placed downwind of major metropolitan areas.

Particulate Monitoring Network

Particulate monitoring has a long and changing history in North Carolina as it does nationwide. Originally, with the Clean Air Act Amendments of 1970, only the larger particles of 100 microns and above were monitored. This air pollutant is called Total Suspended Particulate or TSP. TSP is emitted by most of the coal-fired power plants and industrial and vehicular sources nationwide.

The particulate standard was revised by EPA in 1990 to reflect health concerns from smaller particulates known as ten micron particulate or PM10. PM10 was smaller in size and thus much more likely to enter deeper into lungs and cause respiratory problems. There were very few violations of the PM10 standard in NC during the 1990s. The NC DAQ and Local programs, in participation with EPA and in anticipation of the National Monitoring Strategy passage, began re-assessing their PM-10 monitoring networks in 2002. EPA allowed that sites 60% below the NAAQS could be terminated. NC DAQ and the local programs met these requirements to terminate all of its PM10 monitors but the NC DAQ decided to keep at least one PM10 monitor operating in each of its seven regions. The local programs also kept representative monitors. There have continued to be no violations of the PM10 NAAQS in NC over the past years.

In 1997, EPA again revised the particulate standard, adding a requirement for sampling fine particles (PM 2.5). The reference method for sampling PM2.5 is a manual method requiring very tedious and labor intensive maintenance by trained technicians. The method requires a technician to deliver and collect samples collected on a 47 mm Teflon filter from a calibrated sampler that uses a mass flow device to control the amount of air sampled during its 24-hour operation. Samples usually run every three days but can run every day or every six days depending on location. Specific monitoring requirements must be maintained and measured by the monitor. Samples are collected in canisters and shipped to one central laboratory in Raleigh for the final weighing process. The filters are initially weighed in this same laboratory and shipped to the regions before sampling.

Carbon Monoxide

The story of carbon monoxide reductions in North Carolina reflects the story of this pollutant nationwide. CO was a major pollutant that caused non-attainment of the NAAQS 15 years ago but levels have now been reduced to well below the 1 hour and 8 hour federal and State standards.

Carbon monoxide levels have become lower in recent years because of newer automobiles manufactured with better emission controls. Traffic pattern studies and resultant action plans to keep traffic flowing in larger cities also have resulted in lower emissions. Industries have switched to more efficient fuel sources, further reducing CO levels.

As a result of these changes, the CO network in North Carolina has been reduced from a network of 15 sites in 1988 in 5 cities to a network of only 5 sites in 5 cities in 2006. In 1988, carbon monoxide was measured in Charlotte (6 sites), Winston-Salem (3 sites), Raleigh (3 sites), Durham (2 sites) and Fayetteville (1 site). In 2006, carbon monoxide was measured in Charlotte (1 site), Winston-Salem (1 site), Raleigh (1 site), Greensboro (1site) and Fayetteville (1 site).

As a result of the October 17, 2006, National Monitoring Strategy (NMS) promulgation, EPA does not require any minimum monitoring for carbon monoxide if the monitor is not

required in the state implementation plan (SIP) and the area is unlikely to exceed the NAAQS. The monitor must have recorded levels below 80% of the NAAQS for the past five years and have less than a 10% chance of exceeding the NAAQS in the next three years. Levels of CO are 50% below the NAAQS in North Carolina. Carbon monoxide monitors are required in Forsyth, Mecklenburg, and Wake Counties until 2015 as part of the CO maintenance plan in the SIP.

The EPA requires that the NCore sites in each state have at least one "trace level" monitor for carbon monoxide. The reason for this is that CO is a precursor pollutant for measuring fine particulate matter (PM 2.5). Fine particulate levels are a pollutant of concern in North Carolina.

Carbon monoxide is also a precursor for ozone pollution. Ozone is and has been a pollutant of prime concern in North Carolina for many years. In 1998, the ozone National Ambient Air Quality Standard was changed to a new 8-hour standard as opposed to the old 1-hour standard. It was obvious because of the high levels of ozone measured in the State at the time that North Carolina would be non-attainment for ozone. The State initiated an Urban Air shedAir shed Monitoring (UAM) network or as it is now called, the Ozone Precursor Network (OPN), to help the modelers determine how best to meet the standard.

This was a network originally of 15-17 sites that measured ozone and its precursors - carbon monoxide, oxides of nitrogen and non-methane hydrocarbons. These sites were located in 4 main air sheds - Raleigh, Durham, Greensboro/Winston-Salem and Charlotte. Sites were placed upwind, center city and downwind of these major metropolitan areas to collect data for modeling purposes. The models helped the NC DAQ to better understand ozone formation, track where it formed and track reductions as the result of SIPs.

Ozone precursor sites still exist in North Carolina. The network has now been reduced from 15 sites in 1994 to 5 sites in 2007. The current OPN sites are in Raleigh, Durham, Cherry Grove (in Caswell County - a downwind Greensboro site), and in Charlotte (at the Garinger center city site). "Trace level" CO is measured at these 5 sites during the prime ozone season from May 15 to September 15 each year. Normal range CO sites operated by NC DAQ and the local programs measure CO at maximum range of 50 ppm. Trace level CO sites measure CO at a maximum range of 5 ppm.

NC is considering expanding its trace level CO monitoring from the May 15 - Sept 15 ozone season to operating on a year round basis for all OPN sites. Currently - 2 sites - the Raleigh Millbrook site (which will be the NCore Trace Level CO monitoring site starting in 2011) and the proposed Rural NCore site in Rockwell, where North Carolina currently operates year round trace level CO monitor, are year-round sites.

Sulfur Dioxide Network

One of the primary reasons for establishing and maintaining the sulfur dioxide network in NC was to provide Prevention of Significant Deterioration (PSD) data for industry interested in moving into NC. In general, industries that emit over 250 tons of a pollutant are required to collect one year's background data for that pollutant before the industry can begin operations. Sulfur dioxide monitoring is also done in areas that have more than one million people and for certain areas of the State that have higher source emissions of SO2, such as from power plants and phosphate mining and production facilities.

The sulfur dioxide network has been reduced in recent years due to a gradual reduction of SO2 emissions in NC over the past 20 years. In 1988, there were 11 SO2 monitoring sites in NC. The SO2 network was assessed in 2002 based on requirements set forth by EPA, and the State re-structured and reduced its SO2 network at that time.

The NC DAQ SO2 network in 2007 consists of monitors in 4 major regions of North Carolina. The regions are:
1) Asheville (west of I-77)- Swain county Bryson City SO2 monitor-operates every third year
2) Charlotte- Piedmont - Rowan County-Rockwell, NC & Charlotte- every year
3) Raleigh-Durham - Wake County - Millbrook site - every year
4) Down East NC - Three rotational sites - operates on a rotation basis every 3 years:
    New Hanover - Wilmington - 2005, 2008, 2011
    Cumberland Co. - Fayetteville - 2006, 2009, 2012
    Martin County - Jamesville - 2007, 2010, 2013

The Forsyth and Mecklenburg local programs also operate SO2 monitors in their respective counties.

Trace level SO2 data can also be used as fine particulate matter (PM2.5) precursor information. The State and local programs operate trace level SO2 sites year-round to obtain this information.

Nitrogen Dioxide (NO2) and Oxides of Nitrogen (NOy) Networks

As explained above for CO, trace level oxides of nitrogen monitors are co-located with CO trace level monitors at certain ozone sites in NC to provide data for modelers to study how to forecast ozone levels. This makes up the primary network of oxides of nitrogen for NC.

There are only two sites in NC that monitor for Nitrogen Dioxide (NO2) and they are in Winston-Salem and Charlotte. The State's Division of Air Quality ceased monitoring for NO2 after 1993 because the levels were so far below the NAAQS. Indeed, EPA has stated under the National Monitoring Strategy that for any NO2 levels 80% below the NAAQS, no minimum number of monitors are required. The current NO2 sites in

Winston-Salem and Charlotte are being retained to continue to track NO2 to assure that these levels remain well below non-attainment status.

The NC DAQ and the Mecklenburg County local program operate five sites in the Ozone Precursor Network that include NOy monitors. These sites are operated as the trace level CO monitors are operated from May through September. The sites are in Raleigh, Durham, Cherry Grove (Caswell county downwind of Greensboro), Rowan County (downwind of Charlotte) and at the Garinger and County Line sites in Mecklenburg County. Additional NOy sites are operated in Eastern North Carolina to assist with ammonia monitoring in Lenoir and Sampson counties.

Future Ambient Air Criteria Monitoring in North Carolina

North Carolina, along with most states in the nation, has benefited from the existence and implementation of the Clean Air Act and State programs. The criteria pollutants of carbon monoxide, nitrogen and sulfur dioxides and lead have fallen to such low levels that the EPA has no minimum requirements for monitoring these pollutants, as long as one of these monitors is not required in the State Implementation Plan (SIP) and the area is unlikely to exceed the NAAQS.

North Carolina continues to have problems with two of the criteria pollutants - ozone and fine particle pollution.

As of 2006, only one area in North Carolina showed violations of the ozone standard - Charlotte, with two monitors in Mecklenburg County and one monitor in Rowan County violating the standard. Based on modeling, NC DAQ expects this area to attain the ozone standard by its attainment date of June 15, 2010. Several other areas are still designated as non-attainment and/or maintenance areas, and have ozone levels just below the standard.

The primary sources for ozone and particle pollution remain vehicular emissions, industrial source emissions and coal-fired power plant emissions. Controls that limit emissions are in effect with the passage of the Clean Smokestacks Act in 2002, which is expected to lower sulfur dioxide and nitrogen oxide emissions from the state's 14 largest coal-fired power plants dramatically in the coming years.

Low-sulfur fuel and retro-fitting diesel school buses are some of the other methods being used to reduce sources of ozone and fine particles from motor vehicles.

Two monitors currently violate the annual PM 2.5 standard, one in Catawba County and one in Davidson County. Also, a monitor in Mecklenburg County had a violation or the annual PM 2.5 standard in 2003-2005. This monitor was shut down at the end of 2005, because the site was renovated by the owners. Analysis of the other Mecklenburg County data is ongoing and will be assessed to determine compliance with the annual standard. NC DAQ believes that all areas of the State will be in compliance with the

annual PM 2.5 standard no later than the end of 2009, but both PM2.5 and ozone present a danger even at lower levels.

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