2020

Forsyth County
Office of Environmental Assistance and Protection

Minor Barnette, Director
Jason R. Bodenhamer, Program Manager

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FIVE YEAR NETWORK ASSESSMENT

In 2006 EPA amended the ambient air monitoring regulations. As part of this amendment, EPA is requiring monitoring agencies to conduct a network assessment once every five years. The purpose is to optimize U.S. air monitoring networks to achieve, with limited resources, the best possible scientific value and protection of public and environmental health and welfare.

Background

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

> *"(d) The State, or where applicable local, agency shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in appendix D to this part, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby States and Tribes or health effects studies. For $PM_{2.5}$, the assessment also must identify needed changes to population-oriented sites. The State, or where applicable local, agency must submit a copy of this 5-year assessment, along with a revised annual network plan, to the Regional Administrator. The first assessment is due July 1, 2010."*

This requirement is an outcome of implementing the National Ambient Air Monitoring Strategy (NAAMS, the most recent version is dated December 2005, U.S. Environmental Protection Agency, 2005). The purpose of the NAAMS is to optimize U.S. air monitoring networks to achieve, with limited resources, the best possible scientific value and protection of public and environmental health and welfare. A network assessment includes (1) re-evaluation of the objectives and budget for air monitoring, (2) evaluation of a network's effectiveness and efficiency relative to its objectives and costs, and (3) development of recommendations for network reconfigurations and improvements. EPA expects that a multi-level network assessment will be conducted every five years (U.S. Environmental Protection Agency, 2005). Initial network assessments for the NAAMS were led by EPA and its 10 regional offices in 2001 through 2004 (U.S. Environmental Protection Agency, 2003b). This initial assessment, as well as peer reviews of the NAAMS by subcommittees of the EPA Clean Air Scientific Advisory Committee (Hopke, 2003), (Henderson, 2005), produced the recommendation that guidance for regional scale network assessments be established. The NAAMS (U.S. Environmental Protection Agency, 2005), (U.S. Environmental Protection Agency, 2005), (Clean Air Scientific Advisory Committee and National Ambient Air Monitoring Strategy Subcommittee, 2003) and documentation of the initial national- and regional scale network assessments provide a valuable context and a summary of the key technical issues for network assessment guidelines. This document builds on the lessons learned in the NAAMS and focuses on providing guidance on analytical techniques that can be used for multiple-scale assessments.

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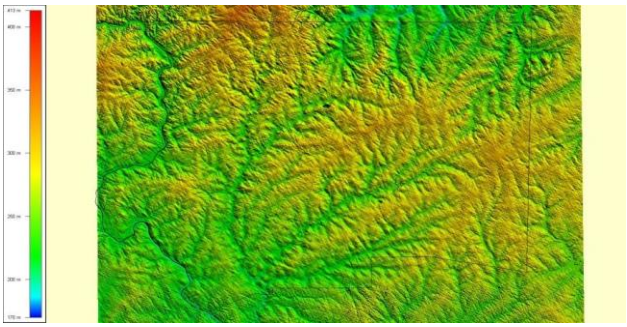
Geography

The Forsyth County Office of Environmental Assistance and Protection (FCEAP) operates the air program and air monitoring network for the Forsyth County, NC area. FCEAP's local program is certified by the US Environmental Protection Agency and operates under an approved Quality Assurance Project Plan (QAPP) and Quality Management Program (QMP).



The County is located in the western piedmont of North Carolina with a land area of 408.15 square miles. It features a unique topography consisting of flat, rolling, and elevated terrain. The climate has four (4) distinct seasons with summertime highs reaching 90 degrees Fahrenheit or more on several occasions and wintertime snowfall averaging 6 inches per year. This favorable climate and attractive topography combine with a stable economy and ample tourist attractions to produce an increasing population across the area.

Demographics

The growing trend in demographics shows that the highest concentration of minority populations is within the city limits of Winston-Salem, with smaller concentrations residing in the outskirts of Winston-Salem as well as Clemmons, Rural Hall, Kernersville, and other smaller cities and towns across the County. A wide variety of demographics exist across the County with many minority groups showing population increases over the last 10 years. A diverse transportation network links the rural areas of the County to the cities and provides a good opportunity for movement of people and goods throughout the County. Forsyth County has two monitoring sites located in the heart of Winston-Salem (Hattie Avenue A and B) to monitor pollution levels within the core area of Winston-Salem. These two sites are centralized within 5 miles from approximately 40 percent of the permitted stationary sources in Forsyth County. The Hattie Avenue site provides information beneficial for assessing pollutant levels in minority occupied neighborhoods in the central area of Winston-Salem.

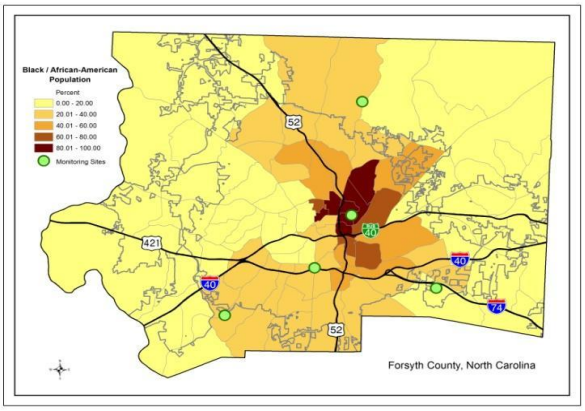


Figure 1 - Black\African-American Population Density

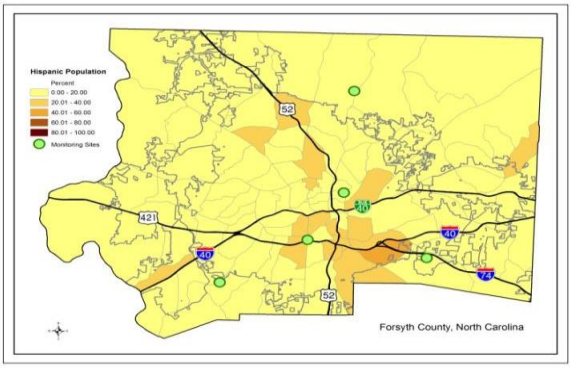


Figure 2 - Hispanic Population Density

Permitting and Inspection Programs

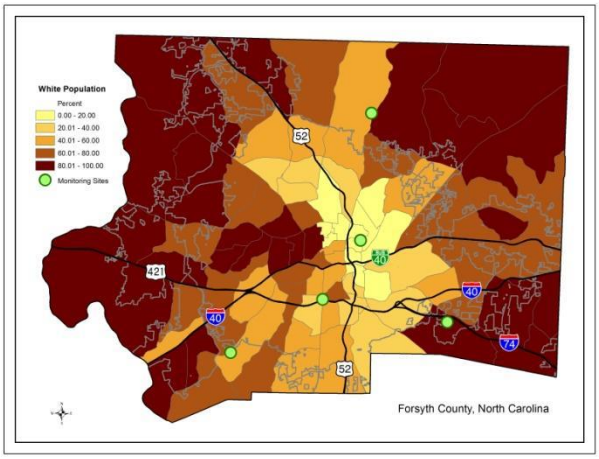


Figure 3 - Employment Sector Trend - 2008-2012

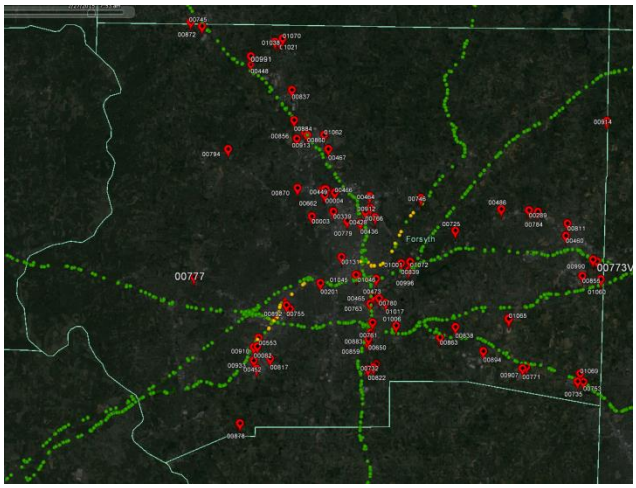


Figure 4 - Forsyth County Permitted Stationary Sources

Forsyth County has seen a small decline in industry in recent years. Favorable economic planning efforts and local educational institutions have helped transition the community towards jobs in the growing service, health, and innovation sectors. Local planners and business development leaders have helped to establish and promote several business parks capable of attracting new companies in all employment sectors.

Currently, FCEAP permits 56 facilities in Forsyth County. Of these, 8 are major Title V facilities, 24 Synthetic Minors, 4 Exclusionary Small, and 12 Small facilities. Unsurprisingly, these facilities are located along the major traffic corridors of the county for convenient transport of goods and services. FCEAP has a well-established permitting and inspection program and remains diligent in assuring all facilities comply with regulatory requirements. Permitting includes the Prevention of Significant Deterioration/New Source Review (PSD/NSR) programs necessary to limit the impact of local stationary emission sources on the health and well-being of the surrounding communities as well as maintaining pollution levels below the National Ambient Air Quality Standards. As needed, FCEAP performs computer modeling to assist local business assess their impact when constructing and operating new emission sources or modifying existing emission sources. Modeling includes determining the impact of air toxics from emission sources to assure facilities comply with state and local acceptable emission standards for toxic air pollutants.

In addition to permitting, FCEAP registers and annually inspects 202 gasoline dispensing facilities utilizing Stage 1 Vapor Recovery and 19 dry cleaning facilities using perchloroethylene. FCEAP believes that regular, periodic inspection of these facilities further limits the impact of toxic pollutants on the community and reduces VOC emissions (especially from gasoline dispensing facilities),

The permitting and inspection programs performed by FCEAP contribute to the continued decline of ambient concentration of criteria pollutants emitted by stationary sources. Additionally, with assistance and guidance from FCEAP, many local industries are implementing strategies to reduce emissions and are engaging in pollution prevention work practices that enhance their financial success. These pollution prevention practices, along with the benefits that business and institutions find in reducing energy costs, compliment an effective regulatory program.

Transportation

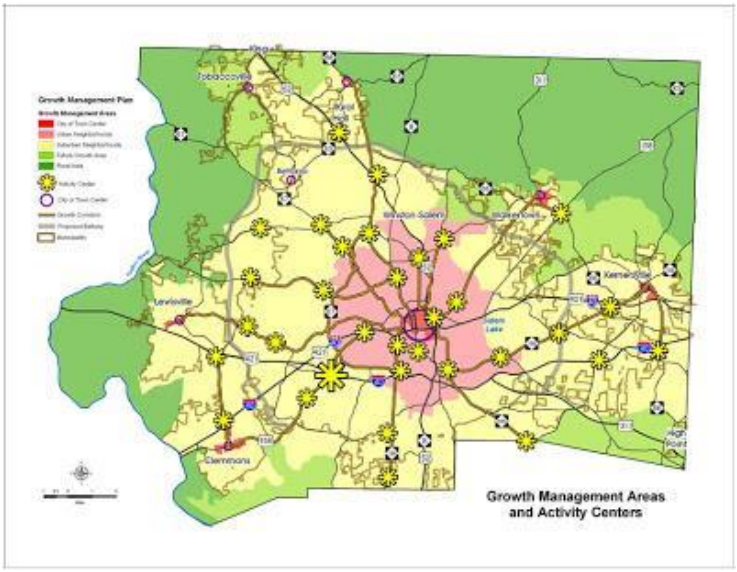


Figure 5 - Forsyth County Growth Management Plan

The sustained growth and creation of business parks and activity centers have also led to an increase in daily vehicle miles traveled as more individuals commute to different locations across the area. According to Census Bureau statistics for the period of 2014 to 2018, the mean travel time to work was estimated to be about 22 minutes for workers aged 16 years and older. Vehicular traffic has a major impact on local air quality. Monitored levels of ozone and particle pollution continue to justify concern for future compliance with the National Ambient Air Quality Standards (NAAQS) that have recently been lowered or are proposed to be lowered to protect the health and safety of the communities impacted.

FCEAP has been a leader in Air Quality Forecast and AQI reporting since 1996. Daily air quality forecasts are issued by FCEAP to help assist citizens in planning and preparing for the upcoming days, regardless of the air pollution levels. Provided a good response from the community, daily forecasts have the potential to reduce actual monitored pollution levels and provide some protection to those most sensitive to unhealthy air quality. Together with the state funded Air Awareness program housed at FCEAP's office, FCEAP acts proactively to improve air quality and guide susceptible individuals with timely information that enables them to enjoy enhanced quality of life in Forsyth County.

FCEAP staff participate with the local transportation boards as technical advisors to assist them in assuring that the effects of transportation projects with regards to impacts on air quality are properly addressed during the planning process.

Meteorology

For the period from January 2015 to December 2019, the average monthly temperature in this area was approximately 58.9 ^{0}F with a maximum monthly average of 80.7 ^{0}F and a minimum of 33.3 ^{0}F. The monthly average rainfall is 3.5 inches with approximately 77 days of precipitation per year measuring .1 inch or more. This moderate climate and adequate water supply are valuable assets for Forsyth County's future growth in both population and business development.

Wind direction and speed measured at Smith Reynolds Airport, located in Winston-Salem, show the predominant winds flowing from the S to SW and from the NNE to NE. Coincidently, these predominant wind patterns follow along the business corridor (I-40, I-77 and I-85) with Charlotte and Atlanta to the SW and Belews Creek Power plant, Roanoke, and Richmond, Va. to the NE.

Current Air Monitoring Network

Introduction

FCEAP's monitoring program provides air quality monitoring services for Forsyth County, NC. FCEAP is a state "certified local air pollution program" whose purpose is to improve and maintain ambient air quality and reduce exposure to unhealthful air pollutants.

Figure 8 - National Ambient Air Quality Standards (NAAQS)

	Primary/ Secondary	Averaging Time	Level	Form
CO	primary	8-hour	9 ppm	Not to be exceeded more than once per year
		1-hour	35 ppm	
Lead	primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$ (1)	Not to be exceeded
NO_2	primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	primary and secondary	Annual	53 ppb (2)	Annual Mean
O_3	primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
$PM_{2.5}$	primary	Annual	12 $\mu g/m^3$	annual mean, averaged over 3 years
	secondary	Annual	15 $\mu g/m^3$	annual mean, averaged over 3 years
	primary and secondary	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
PM_{10}	primary and secondary	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
SO2	primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

FCEAP has operated an air quality monitoring program since the early 1970's. The air monitoring services are provided to measure concentrations of criteria air pollutants, Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Particulate Pollution ($PM_{2.5}$ and PM_{10}) and Ozone (O_3)] in accordance with US EPA regulatory requirements. The requirement for monitoring lead is source specific and requires monitoring in the vicinity of facilities emitting .5 tons or more of lead per year. At this time, Forsyth County does not have a facility with lead emissions approaching this threshold. Urban Air Toxics are monitored at the Hattie Avenue site by the NC Division of Air Quality (DAQ). FCEAP services the DAQ sampling equipment and sends the samples to their lab for analysis. Measurements at FCEAP's monitoring sites are used to:

- Evaluate compliance with the NAAQS,
- Serve as baseline data so that changes in air quality can be tracked,
- Document current dynamic concentration of monitored pollutants,
- Support daily forecasting efforts including the activation of emergency control procedures to prevent or alleviate air pollution episodes and provide information to citizens, enabling them to limit their exposure to pollutants of concern,
- Provide data upon which long term control strategies can be reliably developed locally and utilized to inform regional planning efforts,
- Observe trends in the area, and
- Provide a database for research and analytical purposes.

The FCEAP air monitoring network includes four state and local air monitoring stations (SLAMS) in Forsyth County. The current network configuration consists of four monitoring stations that measure concentrations of criteria air pollutants. In addition to the SLAMS network the county network also

includes monitoring for meteorological parameters (co-located at Union Cross monitoring station) and visibility conditions (via a webcam on Sauratown Mountain).

The annual monitoring network plan, as provided for in 40 CFR Part 58.10, *Annual Monitoring Network Plan and Periodic Network Assessment,* must contain the following information for each monitoring station in the network:

1. The Air Quality System (AQS) site identification number for existing stations.
2. The location, including the street address and geographical coordinates, for each monitoring station.
3. The sampling and analysis method used for each measured parameter.
4. The operating schedule for each monitor.
5. Any proposal to remove or relocate a monitoring station within a period of eighteen months following the plan submittal.
6. The monitoring objective and spatial scale of representativeness for each monitor.
7. The identification of any sites that are suitable and sites that are not suitable for comparison against the annual $PM_{2.5}$ NAAQS.
8. The Metropolitan Statistical Area (MSA), Core Based Statistical Area (CBSA), combined Statistical Area (CSA) or other area represented by the monitor.

The following information replicates the Forsyth County Air Quality ambient air monitoring network plan and continues in the sections outlined below:

I. Site Description Background Information and Definitions: An outline of the designations, parameters, monitoring methods, and the basis for site selection.

II. Network Summary: This section presents an overview of the total number of sites and monitors in Forsyth County. Also included is a listing of all proposed changes to the current network.

III. Air Monitoring Station Description: Each air monitoring station is described in detail as per the outline in (II.) above. Modification to the network as determined by an annual review process will be made each year to maintain a current up-to-date network description document.

Site Description Background Information and Definitions

1. Site Description

Specific information is provided to show the following: location of the monitoring equipment at the site, if the site is located in a CSA/MSA, the AQS identification number, the GPS coordinates, and evidence that monitors and monitor probes conform to the siting criteria.

2. Date Established

The date when each existing monitoring station was established is specified in the description. For any stations which are proposed, a date is provided for the anticipated commencement of operation.

3. Site Approval Status

Each monitoring station in the existing network has been reviewed for the purpose of determining whether it meets all design and siting criteria for inclusion in the SLAMS network. Stations that do not meet the criteria will either be relocated in a nearby area or, when possible, modified at the present location.

4. Monitoring Objectives

Per 40 CFR 58 Appendix D Section 1.1:

> *"The ambient air monitoring networks must be designed to meet three basic monitoring objectives. These basic objectives are listed below. The appearance of any one objective in the order of this list is not based upon a prioritized scheme. Each objective is important and must be considered individually."*

The objectives are summarized as follows:

(a) Provide air pollution data to the general public in a timely manner.

(b) Support compliance with ambient air quality standards and emissions strategy development. Data from FRM (Federal Reference Method), FEM (Federal Equivalent Method), and ARM (Approved Regional Method) monitors for NAAQS pollutants will be used for comparing an area's air pollution levels against the NAAQS.

(c) Support for air pollution research studies.

5. Monitoring Stations' Designations

Most stations described in the air quality surveillance network are designated as State and Local Air Monitoring Stations (SLAMS). In addition, some of these stations fulfill other requirements, which must be identified. In this description of the network, designations are also made for National Air Monitoring Stations (NAMS), Special Purpose Monitors (SPM), and National Core (community oriented) stations (NCore). The following criteria are used for each of these designations:

SLAMS

Requirements for air quality surveillance systems provide for the establishment of a network of monitoring stations designated as State and Local Air Monitoring Stations (SLAMS) that measure ambient air concentrations of those pollutants for which standards have been established. These stations must meet requirements that relate to four major areas: quality assurance, monitoring methodology, sampling interval and siting of instruments and instrument probes.

NAMS

Within the SLAMS network certain monitors are selected to provide the USEPA with timely data for use in national trends analysis. These NAMS monitors are identified in the summary of network stations.

SPM

Not all monitors and monitoring stations in the air quality surveillance network are included in the SLAMS network. In order to allow the capability of providing monitoring for various reasons such as: special studies, modeling verification and compliance status, and other objectives; certain monitors are designated as Special Purpose Monitors (SPM). These monitors are not committed to any one location or for any specified time period. They may be located as separate monitoring stations or be included at SLAMS locations. Monitoring data may be reported, provided that the monitors and stations conform to all requirements of the SLAMS network.

NCORE

National Core (community-oriented) multi-pollutant monitoring station data will be used to evaluate the regional air quality models used in developing emission strategies and to track trends in air pollution abatement control measures' impact on improving air quality.

6. Monitoring Methods

Sampling and analytical procedures for criteria air pollutant monitoring performed in the FCEAP ambient air monitoring network are conducted in accordance with applicable USEPA Designated Federal Reference (FRM) or Equivalent (FEM) Methods unless otherwise noted. Analytical techniques for non-criteria air pollutant monitoring (methods employed that are not USEPA Designated Federal Reference (FRM) or Equivalent (FEM) Methods) are documented in the applicable FCEAP Quality Assurance Project Plans (QAPP), FCEAP Standard Operating Procedures (SOP), or the appropriate North Carolina Division of Air Quality (NCDAQ) QAPP or SOP. Methods used by FCEAP for criteria pollutant monitoring are listed below:

Particulate Matter 10 microns in size (PM_{10})

All PM_{10} samplers operated by FCEAP are operated as federal reference method (FRM) or equivalent samplers and are operated according to the requirements set forth in 40 CFR 50 and 40 CFR 53. Listed below is the USEPA Designated Reference or Equivalent Method used in the FCEAP monitoring network:

Method	Designation Number	Method Code
T640 PM Mass Monitor w/640X Option	EQPM-0516-239	239

Particulate Matter 2.5 microns in size ($PM_{2.5}$)

With the exception of continuous samplers and speciation samplers all $PM_{2.5}$ samplers operated by FCEAP are either FRM or FEM samplers. Listed below is the USEPA Designated Reference or Equivalent Method used in the FCEAP monitoring network:

Method	Designation Number	Method Code
R & P Partisol-Plus 2025i PM-2.5 Seq.	EQPM-0202-145	145
T640 PM Mass Monitor w/640X Option	EQPM-0516-238	238
TAPI Model T640 PM Mass Monitor	EQPM-0516-236	236

Particulate Matter 10-2.5 microns in size ($PM_{10-2.5}$)

With the exception of continuous samplers and speciation samplers all $PM_{2.5}$ samplers operated by FCEAP are either FRM or FEM samplers. Listed below is the USEPA Designated Reference or Equivalent Method used in the FCEAP monitoring network:

Method	Designation Number	Method Code
T640 PM Mass Monitor w/640X Option	EQPM-0516-240	240

$PM_{2.5}$ Speciation sampling and analysis

In addition to operating $PM_{2.5}$ samplers that determine only $PM_{2.5}$ mass values, FCEAP also operates $PM_{2.5}$ speciation samplers that collect samples that are analyzed to determine the chemical makeup of $PM_{2.5}$. Data collected using this method cannot be compared to the NAAQS. Listed below is the method used in the FCEAP monitoring network:

Method	Designation Number	Method Code
MetOne SASS	NA	NA
URG	NA	NA

Sulfur Dioxide

Instruments used to continuously monitor sulfur dioxide levels in the atmosphere employ the pulsed UV fluorescence method. Listed below is the USEPA Designated Reference or Equivalent Method used in the FCEAP monitoring network:

Method	Designation Number	Method Code
Teledyne API T100U	EQSA-0495-100	600

Ozone

Ozone is monitored using the UV photometry method. Listed below is the USEPA Designated Reference or Equivalent Method used in the FCEAP monitoring network:

Method	Designation Number	Method Code
TAPI. Model 400E, T400	EQOA-0992-087	087

Nitrogen Dioxide

The chemiluminescence method is used in monitoring the nitrogen dioxide level in the ambient air. Listed below is the USEPA Designated Reference or Equivalent Method used in the FCEAP monitoring network:

Method	Designation Number	Method Code
TAPI Model 200EU, T200U	RFNA-1194-599	599

Air Toxics

Air toxics sampling is conducted in Forsyth County using equipment on loan from the State of North Carolina, Division of Air Quality. Listed below is the USEPA Designated Reference or Equivalent Method used in the FCEAP monitoring network:

Method	Designation Number	Method Code
Compendium Method for Toxic Organics	Compendium Method TO-15	150

7. Quality Assurance Status

FCEAP has an extensive quality assurance procedure to ensure that all air monitoring data collected meets established criteria for precision and accuracy. FCEAP operates according to EPA approved Quality Assurance Project Plans (QAPP) and Standard Operating Procedures. Staff members audit instrumentation on a scheduled basis to ensure that each instrument is calibrated and operating properly. Data validation is performed monthly to ensure data reported by each instrument is recorded accurately in the air quality monitoring database.

8. Scale of Representativeness

Each station in the monitoring network must be described in terms of the physical dimensions of the air parcel nearest the monitoring station throughout which actual pollutant concentrations are reasonably similar. Area dimensions or scales of representativeness used in the network description are:

(a) Microscale - defines the concentration in air volumes associated with area dimensions ranging from several meters up to about 100 meters.

(b) Middle scale - defines the concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometers.

(c) Neighborhood scale – defines concentrations within an extended area of a city that has relatively uniform land use with dimensions ranging from about 0.5 to 4.0 kilometers.

(d) Urban scale - defines an overall citywide condition with dimensions on the order of 4 to 50 kilometers.

(e) Regional Scale - defines air quality levels over areas having dimensions of 50 to hundreds of kilometers.

Closely associated with the area around the monitoring station where pollutant concentrations are reasonably similar are the basic monitoring exposures of the station. There are six basic exposures:

(a) Sites located to determine the highest concentrations expected to occur in the area covered by the network.

(b) Sites located to determine representative concentrations in areas of high population density.

(c) Sites located to determine the impact on ambient pollution levels of significant sources or source categories.

(d) Sites located to determine general background concentration levels.

(e) Sites located to determine the extent of regional pollutant transport among populated areas; and in support of secondary standards.

(f) Sites located to measure air pollution impacts on visibility, vegetation damage, or other welfare-based impacts.

The design intent in siting stations is to correctly match the area dimensions represented by the sample of monitored air with the area dimensions most appropriate for the monitoring objective

of the station. The following relationship of the six basic objectives and the scales of representativeness are appropriate when siting monitoring stations:

Site Type	Appropriate Siting Scales
1. Highest concentration	Micro, middle, neighborhood (sometimes urban or regional for secondarily formed pollutants).
2. Population oriented	Neighborhood, urban.
3. Source impact	Micro, middle, neighborhood.
4. General/background & regional transport	Urban, regional.
5. Welfare-related impacts	Urban, regional.

Table 1 - Siting Objectives and Scales

9. Data Processing and Reporting

All ambient air quality data are stored on the Achilles Server managed by the Forsyth County MIS (IT) department located on the 3rd floor of the Forsyth County Government Center, FCEAP, 201 N. Chestnut Street, Winston-Salem, North Carolina. The AirVision SQL based database is accessed from computers located on the 5th floor of the Forsyth County Government Center, FCEAP, 201 N. Chestnut Street, Winston-Salem, North Carolina. On a daily basis, all data are backed up and maintained at an off-site location. After all monthly data validation procedures are successfully completed, data is transmitted to the USEPA's national Air Quality System (AQS) database. The AQS database is maintained by EPA as the official repository of the fully quality assured ambient air quality dataset.

Network Summary

1. Site Table and Criteria Pollutants Monitored

Site	AQS ID #	CO	NO_2	O_3	Pb	$PM_{2.5}$	PM_{10}	SO_2	Air Toxics
Clemmons Middle School	37-067-0030			X		X			
Hattie Avenue A&B	37-067-0022		X	X		X	X	X	X
Union Cross	37-067-1008			X					

Table 2 - Forsyth County Monitoring Sites

2. Site Map

AIR QUALITY MONITORING STATIONS FORSYTH COUNTY, NC 2020

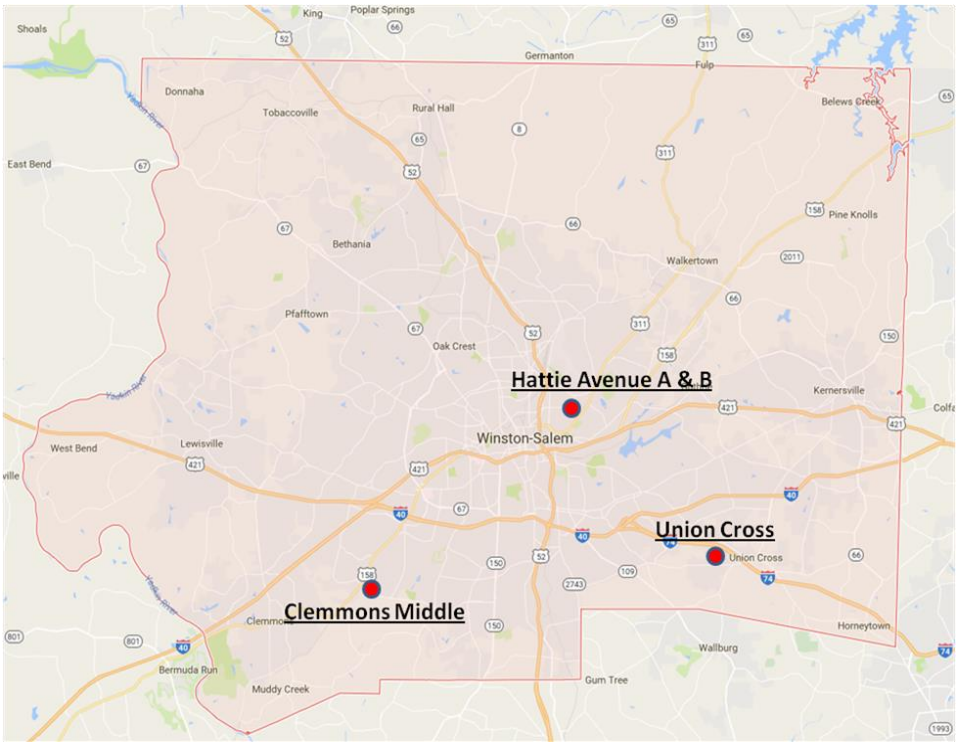


Figure 6 - Forsyth County Monitor Locations

3. Monitoring Methods

Site	Parameter	Instrument / Method	Method Number	Parameter Number	Monitor Type†	Serial Number	Purchase Date	Replace Date	Condition
37-067-0022	Ozone	UV Photometric	087	44201	SLAMS	3093	2017	2027	Good
37-067-0022	SO2	Pulsed UV Fluorescent	600	42401	SLAMS	179	2017	2027	Good
37-067-0022	NO	Chemi-luminescence	599	42601	SLAMS	T200U-214	2017	2027	Good
37-067-0022	NO_2	Chemi-luminescence	599	42602	SLAMS	T200U-214	2017	2027	Good
37-067-0022	NO_x	Chemi-luminescence	599	42603	SLAMS	T200U-214	2017	2027	Good
37-067-0022	Air Toxics	Compendium Method for Toxic Organics (TO) 15	150	Multiple	NON	4518 3603	NCDENR Owned		
37-067-0022	PM2.5	FRM	145	88101	SLAMS	2025I203541302	2014	2024	Good
37-067-0022	PM2.5	Speciation	118	Multiple	SLAMS	A2591	2001	2024	Fair
37-067-0022	PM2.5	T640x	238	88101	SLAMS	96	2017	2027	Good
37-067-0022	PM2.5 CR	T640x	240	86101	SLAMS	96	2017	2027	Good
37-067-0022	PM2.5	Carbon Speciation	118	88101	SLAMS	3NB0191	2007	2024	Good
37-067-0022	PM10	T640x	239	81102	SLAMS	96	2017	2027	Good
37-067-0030	Ozone	UV Photometric	087	44201	SLAMS	4061	2018	2028	Good
37-067-0030	PM2.5	T640	236	88101	SLAMS		2017	2027	Good
37-067-0030	PM2.5	FRM	145	88101	SLAMS	2025B217080407	2010	2020	Good
37-067-1008	Ozone	UV Photometric	087	44201	SLAMS	4060	2018	2028	Good
37-067-1008	Temp	Climatronics	020	61101	SLAMS		2016	2026	Good
37-067-1008	Humidity	Climatronics	020	61103	SLAMS		2016	2026	Good
37-067-1008	WD	Climatronics	020	61104	SLAMS	102779	2016	2026	Good
37-067-1008	WS	Climatronics	020	61103	SLAMS	102779	2016	2026	Good
37-067-1008	Pressure	Climatronics	011	64101	SLAMS		2016	2026	Good

Table 3 - Forsyth County Monitoring Methods

†- Monitor Type:
SLAMS- State and Local Air Monitoring Station
SPM- Special Purpose
NON- Non-regulatory
TRENDS- Trends Speciation

Air Monitoring Station Descriptions

1. Clemmons Middle School

(a) Site Table

Site Name:	Clemmons Middle School		
AQS Site Id #:	37-067-0030		
Location:	Fraternity Church Road		
	Winston-Salem, NC		
Latitude:	N 36.026612		
Longitude:	W 80.341962		
Elevation:	245 meters		
Date Monitor Established:	Ozone	April 27, 2005	
Date Monitor Established:	PM2.5 T640	Jan. 1, 2018	
Date Monitor Established:	PM2.5 FRM	Oct 1, 2018	
Nearest Road:	Fraternity Church Road	Distance to Road: 40 meters	
Traffic Count[3]:	4400	Year of Count:	2017
MSA[4]:	Winston-Salem, NC Metropolitan Statistical Area	MSA #:	49180

Parameter	Method	Method Number	Sampling Schedule
Ozone	UV Photometric	087	March 1 – Oct. 31, (Continuous)
PM2.5	T640	236	Continuous
PM2.5	FRM Gravimetric	145	1/6 day

Table 4 - Clemmons Middle School Monitoring Station Summary

(b) Site Description and Statement of Purpose

An ozone monitor and $PM_{2.5}$ continuous monitor have been located at a manufactured structure since April 27, 2005. The site is located in a mixed use environment at latitude N36.025931º and longitude W80.342257º. The site elevation is 245 meters above sea level. The nearest road is Fraternity Church Road with an annual traffic volume of 4100 vehicles (2017) at a distance of 40 meters from the sample inlet.

The inlet of the samplers is approximately 3 meters above ground level and 1 meter above roof level. There were trees encroaching on the minimum distance from the inlet and those trees were removed during the summer of 2015. The area is a transition zone of business (~50%) to residential (~50%) within a 1 km radius. The samplers are SLAMS.

The ozone instrument is operated during the North Carolina ozone monitoring season which begins March 1 and ends October 31. The ozone instrument operates continuously during this period.

OBJECTIVE AND SPATIAL SCALE

The monitoring objectives of the instruments are to measure: 1) upwind background ambient concentrations and 2) population exposure.

The site is a neighborhood spatial scale for ozone and $PM_{2.5}$. Data from this site is used to assess compliance with the NAAQS for ozone and $PM_{2.5}$.

The site is located in the Winston-Salem, NC Metropolitan Statistical Area[4]. The principal cities and counties in the MSA are Winston-Salem, Davie County, Forsyth County, Stokes County, and Yadkin County, NC.

(c) Site Photographs

NORTH

EAST

SOUTH

WEST

2. Hattie Avenue

(a) Site Table

Site Name:	Hattie Avenue (Two buildings {A & B} at one location)		
AQS Site Id #:	37-067-0022		
Location:	1300 Hattie Avenue		
	Winston-Salem, NC		
Latitude:	N 36.110940		
Longitude:	W 80.224501		
Elevation:	284 meters		
Date Monitor Established:	Ozone	May 21, 1993	
Date Monitor Established:	NO_2	January 1, 1984	
Date Monitor Established	SO_2	January 1, 1983	
Date Monitor Established:	$PM_{2.5}$ – FRM	January 1, 1999	
Date Monitor Established:	$PM_{2.5}$ - PM_{10} - $PM_{10\text{-}2.5}$	January 1, 2018	
Date Monitor Established:	Air Toxics	January 1, 2000	
Date Monitor Established:	Speciation	January 1, 2001	
Date Monitor Established:	Carbon Speciation	January 1, 2007	
Nearest Road:	Hattie Avenue	Distance to Road:	27 meters
Traffic Count[3]:	6000	Year of Count:	2017
MSA[4]:	Winston-Salem, NC Metropolitan Statistical Area	MSA #:	49180

Parameter	Method	Method Number	Sampling Schedule
Ozone	UV Photometric	087	March 1 – Oct. 31, (Continuous)
NO_2	Chemiluminescence	599	Continuous
SO_2	UV Pulsed Fluorescence	560	Continuous
$PM_{2.5}$ FRM	FRM Gravimetric	145	1/3 day
$PM_{2.5}$ PM_{10} $PM_{10\text{-}2.5}$	T640x, Continuous	238-239-240	Continuous
Air Toxics	Compendium Method for Toxic Organics (TO) 15	150	1/6 day
Speciation	MET-one	118	1/6 day
Carbon Speciation	URG Sampler	118	1/6 day

Table 5 - Hattie Avenue "A" Monitoring Station Summary

(b) Description and Statement of Purpose

The Hattie Avenue A site monitors ozone, sulfur dioxide, oxides of nitrogen, $PM_{2.5,}$ PM_{10}, PM $_{10\text{-}2.5}$, toxics, speciation, and carbon speciation. The site is located in the 1300 block of Hattie Avenue in downtown Winston-Salem. The site is located approximately 2.2 km NE of downtown, 1.1 km E of US52 and approximately 1.8 km NNW of Interstate 40 Business in a residential district at latitude N36.110941º and longitude W80.224423º. The site elevation is 284 meters. The nearest road, Hattie Avenue, is 27 meters from the inlets and has a daily traffic flow of 6000 vehicles (2017). The nearest tallest building is St. Benedict's Church (approximately 10

meters). The inlets are approximately 43 meters from the shopping center. The inlets are approximately 4 meters above the ground and 1 meter above the roof of the monitoring station. The area is residential. The ozone, sulfur dioxide, and NO_2 monitors are all SLAMS.

The ozone instrument is operated during the North Carolina ozone monitoring season which begins March 1 and ends October 31. The ozone instrument operates continuously during this period.

The SO_2 and NO_2 instruments operate continuously.

The $PM_{2.5,}$ PM_{10}, and PM_{10}-2.5 T640x instruments operate continuously.

The $PM_{2.5}$ primary monitor is a continuous sampler and the co-located FRM is on the 1 in 3 day schedule. The FRM sampling interval is 24 hours, from midnight to midnight every third day.

The $PM_{2.5}$ Speciation sampling frequency is 1 in 6 days. The sampling interval is 24 hours, from midnight to midnight every six days.

Monitoring for Urban Air Toxics (UAT) is currently conducted at this site by the North Carolina Division of Air Quality (NC-DAQ), Toxics Protection Branch (TPB). Currently, the NC-DAQ TPB collects whole air samples in stainless steel 6 liter- pressurized canisters. The samples are then analyzed using cryogenic preconcentration gas chromatography with mass spectrometric detection (GC/MS) via the Compendium Method for Toxic Organics (TO) 15 for the list of 68 compounds (below).

- *Propene*
- *Freon 12*
- *Freon 22*
- *Freon 114*
- *Chloro Methane*
- *(Methylchloride)*
- *Isobutene*
- *Vinyl chloride*
- *1,3-Butadiene*
- *Bromomethane*
- *Chloroethane*
- *Freon 11*
- *Pentane*
- *Ethanol*
- *Isoprene*
- *Acrolein*
- *1,1-Dichloroethene*
- *(Vinylidene chloride)*
- *Freon 113*
- *Methyl Iodide*
- *Isopropyl Alcohol*
- *Carbon Disulfide*
- *Acetonitrile*
- *Methylene chloride*

- *Cyclopentane*
- *MTBE*
- *Hexane*
- *Methacrolein*
- *Vinyl Acetate*
- *1,1-Dichloroethane*
- *Methyl Vinyl Ketone*
- *Methyl Ethyl Ketone*
- *1,2 Dichloroethene*
- *Chloroform*
- *1,1,1-Trichloroethane*
- *(Methyl chloroform)*
- *Cyclohexane*
- *Carbon Tetrachloride*
- *Benzene*
- *1,2-Dichloroethane*
- *(ethylene dichloride)*
- *1-Butanol*
- *Trichloroethylene*
- *2-Pentanone*
- *3-Pentanone*
- *1,2-Dichloropropane*
- *1,4-Dioxane*
- *Bromodichloromethane*
- *trans-1,3 Dichloropropene*
- *Methyl Isobutyl Ketone*
- *Toluene*
- *cis-1,3 Dichloropropene*
- *1,1,2-Trichloroethane (vinyl trichloride)*
- *Ethylpropylketone*
- *Tetrachloroethylene*
- *(perchloroethylene)*
- *Methyl Butyl Ketone*
- *Dibromoethane*
- *Chlorobenzene*
- *(phenylchloride)*
- *Ethylbenzene*
- *m- & p-Xylene*
- *o-Xylene*
- *Styrene*
- *Bromoform*
- *1,1,2,2-Tetrachloroethane*
- *1,3,5-Trimethylbenzene*
- *(mesitylene)*
- *1,2,4-Trimethylbenzene*
- *(pseudocumene)*

- *m-Dichlorobenzene*
- *1,2,3-Trimethylbenzene*
- *p-Dichlorobenzene*
- *Benzylchloride*
- *o-Dichlorobenzene*
- *1,2,4-Trichlorobenzene*

The site complies with the siting requirements of 40CFR58 for criteria air pollutants. It is recommended that the current site status be maintained.

OBJECTIVE AND SPATIAL SCALE

The monitoring objectives of the instruments are to measure: 1) background ambient concentrations and 2) population exposure.

The site is a neighborhood spatial scale. Data from this site is used to assess compliance with the NAAQS for ozone, sulfur dioxide, and nitrogen dioxide.

The site is located in the Winston-Salem, NC Metropolitan Statistical Area[4]. The principal cities and counties in the MSA are Winston-Salem, Davie County, Forsyth County, Stokes County, and Yadkin County, NC.

(c) Site Photographs

NORTH (unable to update due to locked gate)

EAST

SOUTH

WEST

3. Union Cross

(a) Site Table

Site Name:	Union Cross		
AQS Site Identification Number:	37-067-1008		
Location:	3656 Piedmont Memorial Drive		
	Winston-Salem, NC		
Latitude:	N 36.051805		
Longitude:	W 80.144933		
Elevation:	285 meters		
Date Monitor Established:	Ozone	April 1, 1998	
Nearest Road:	Piedmont Memorial Dr.	Distance to Road:	55 meters
Traffic Count[3]:	670	Year of Count:	2017
MSA[4]:	Winston-Salem, NC Metropolitan Statistical Area (2006)	MSA #:	49180

Parameter	Method	Method Number	Sampling Schedule
Ozone	UV Photometry	087	March 1 – October 31 (Continuous)
Wind Speed	Climatronics	020	Continuous
Wind Direction	Climatronics	020	Continuous
Pressure	Climatronics	011	Continuous
Outdoor Temperature	Climatronics	020	Continuous
Relative Humidity	Climatronics	020	Continuous

Table 6 - Union Cross Monitoring Station Summary

(b) Site Description and Statement of Purpose

An ozone monitor has been located at this site since April 1, 1998 along with a meteorological tower since 1997. The site is located approximately 10 km SE of the central business district at latitude 36.050746° and longitude -80.143826°. The site elevation is 285 meters above sea level. The nearest road is Piedmont Memorial Drive with an annual traffic volume of 670 vehicles (2017) at a distance of 55 meters from the sample inlet.

The inlet is approximately 3 meters above the ground and 1 meter from the roof. The area is residential. The ozone sampler is SLAMS.

The ozone instrument is operated during the North Carolina ozone monitoring season which begins March 1 and ends October 31. The ozone instrument operates continuously during this period.

The site complies with the siting requirements of 40CFR58 for criteria air pollutants. There are no proposed changes for this site. It is recommended that the current site status be maintained. All equipment has been moved from the old building (green exterior) to the new building (white exterior). The old building will be moved from this location and disposed of.

OBJECTIVE AND SPATIAL SCALE

The monitoring objective of the instrument is to measure population exposure.

The site is a neighborhood spatial scale for ozone. Data from this site is used to assess compliance with the NAAQS for ozone.

The site is located in the Winston-Salem, NC Metropolitan Statistical Area[4]. The principal cities and counties in the MSA are Winston-Salem, Davie County, Forsyth County, Stokes County, and Yadkin County, NC.

(c) Site Photographs

<table>
<tr><td>  </td><td></td><td>  </td></tr>
<tr><td>NORTH</td><td></td><td>EAST</td></tr>
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<tr><td>SOUTH</td><td></td><td>WEST</td></tr>
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Statistical Analysis

Trends

Air quality trends across Forsyth County have shown improvement over the last several years. This has been accomplished using local regulations, state mandates, and Federal programs to improve air quality while balancing economic growth in the County. Businesses have contributed to this improvement as they build in efficiencies in their operations and implement pollution prevention measures such as recycling, reformulation, more efficient work practices, and transitioning their energy usage to utilize cleaner fuels. Although levels of ozone and particle pollution continue to be potential issues in the area, other pollutants have dropped well below the EPA standards. For example, recorded concentrations of lead and carbon monoxide have fallen so far below the National Standards that monitoring for these pollutants is no longer justifiable. Other monitoring sites have been combined with existing sites to help maximize use of staff and resources while maintaining an adequate network for AQI forecasting and public awareness.

Sulfur Dioxide and Nitrogen Oxide

FCEAP continues to operate a sulfur dioxide and a nitrogen oxide monitor. Local emission levels of both pollutants have shown a general decrease, and neither has been a serious issue across the area. Monitored levels show a noticeable improvement in ambient concentrations of both pollutants. This can be explained by improvements in motor vehicle exhaust and technology as well as pollution reductions from large stationary point sources such as power plants. Improved awareness of the impacts of these pollutants (such as acid rain and NOx as a precursor to ozone formation) has also led many citizens to consider alternatives to high SO_2 and NO_2 producing activities. These voluntary measures not only affect sulfur dioxide and nitrogen dioxide, but also impact $PM_{2.5}$, carbon dioxide and other greenhouse gasses.

Particle Pollution

One of the major successes in Forsyth County is the reduction in local particle pollution levels. The NAAQS includes standards for $PM_{2.5,}$ (particle pollution smaller than 2.5 microns in diameter). These particles are especially harmful. Studies show that a number of health problems such as stresses to the pulmonary and cardiovascular systems can be linked to elevated particle pollution levels. Recent studies have suggested high particle pollution levels can have greater impacts on more people than ozone.

The good news is that levels of particle pollution ($PM_{2.5}$) have shown a steady decline since monitoring of the pollutant began in 1999. Much of this decrease can be attributed to the transition to cleaner fuels by industry, stricter control requirements for power plants, and cleaner automobile emissions. FCEAP's vigilance in enforcing local open burning regulations also contributes to reduced PM levels, especially at the neighborhood level and the reduction of smoke in the overnight hours when smoke tends to remain at ground level.

The 24-hour compliance to the NAAQS (35 $\mu g/m^3$) is demonstrated by the average of the 98th percentile of the daily averages, averaged over 3 years. As Figure 10 shows, the 98th percentile averages have declined significantly since 2005. Additionally, Forsyth County data demonstrates that the annual average of $PM_{2.5}$ is declining and easily below the annual $PM_{2.5}$ annual NAAQS of 15 $\mu g/m^3$.

Despite lower annual averages, daily levels of particle pollution can still approach or potentially exceed the standard. For this reason, FCEAP includes particle pollution in its daily AQI forecast to alert the public to potentially unhealthy air quality levels. Additionally, as NAAQS standards come up for review (currently every 5 years as required under the Clean Air Act), further strengthening of standards may be warranted based on epidemiological evidence showing adverse health impacts.

Carbon Monoxide and Ozone

Since 1995, Forsyth County and the entire Triad area have been classified by the USEPA as maintenance areas for Carbon Monoxide (CO) and Ozone (O3). Air Quality levels since then have shown declining trends in both pollutants.

Ground level or "bad" ozone is not emitted directly into the air. It is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Emissions from mobile sources, industrial facilities and electric utilities, gasoline vapors, and chemical solvents are some of the major sources of NOx and VOC. Breathing ozone can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma.

Ozone levels have shown significant improvements in recent years and Forsyth County is now in attainment with the 8-hour ozone standard (.075 ppm). Despite a reduction in the number of ozone exceedance days in 2013 and 2014, Forsyth County has had days that exceeded the standard in all years prior to 2014. Although air quality levels of ozone are improving, new information and susceptibility studies show that exposure to ozone at lower levels is still a health concern. Ozone concentrations have been found harmful to sensitive populations at much lower concentrations for a longer period of time. Therefore, lower ozone levels averaged over 8 hours were developed and lower standards have become the focus of future attainment concerns across many areas. In fact, a more health protective and lower ozone standard is currently under the process of review and may be promulgated in the 2015 or 2016 ozone season.

Over the last 10 years (2009-2019), Forsyth County has experienced over 38 days where ozone levels exceeded the current standard (reduced from .08 ppm to .075 ppm effective in 2012). With the majority of precursor ozone emissions coming from power plants and automobiles, ambitious measures must be implemented to limit emissions in these areas. Under the Clean Smokestacks Bill, The North Carolina General Assembly implemented legislation to reduce the amount of ozone precursors from power plants nearly 70%. Some steps have been taken to counteract the expected growth in VMTs over that same time frame. Ongoing efforts are underway to help change the popular mindset of one-person automobile trips. Ride sharing plans, carpooling practices, and mass transit initiatives are all possible solutions. The Winston-Salem Transit Authority's Strategic Plan summarizes various mindsets of the public and outlines their plans going forward as funding allows. For commuter traffic entering and leaving Forsyth County, the Piedmont Authority for Regional Transportation (PART) has established several Park and Ride lots. PART is constantly evaluating their strategy to increase ridership and efficiency and have added routes to Surry County and Mebane, NC among others. Besides the normal local and commuter traffic, the Triad experiences a "population growth" each year with large events such as the local fairs, film and music

festivals, and the annual furniture market. Giving patrons to these events the opportunity to use the mass transit system developed across the region would significantly reduce the amount of ozone precursors and hopefully limit the amount of traffic congestion on the already taxed roadways. As the Triad continues to grow, we must make attempts to reduce single occupant vehicles or the declining trend in air pollution will make a noticeable reversal that could result in widespread populations being affected by the worsening air quality.

PM_{10}

Except during exceptional events (e.g. impact from wild fires, etc.), PM_{10} levels (particles less than 10 microns in diameter) have never reached a level of serious concern in Forsyth County. Filter based sampling began in the 1980s and continued through 1998. Consistently low levels of PM_{10} led to a reduction in the number of monitoring locations across the County. In addition, new technology and improved equipment led FCEAP to eliminate all filter based sampling monitors and implement continuous PM_{10} monitors at two (2) locations until recently. With the approval of U.S. EPA, FCEAP eliminated its PM_{10} monitor at the Peters Creek location due to the equipment being in poor repair coupled with historically low readings that did not warrant the expense for new equipment. FCEAP now operates one PM_{10} monitoring at Hattie Ave, where it is co-located with existing $PM_{2.5}$ monitors. The co-location of $PM_{2.5}$ and PM_{10} monitors at one location (Hattie Ave B) is useful to validate particle pollution levels during unexpected or elevated events. This strategy ensures the network is operating efficiently while minimizing staff responsibilities.

Site correlations

Particle Pollution

Forsyth County EAP operates a fairly extensive particle pollution network. Two (2) Federal Reference Method (FRM) monitors and two (2) continuous Teledyne T640 instruments provide particle pollution values to the staff and the public. FCEAP is also fortunate to have a good correlation (R^2 value >.80) between its FRM and T640 data. This allows local AQI forecasters to use this data for daily particle pollution forecasts and validation of previous day's forecasts. Good correlation also allows for many uses of the continuous particle pollution data especially in cases where insufficient time is available for a laboratory analysis of the FRM sample.

Ozone

The ozone network in Forsyth County has remained relatively static over the last ten years. Only one monitor has been removed during that time. The three (3) ozone monitors across the County continue to show good correlation, but each site has its own merits. Two (2) ozone monitors, Clemmons Middle School (CM), and Union Cross (UC) are located in more rural settings and are sited in locations to provide a quick look at ozone conditions across the county. Hattie Avenue (HA) is in an urban area surrounded by largely minority owned properties and is an ideal location for monitoring urban ozone concentrations possibly impacted by higher temperatures and more static conditions due to its urban setting. The observed readings at each site are essential to the mission of FCEAP as well as its County leaders. Routine maintenance and scheduled repairs also help in attaining the consistent correlation that is observed.

Comparison to NAAQS

Current data over the last 5 years (2015-2019) show that Forsyth County is in compliance with all NAAQS. Fortunately, the data demonstrates that the Forsyth County ozone levels continue to improve from 2015 to 2019. This is partially due to favorable weather conditions, Federal efforts to improve efficiency in automobiles, and the reduction of Volatile Organic Compound and Nitrogen Dioxide emissions from stationary and other sources. It is anticipated that as the average age of vehicles on the roads decrease and further reductions in VOC and NOx emissions are realized from stationary sources, Forsyth County will continue to show improvement in its ozone levels. Forsyth County will likely see limited adverse effects to economic growth in the Triad area if ozone concentrations continue to trend downward as expected. Good transportation planning along with further reductions in emissions by industry and utilities are crucial to this effort for cleaner air and compliance with the national standards.

Particle pollution levels remain below the national standard, but levels to our south and west continue to run right below the standard. New standards for NO_2 and SO_2 will not likely affect the area. However, hourly averages of both pollutants can easily reach code YELLOW levels under the AQI scale. In 2011, EPA proposed to retain the existing Carbon Monoxide (CO) standard and reduced the concern that Forsyth County will exceed this standard. Carbon Monoxide levels have continued to decline since the last Network assessment and monitoring for CO has become less essential.

Situational Analysis

Risk of future NAAQS exceedances

Ozone and particle pollution remain the main focus of concern for NAAQS violations across Forsyth County. Improvements to various industries, better controls for motor vehicle emissions, increased public transportation options, and improved air quality awareness contribute to the decreases in ozone exceedances in the past several years. However, with a change to the national ozone standard on the horizon, particle pollution still a concern, and a lower NO_2 standard in place, the area is far from taking a relaxed approach to monitoring. It remains imperative that FCEAP continue operating the current monitoring network and continue outreach activities to protect the health of citizens of the County. Historically, the Office has shown that it can meet the challenges set by USEPA to attain the NAAQS. By maintaining the current network, FCEAP has the means to meet these challenges and strive for cleaner air for everyone.

Demographic shifts

Population across Forsyth County has steadily increased over the last several years. Despite the loss of many furniture and other manufacturing facilities, people continue to move to the region for its favorable climate, hospitality, and attractive amenities. Technology based jobs are on the rise as well which helps attract younger populations and stabilize the population. As described earlier, minority populations tend to reside more closely to inner city locations where minority owned businesses are more prevalent. A smaller percentage of minorities live in the suburban and rural areas of the County. Statistics demonstrate this trend to be relatively stable.

One demographic statistic important to note is the trend towards an aging population in Forsyth County. Since older adults tend to have more health problems and, consequently, are more susceptible to air pollution events, Forsyth County's efforts remain important to reduce high air pollution events and to provide accurate forecasting to help area residents determine their daily activities.

An increase in public transportation and carpooling has helped make the rural areas more attractive to many people. This promotes urban sprawl and a more diverse population across a larger area. For that reason, it is important for FCEAP to track demographic and population shifts and uses this information when a new monitoring site (or the relocation of an existing one) is warranted. While targeting the areas of highest concentrations of pollutants is a primary rationale for locating monitoring equipment, ensuring adequate coverage of the entire population is equally important. For this reason, population data is frequently used when assessing monitoring site locations.

SIP requirements

Currently none of Forsyth County's monitoring network is sited based on SIP requirements.

Density of existing network

The Forsyth County air monitoring network has undergone many changes over the years. Originally, the network consisted of a wide variety of monitor locations across the County. Criteria pollutants were the main focus with over 20 PM_{10} monitors placed across the County. Over time, the technology of the monitoring equipment improved in operation and efficiency. Multiple gas cylinders were replaced with a single calibrator and a single multi-gas cylinder. The biggest change in the network came with the change to continuous PM_{10} monitoring. The dense gravimetric collection sites were consolidated into two (2) sites and two (2) continuous monitors. Eventually, the manual sites were closed and now the network features only continuous monitors. Other sites were consolidated to maximize staff resources as well as monitoring locations. Currently, the network consists of three (3) sites located at various locations across the County (Figure) with two (2) buildings co-located at Hattie Avenue. Ozone monitors are located at predominant upwind and downwind locations as well as a center city site. This ensures data collection captures ozone levels entering the County, leaving the County, and levels generated from local conditions. Particle pollution levels are located at two (2) locations. The SW location captures levels entering the county while the inner city site captures concentrations representative of typical neighborhood levels across the county. Each site contains a

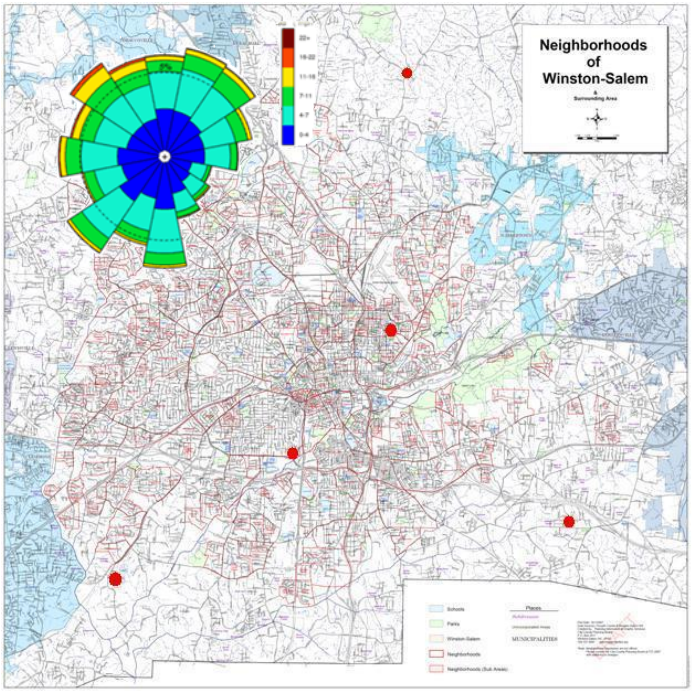

Figure 7 - Forsyth County Neighborhoods and Monitors

Federal Reference Method (FRM) monitor as well as a continuous (TAPI T640) monitor. The PM_{10} network has been consolidated to an inner city site. Carbon monoxide is no longer monitored within the county. Levels of nitrogen oxides and sulfur dioxide are measured at the inner-city site to help measure typical neighborhood concentrations near a variety of pollution sources. Air toxics and particle pollution speciation are measured at the same inner-city site. This network has proven to be efficient and effective in monitoring air pollution levels across the county while still balancing staff resources.

Scientific research or public health needs

From 2005 through 2009 and again in 2014-2016, FCEAP participated in a health based study with the University of Washington. The Multi-Ethnic Study of Atherosclerosis and Air Pollution (MESA Air) is designed to examine the relationship between air pollution exposures and the progression of cardiovascular disease over time. The United States Environmental Protection Agency funds the ten-year study, which involves thousands of participants, representing diverse areas of the United States. The MESA Air Pollution study is headquartered at the University of Washington, but many other institutions are also involved.

This air pollution study builds upon the foundation created by another study, the MESA study. A different branch of the federal government, the National of the National Institutes of Health, funds the population-based MESA study. The original MESA study began in 2000, and recruited subjects for the study of cardiovascular disease in six states – New York, Maryland, North Carolina, Minnesota, Illinois, and California.

Using our existing resources, FCEAP was able to co-locate monitoring equipment with the MESA-Air team and acquire additional data. In addition, the immediate availability of current and historical particle pollution data helped the study organizers implement their project locally without delay or gaps in data.

Political factors

Active participation by local city council members, town aldermen and county commissioners reflect local air quality concerns. Local politicians are kept informed of changing conditions and Forsyth County's air quality status to help them formulate educated opinions about air quality monitoring activities. The current monitoring network has been adopted over time to meet not only the air quality scope and objectives set forth by EPA, but also includes input from local political leaders. This methodology ensures not only air quality concerns are addressed, but also the various populations that are affected by pollution across the County.

Proposed Changes

Listed below are the proposed changes for the FCEAP monitoring network.

Site	Location	Pollutant	Objective	Equipment	Recommendation(s)
CM	SW Forsyth County	Ozone	1. Background 2. Population Exposure	API T400 API 703E	● Keep existing site at present location
		$PM_{2.5}$	1. Background 2. Population Exposure	API T640 R&P 2025 (1 in 6)	● Keep existing site at present location
HA	Downtown (neighborhood)	Ozone	1. Background 2. Population Exposure	API T400, API T700U	● Keep existing site at present location
		NO_2	1. Background 2. Population Exposure	API T200U, API T700U	● Keep existing site at present location
		SO_2	1. Background 2. Population Exposure	API T100U, API T700U	● Keep existing site at present location
HB	Downtown (neighborhood)	$PM_{2.5}$	1. Background 2. Population Exposure	API T640X R&P 2025i (1 in 3) Met One (1 in 6) URG (1 in 6)	● Keep existing site at present location
		PM_{10}	1. Background 2. Population Exposure	API T640X	● Keep existing site at present location
UC	SE Forsyth County	Ozone	1. Background 1. Population Exposure	API T400, API 703E	● Keep existing site at present location

Table 10 - Proposed Network Changes

Public Input

Set for public comment period from June 4, 2020 to July 4, 2020. There were no comments received during this period.

References

1. Title 40 Code of Federal Regulations Part 58, Ambient Air Quality Surveillance. Part 58 and Part 58 Amended: Federal Register/Vol. 71 No. 200/Tuesday, October 17, 2006/Rules and Regulations.

2. Watson, John G., Chow, Judith C., DuBois, David, Green, Mark, Frank, Neil, Pitchford, Marc. Guidance for Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}. Office of Air Quality Planning and Standards, U. S. Environmental Protection Agency, Research Triangle Park, NC 27711. December 15, 1997.

3. Winston-Salem Department of Transportation. Current Traffic Counts
Note: Traffic Count taken from nearest road providing most impact to site

4. US Census Bureau. Current Lists of Metropolitan and Micropolitan Statistical Areas and Definitions. http://www.census.gov/population/metro/data/metrodef.html