Environmental Health

Environmental Health

Human health and development is largely impacted by the environment. Exposures to certain environmental qualities and disease have been linked through research to solidify the environment's impact on human health. One example of the environment's direct impact on human health and development is the exposure to lead and correlated impaired cognitive development in children (1).

The built and natural environments both play a role in the community's health. The built environment includes man-made structures that influence healthy behaviors. A part of environmental public health's purpose is to maintain good air and water quality by ensuring low levels of pollutants while also monitoring the safety and sanitation of places that serve food, provide lodging, serve as pools, and provide child and elder care (2).

AIR

Air is a constant environmental factor that varies in quality for indoor and outdoor air. Air pollution refers to the presence of substances that are either present in the environment where it does not belong or at levels higher than they should be. Pollutants may be natural, like those from forest fires, soil erosion, or volcanoes, while some are a result of human behavior, like environmental tobacco smoke or car emissions. Air pollution has been strongly linked to health effects such as decreased lung functioning and increased heart attacks (3).

Outdoor/Ambient Air Quality

Air quality can be affected by pollutants from stationary sources (e.g., factories, power plant, dry cleaners, and degreasing operations), mobile sources (e.g., cars, buses, planes, trucks, and trains), or natural sources (e.g. windblown dust and volcanic eruptions). The Environmental Protection Agency (EPA) classifies pollutants into six principal, or criteria pollutants, which are monitored by the EPA, national, state, and local organizations (4). The six principal pollutants are:

- Carbon Monoxide
- Sulfur Dioxide
- Nitrogen Dioxide
- Ozone (smog)
- Lead
- Particulate Matter

When levels of these pollutants are higher than standards, the area is then considered a nonattainment area (4). Each pollutant has different effects on human health and the environment described below in Table 1.

Table 1. Effects of Air Pollutants

Pollutant	Description	Sources	Health Effects	Welfare Effects
Carbon Monoxide (CO)	Colorless, odorless gas	Motor vehicle exhaust, indoor sources include kerosene or wood burning stoves.	Headaches, reduced mental alertness, heart attack, cardiovascular diseases, impaired fetal development, death.	Contribute to the formation of smog.
Sulfur Dioxide (SO_2)	Colorless gas that dissolves in water vapor to form acid, and interact with other gases and particles in the air.	Coal-fired power plants, petroleum refineries, manufacture of sulfuric acid and smelting of ores containing sulfur.	Eye irritation, wheezing, chest tightness, shortness of breath, lung damage.	Contribute to the formation of acid rain, visibility impairment, plant and water damage, aesthetic damage.
Nitrogen Dioxide (NO_2)	Reddish brown, highly reactive gas.	Motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels.	Susceptibility to respiratory infections, irritation of the lung and respiratory symptoms (e.g., cough, chest pain, difficulty breathing).	Contribute to the formation of smog, acid rain, water quality deterioration, global warming, and visibility impairment.
Ozone (O_3)	Gaseous pollutant when it is formed in the troposphere.	Vehicle exhaust and certain other fumes. Formed from other air pollutants in the presence of sunlight.	Eye and throat irritation, coughing, respiratory tract problems, asthma, lung damage.	Plant and ecosystem damage.
Lead (Pb)	Metallic element	Metal refineries, lead smelters, battery manufacturers, iron and steel producers.	Anemia, high blood pressure, brain and kidney damage, neurological disorders, cancer, lowered IQ.	Affects animals and plants, affects aquatic ecosystems.
Particulate Matter (PM)	Very small particles of soot, dust, or other matter, including tiny droplets of liquids.	Diesel engines, power plants, industries, wind-blown dust, wood stoves.	Eye irritation, asthma, bronchitis, lung damage, cancer, heavy metal poisoning, cardiovascular effects.	Visibility impairment, atmospheric deposition, aesthetic damage.

Source: US EPA. Air Pollution Control Orientation Course. Effects of Air Pollutants-Health Effects.

The Clean Air Act, last amended in 1990, provides a framework for protecting the quality of the air, while giving the EPA the authority to set air quality standards. The national ambient air quality standards (NAAQS) are for criteria pollutants that are harmful not only to humans, but to the environment as well. Primary Standards provide public health protection, including those populations which are considered sensitive (such as those who are asthmatics, children, and elderly) while secondary standards provide public welfare protections, such as protections against decreased visibility or damage to animals, crops, vegetation and buildings (4). These standards are detailed in Table 2, while Forsyth County's performance on the NAAQS in 2011 are shown in Table 3.

Table 2. National Ambient Air Quality Standards

Pollutant	Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide	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 µg/m3	Not to be exceeded
Nitrogen Dioxide	primary	1-hour	100 ppb	98th percentile, averaged over 3 years
	primary and secondary	Annual	53 ppb	Annual Mean
Ozone	primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution PM2.5	primary and	Annual	15 µg/m^3	Annual mean, averaged over 3 years
	secondary	24-hour	35 µg/m^3	98th percentile, averaged over 3 years
PM10	primary and secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide	primary	1-hour	75 ppb	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
Source: Environmental Protection Agency. Air and Radiation: National Ambient Air Quality Standards.				

The Air Quality Index (AQI) is used by the EPA and others to provide the public with information regarding local air quality and whether or not air pollution levels pose a health concern. Health effects can happen within a few hours or days after breathing polluted air (3). Table 4 below gives a brief description of AQI range, level of health concern, and color symbolization.

Table 3. Forsyth Air Quality Statistics Report, 2009

County	CO 2nd Max 1-hr	CO 2nd Max 8-hr	NO2 98th Percentile 1-hr	Ozone 2nd Max 1-hr	Ozone 4th Max 8-hr	SO2 2nd Max 24-hr	PM2.5 98th Percentile 24-hr	PM2.5 Weighted Mean 24-hr	PM10 2nd Max 24-hr
Forsyth	2.3	1.7	53	0.08	0.068	10	21	9.7	35
Source: US EPA AirData.									

Table 4. Air Quality Index Description

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	…air quality conditions are:	…as symbolized by this color:
0 to 50:	Good	Green
51 to 100:	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200:	Unhealthy	Red
201 to 300:	Very Unhealthy	Purple
301 to 500:	Hazardous	Maroon
Source: CDC ATSDR. Air.		

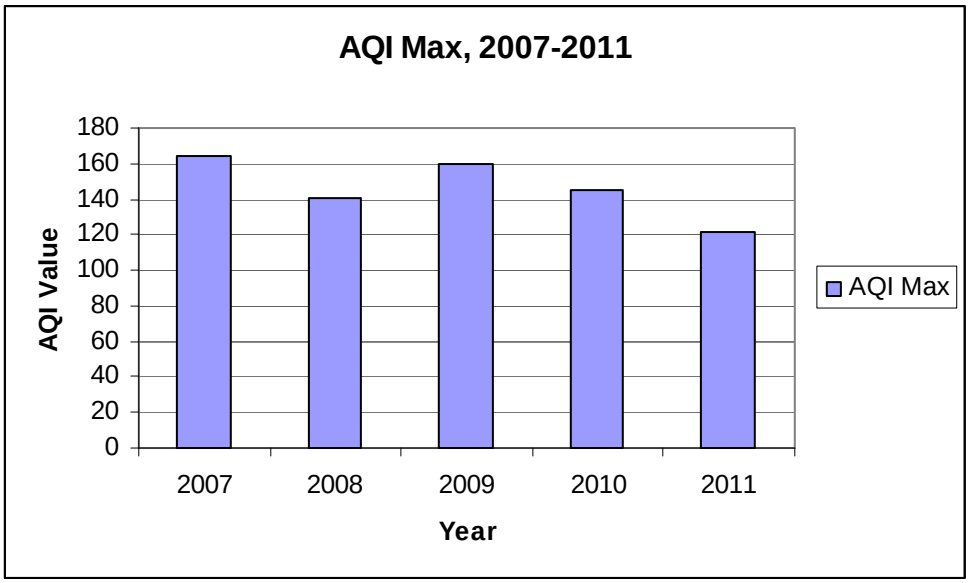
The Forsyth County Office of Environmental Assistance & Protection houses the Triad Air Awareness program which provides air quality education and outreach. During 2011, the Triad area experienced 8 days in which the AQI reached Code Orange, a level which is Unhealthy for Sensitive Groups. There were no days in 2011 in which the AQI reached Code Red, a level this is considered unhealthy for all groups (5). Table 5 shows the AQI Yearly Summary for 2007-2011. The maximum AQI reached 122, the median was 40, and the 90th percentile was 64 (5). Table 5 details Forsyth County's AQI yearly summary for 2007-2011 based on AQI Value, level and number of days at that level. Figure 1 shows the AQI value maximum level reached in Forsyth County each year for the years 2007-2011.

Table 5. AQI Yearly Summary Index Value by Number of Days, 2007-2011

Year	County	# Days with AQI	# Days Good (Green)	# Days Moderate (Yellow)	# Days Un-healthy for Sensitive Groups (Orange)	# Days Un-healthy (Red)	# Days Very Unhealthy (Purple)
2011	Forsyth	365	274	84	7	0	0
2010	Forsyth	365	229	125	11	0	0
2009	Forsyth	365	274	88	2	1	0
2008	Forsyth	366	222	134	10	0	0
2007	Forsyth	365	195	140	28	2	0

Source: US EPA AirData.

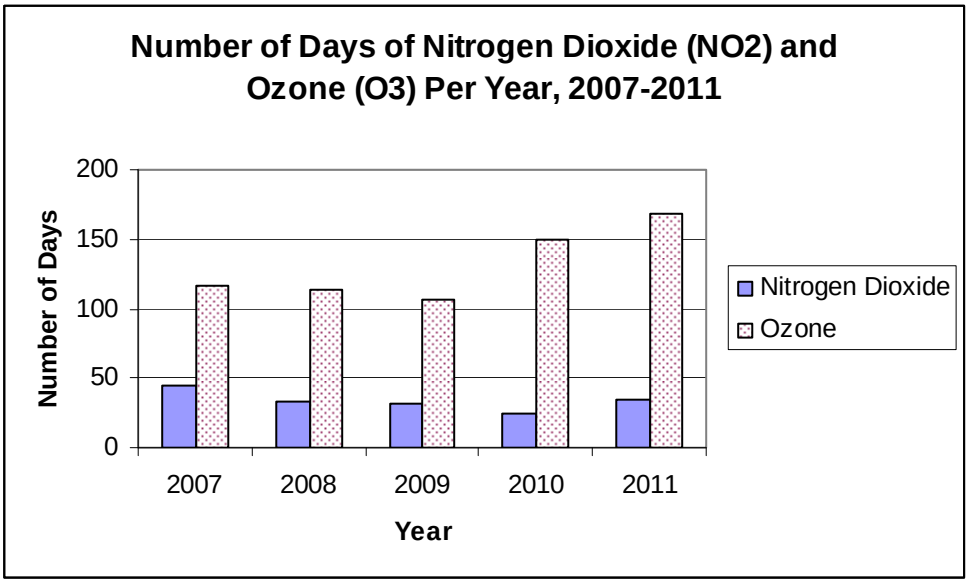
Figure 1. AQI Maximum Value, 2007-2011



Source: US EPA AirData.

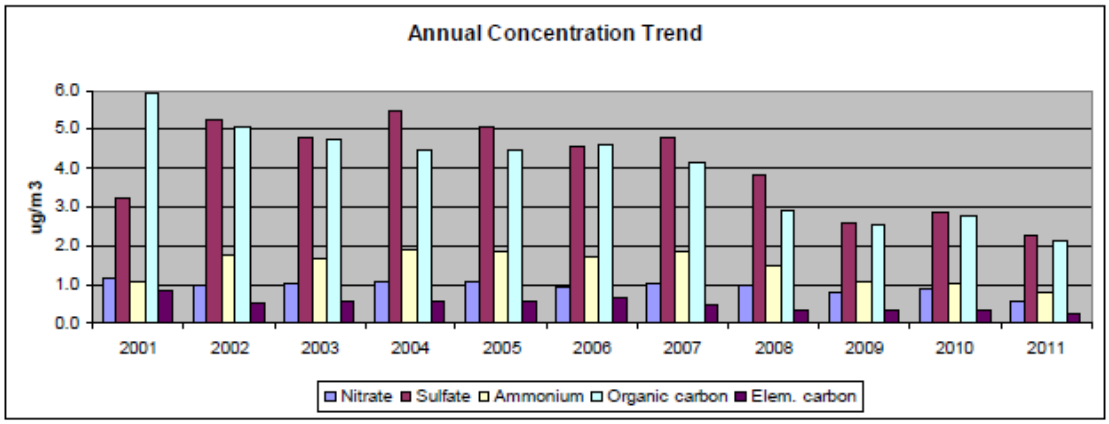
Ozone and particulate matter and ozone are common contributing factors to poor air quality. These two pollutants were the main pollutants for 90% of measured days (5). Smog is a result of nitrogen dioxide and ozone presence in the air. Figure 2 graphs the number of days per year that nitrogen dioxide and ozone was present in the air in Forsyth County between 2007 and 2011 (6).

Figure 2. Number of Days Nitrogen Dioxide and Ozone in Air, 2007-2011



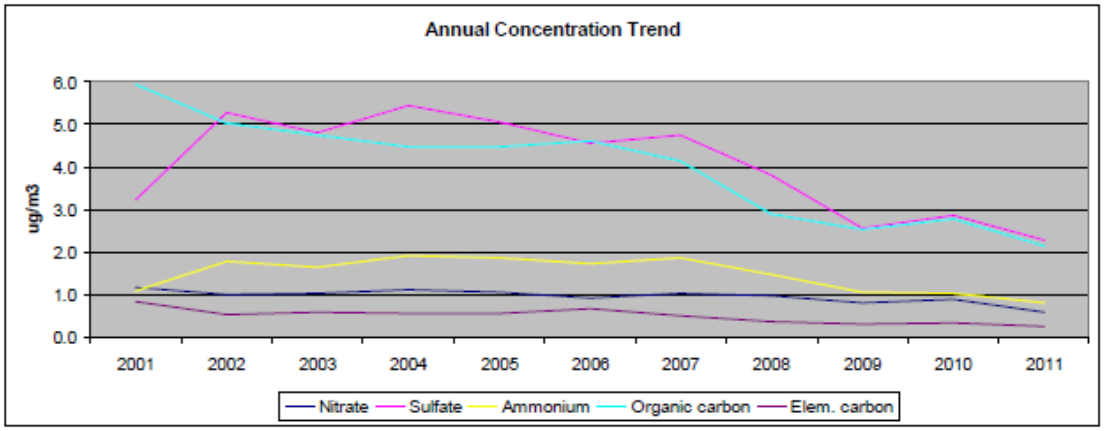
Particulate matter is monitored by the Forsyth County Office of Environmental Assistance and Protection. Individual components of particle pollution are measured which includes: nitrate, sulfate, ammonium, organic carbon, and elemental carbon. Since 2001, the values of the individual particle matters have been decreasing. Sulfate and organic carbon concentration that comprise a majority of the particulate matter measures is a result of the burning of fossil fuels (coal, diesel and gasoline). Cleaner burning technologies for industries and transportation along with stricter power plan emission control are responsible for the decrease. The reductions can mean fewer respiratory and cardiovascular health problems for area citizens. Figures 3 and 4 show the particulate concentration trends from 2001-2011.

Figure 3. Annual Particulate Concentration, 2001-2011



Source: Forsyth County Department of Public Health. Environmental Health Division.

Figure 4. Line Graph of Annual Particulate Concentration, 2001-2011

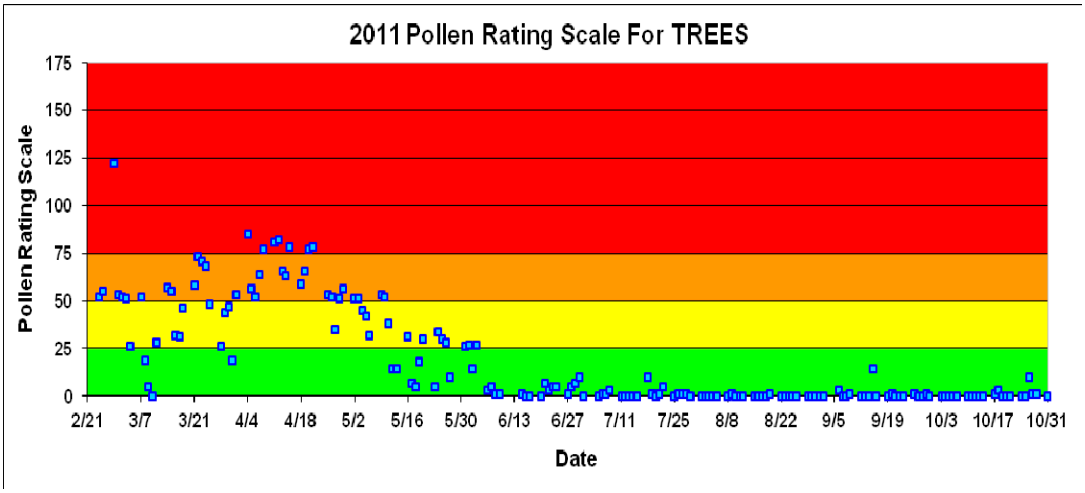


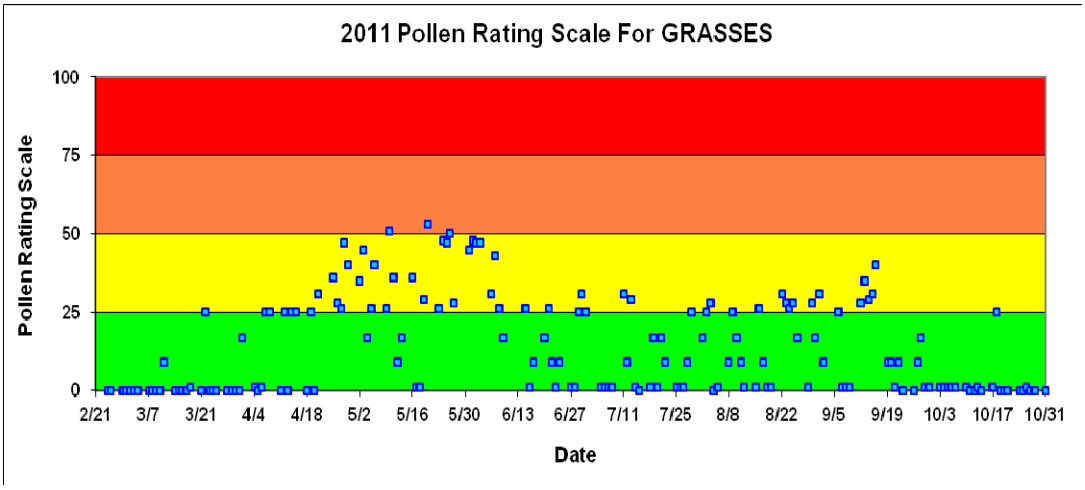
Source: Forsyth County Department of Public Health. Environmental Health Division.

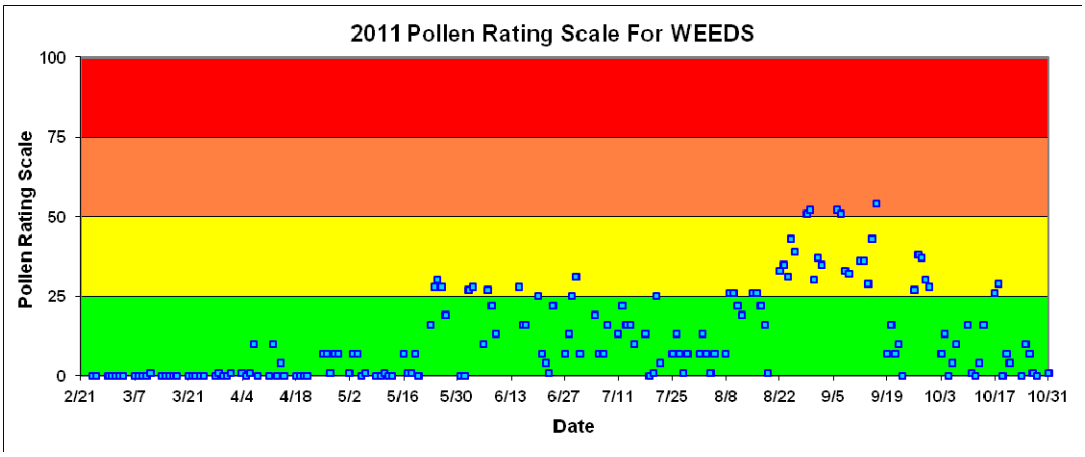
Pollen

Increased temperatures and ground level carbon dioxide, consistent with climate change, result in increased pollen creation. Pollen is an allergen that aggravates allergic rhinitis and other respiratory diseases, such as asthma and chronic obstructive pulmonary disease. Allergic diseases are the sixth leading cause of chronic disease in the United States, with a significant portion of the nation's population suffering from allergies. Asthma itself affects 20 million Americans. When allergens, like pollen, act with air pollution respiratory disease may worsen (7). Figure 5 shows the pollen rating scale for trees, grasses and weeds in 2011.

Figure 5. Pollen Rating Scale for Trees, Grasses and Weeds, 2011





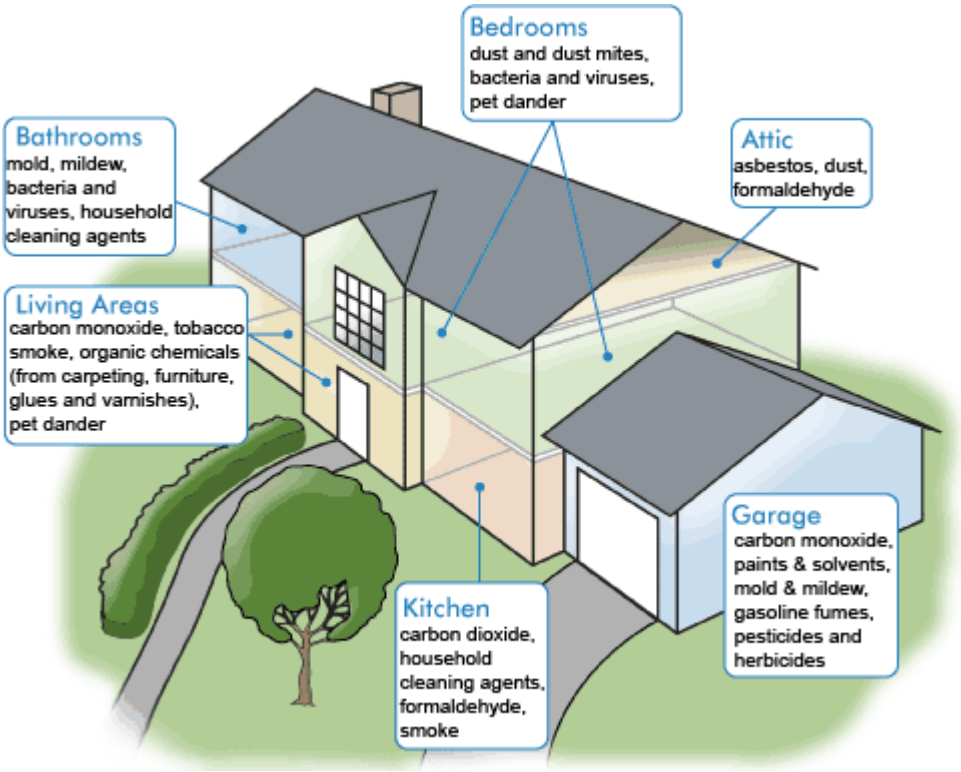


Source: Forsyth County Department of Public Health. Environmental Health Division.

Indoor Air Quality

Indoor air consists of natural and manmade impurities that include: bacteria, viruses, fungi, radon, and combustion by-products from burning. Recently other contaminants (such as asbestos and formaldehyde) have been identified in indoor air. Mold is another contaminant that has become a common problem. Improperly designed homes and buildings can affect not only the comfort, but the health of the structure's occupants. Air testing can be done to determine if an indoor air problem exists, although it may require a series of tests to narrow down a problem. Common indoor air pollutants include: carbon monoxide (CO), formaldehyde, radon, environmental tobacco smoke, lead, asbestos and mold (8). Figure 6 below shows the various pollutants in common home areas.

Figure 6. Pollutants Affecting Indoor Air Quality



Source: Forsyth County Environmental Assistance and Protection. Indoor Air Quality. .

WATER

The quality of water used for drinking, recreation, hygiene, and other uses can be impacted by human activities related to land use and land-management practices. To protect water quality, the minimization of disruption of the natural water cycle is suggested (9). In 2011 Forsyth County residents used 51 gallons of water per capita each day, a 30% decrease from 70 gallons per capita in 2007 (5).

River Basins

Forsyth County's watershed system impacts communities in three separate river basins; the Yadkin/ Pee-Dee River Basin which occupies 76% of Forsyth County, the Roanoke River basin which occupies 21% of the northeastern section of the county, and the Cape Fear River basin which occupies less than 3% of the eastern edge of the county, including a small part of Kernersville (10). Figure 7 delineates the river basins in Forsyth County.

Figure 7. Map of River Basins in Forsyth County

Source: Forsyth County Environmental Assistance and Protection: Water Quality Program.

Ground Water

More than one half of North Carolina's population relies on ground water as a source of drinking water. Approximately 98% of all public water supply systems use ground water to serve over 2 million citizens in North Carolina. Private water supplies for single family homes also use ground water. The quality of ground water in the state is considered good. Coastal areas within the state are identified as having some form of impairment. The state has potable ground water throughout (11).

Public Water Supply

There are 26 water systems in Forsyth County shown in Table 6 below, with details about each system's number, name, type, status, primary county served, primary source, and date of last sanitary survey. Type refers to classifications from the EPA. Forsyth County has 18 Community (C) water supply systems in which there are at least 15 service connections or the system regularly serves 25 year-round residents (such as towns), and 8 Transient Non-Community (NC) water supply systems in which the system regularly serves at least 25 non-residential individuals during 60 or more days per year (such as rest-stops or parks). Status indicates whether the public water system is active (A) or inactive (I). All public water systems listed are active. Primary Source Water Type indicates the origination of the water system, 24 water systems in Forsyth County rely on ground water (GW), 1 uses surface water (SW), and 1 uses purchased surface water (SWP)in which the system purchases water that originates from a surface source (e.g. river, reservoir, intake) (12).

Table 6. Forsyth County Active Public Water Systems, 2011

Water System No.	Water System Name	Type	Status	Primary County Served	Primary Source Water Type	Date of Last Sanitary Survey
NC0234191	ABINGTON S/D	C	A	FORSYTH	GW	05-05-2010
NC0234179	APPLEGATE WATER SYSTEM	C	A	FORSYTH	GW	09-21-2010
NC0234197	BISHOPS RIDGE S/D	C	A	FORSYTH	GW	08-10-2011
NC3034012	BLUE WATER COVE S/D	C	A	FORSYTH	GW	08-10-2011
NC0234115	COUNTRY CLUB ANNEX	C	A	FORSYTH	GW	08-19-2010
NC0234192	DEERPATH S/D	C	A	FORSYTH	GW	09-21-2010
NC0234461	FRATERNITY CH OF THE BRETHREN	NC	A	FORSYTH	GW	01-28-2011
NC0234464	FREEDOM BAPTIST CHURCH	NC	A	FORSYTH	GW	07-14-2010
NC0234124	GRANDVIEW WATER SYSTEM	C	A	FORSYTH	GW	12-13-2010
NC0234182	GRAYSTONE FORREST WATER SYSTEM	C	A	FORSYTH	GW	06-22-2010
NC0234574	KERNERSVILLE LAKE PARK	NC	A	FORSYTH	GW	07-22-2008
NC0234189	KYNWOOD S/D	C	A	FORSYTH	GW	06-22-2010
NC0234475	LONG CREEK CLUB	NC	A	FORSYTH	GW	09-12-2008
NC3034011	MAPLE LEAF GOLF COURSE	NC	A	FORSYTH	GW	01-28-2011
NC0234167	MCBRIDE`S MHP	C	A	FORSYTH	GW	11-29-2011
NC0234193	MIKKOLA DOWNS S/D	C	A	FORSYTH	GW	02-08-2012
NC0234497	NORTHSIDE BAPTIST CHURCH	NC	A	FORSYTH	GW	05-23-2011
NC0234199	PEABODY FOREST S/D	C	A	FORSYTH	GW	06-22-2010
NC0234139	PINE KNOLLS WATER SUPPLY	C	A	FORSYTH	GW	05-18-2010
NC0234183	SMOKERISE WATER SYSTEM	C	A	FORSYTH	GW	05-18-2010
NC0234134	SOMERSET MHP	C	A	FORSYTH	GW	01-28-2011
NC0234196	STONINGTON S/D	C	A	FORSYTH	GW	08-10-2011
NC0234482	TED`S FAMOUS CHICKEN	NC	A	FORSYTH	GW	11-14-2011
NC3034010	WESTBEND WINERY	NC	A	FORSYTH	GW	06-01-2011
NC0234010	WINSTON-SALEM, CITY OF	C	A	FORSYTH	SW	04-28-2011
NC0234165	YORKTOWN S/D	C	A	FORSYTH	SWP	09-06-2011

Source: NC DWR. Public Water Supply. .

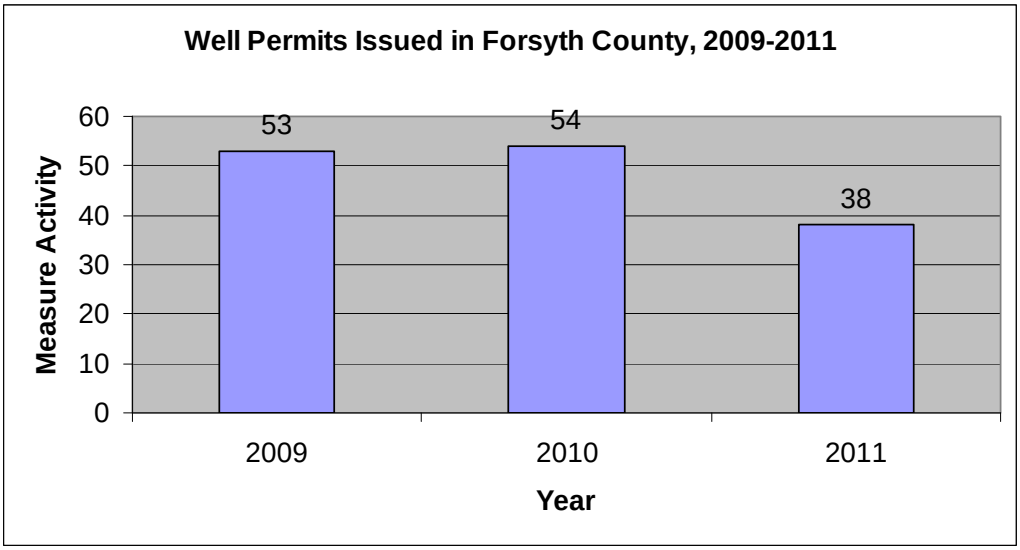
Private Wells

Private drinking water well programs are mandated in each county by North Carolina General Statute 87-97 that requires local health departments to permit, inspect, and test the wells as they are constructed, repaired, or abandoned as of July 1, 2008. The local health department enforces this statute and associated rules in order to protect human health and groundwater quality by ensuring private drinking water wells are correctly built, repaired and abandoned. The types of well include private wells serving a single residence and transient non-community water supply wells that do not meet the criteria for a public water supply (13).

Well permits allow the health department to make sure that wells are properly located, constructed and repaired. Permits include site visits, well water sampling, laboratory testing, and notification of water analysis results.

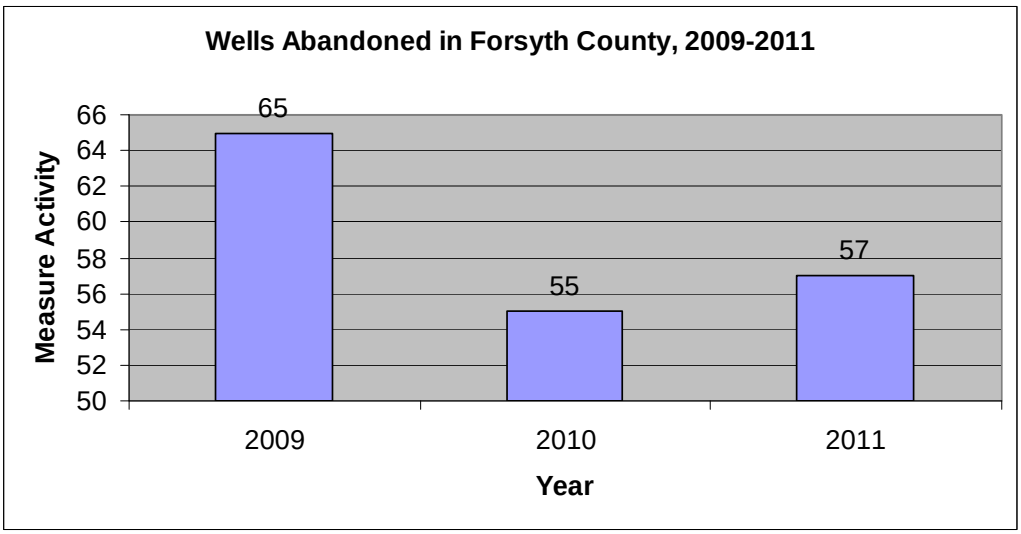
Figure 8 shows the number of well permits issued from 2009-2011. Abandoned wells can be temporary, by sealing with a watertight cap or they can be permanently abandoned by filling the well with clean clay, cement or bentonite grout in order deter groundwater contamination. In order the abandon a well, a permit must be obtained from the local health department and the process witnessed by the local health department to ensure the abandonment procedures are correctly performed (13). Wells constructed for irrigation, household or business use require a permit for construction (14). Figure 9 shows the amount of wells abandoned in Forsyth County from 2009-2011.

Figure 8. Well Permits, 2009-2011



Source: Forsyth County Department of Public Health. Environmental Health Division.

Figure 9. Wells Abandoned, 2009-2011



Source: Forsyth County Department of Public Health. Environmental Health Division.

Water Quality

The Winston-Salem/Forsyth County Utility Commission operates three water treatment systems, the Neilson, Swann, and Thomas Water Plants. Using water from the Yadkin River and Salem Lake, these treatment systems collectively produce 91 million gallons per day of drinking water. In 2011 and the previous year the treatment facilities met or surpassed all state and federal standards for drinking water quality. The Water Quality Report describes detected substances in the Winston-Salem/Forsyth County public water supply during 2011, as detailed in Table 7 (15).

Table 7. Winston-Salem/Forsyth County Public Water Supply Substances, 2011

Regulation Level	Substance	Highest Level Allowed (EPA's MCL)	Idea Goals (EPA's MCLG)	Range of Detections	Average Level Detected	Source
Regulated at the Treatment Plant	Barium, ppb	2000	2000	2.0-17.0	11	Natural geology; drilling operations; metal refinery wastes
	Flouride, ppm	4	4	0.57-1.17	0.88	Water additive promotes strong teeth; erosion of natural deposits
	Nitrate, ppm	10	10	0.40-0.79	0.55	Natural geology; battery manufacturing & metal refinery wastes
	Orthophosphate, ppm	0.5-5.0	1	0.55-1.17	0.84	
	Total Organic Carbon	Treatment Technique	n/a	1.02-2.57	1.45	Natural organic matter
	turbidity, NTU	Treatment Technique	n/a	0.02-0.20	0.05	Soil erosion; natural geology
Regulated in the Distribution System	Tital trihalomethanes, ppb	80 RAA	0	12-114	46.1	Byproducts of drinking water disinfection
	Total Haloacetic Acids, ppb	60 RAA	0	12.9-59.3	32.4 RAA	Byproducts of drinking water disinfection
	Abestos, MFL	7	0	n/a	0.39	
	Chlorine, ppm	4	4	0-1.8	0.96	
	Orthophosphate, ppm	0.25-1.5	1	0.57-0.81	0.69	Natural geology
	Alpha Emitters, pCi/L	15	0	0	0	Natural geology
	Beta Emitters, pCi/L	50	0	0	0	Natural geology and man-made sources
	Total Coliforms	Less than 5% positive	0	n/a	0	

Unregulated Substance	Sulfafe, ppm	500 proposed	Not Regulated	8.49-18.4	11.8	
	Substance	**Highest Level Allowed (EPA's MCL)**	**Ideal Goals (EPA's MCLG)**	**Number of Sites Sampled**	**Number of Sites Above the Action Level**	**90th Percentile Concentration, ppb**
Regulated at the Consumer's Tap	Lead, ppb	15.0 (action level)	0	50	0	< 3.0
	Copper, ppb	1300 (action level)	1300	50	0	70
	Source (both lead and copper): Corrosion of household plumbing; Erosion of natural deposits					

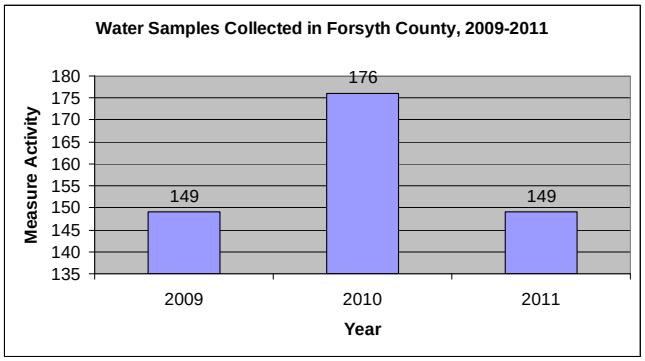
MCL: Maximum Containment Level, the highest level of a contaminant that is allowed in drinking water.
MCLG: Maximum Containment Level Goal, the level of a contaminant in drinking water below which there is no known or expected risk to health.
ppb: one part per billion (e.g. one penny in $10,000,000).
ppm: one part per million (e.g. one penny in 10,000).
EPA MCL of Flouride is 4.0 mg/L, NC has MCL of 2.0 mg/L.
NTU: nephelometric turbidity unit, a measure of cloudiness of water.
RAA: Running annual average, last four quarterly samples collected from the system.
MFL: a measure of asbestos contamination as measured by millions of fibers per liter of water.
pCi/L: picocuries per liter is a measure of the radioactivity in water. A picourie is 10^{-12} curies and is the quantity of radioactive material producing 2.22 nuclear transformations per minute.
Action level: the concentration of a contaminant that triggers treatment or other requirement that a water system must follow. Action levels are reported at the 90th percentile for homes at greatest risk.

Source: Winston-Salem /Forsyth County Utility Commission. Statistics and Reports: 2011 Water Quality Report.

Water Sampling

The NC Division of Public Health's State Laboratory of Public Health analyzes water samples from public and private water systems for chemical or physical substances. A private water system can have a chemical analysis performed by the state lab for alkalinity, arsenic, calcium, chloride, copper, hardness, lead, iron, magnesium, manganese, pH, fluoride, and zinc if submitted through the local health department . Additional tests can be done for fluoride and nitrate/nitrite analysis. Tests can also be completed for bacteriological analysis such as coliform bacteria which are indicators of fecal contamination. Also non-drinking water found in lakes, streams, rivers, and ponds can be submitted for testing by a health department to be examined for total and fecal coliform bacteria to determine the degree of contamination (16). Figure 10 below shows the number of water samples collected from 2009—2011.

Figure 10. Water Samples Collected, 2009-2011



Source: Forsyth County Department of Public Health. Environmental Health Division

LEAD

The metal lead has been used in the manufacturing of products including paint, plumbing pipes and solder, and gasoline among others. When these products deteriorate, small lead particles can contaminate the environment and lead to health problems when swallowed or inhaled. Regulations currently limit the amount of lead used in manufacturing, while environmental lead continues to be a health hazard. At high levels, lead can lead to seizures, coma, and death. Children less than 6 years of age are greatly affected as lead poisoning can hinder development of the brain and nervous system (17).

Children and Lead

Lead can greatly impair development in children. The Centers for Disease Control and Prevention (CDC) recommends that public health action be taken when blood lead levels in children aged 1-5 years reaches more than 10 micrograms of lead per deciliter of blood. In January of 2009, the Forsyth County Board of Health, in recognition: (1) that a growing body of evidence indicates that blood lead levels below 10 micrograms/deciliter are harmful to young children; (2) that the disproportionately greater age of the housing stock in Forsyth County places children at increased risk of lead exposure; and (3) that an effective housing-based program to reduce risk of lead exposure to children is not in place, recommended as an optimal standard of care for children in Forsyth County that all licensed primary care physicians providing well child care in Forsyth County should conduct blood lead screening on all children at 1 year and again at 2 years of age during their well child examinations. Children not tested at one of these times should be tested at least once before the age of 6 years. The rule also establishes a confirmed blood lead level of 5µg/dL as the public health action level. Under this local rule education and environmental investigation is offered to families with children aged 1-5 with confirmed blood lead levels from 5-7µg/dL. Education, environmental investigation and remediation of lead hazards is required when children aged 1-5 years are confirmed with blood lead levels of 8µg/dL or above. Lead can affect almost all body systems, without obvious symptoms it goes unrecognized in many instances. Table 8 details lead housing indicators and susceptible populations, while Tables 9 and 10 show lead screening results in Forsyth County between 2005 and 2009 (18). Table 11 shows lead screening from 2009-2011, based on investigation requirement

Table 8. Forsyth County Lead Hazard Indicators, 2007

County Name	Census 2000 Data			Estimated Population of Children < 6, 2007
	Total Housing Units	Pre-1950 Housing Units	% of Children < 6 Under Poverty	
Forsyth County	133,093	18,461	17.0%	29,381

Source: CDC Lead. North Carolina Data, Statistics and Surveillance.

Table 9. Children Ages 1 & 2 Lead Screening Results, 2009

Year	County	Target Population	Number Tested	Percent Tested	Tested Among Medicaid	Lead >10*	Percent >10
2009	Forsyth	10,230	5,873	57.4	86.5	27	0.5
2008	Forsyth	10,130	5,265	52.0	84.8	28	0.5
2007	Forsyth	9,722	4,936	50.8	----	22	0.0
2006	Forsyth	9,323	4,406	47.3	56.0	39	0.9
2005	Forsyth	9,225	4,249	46.1	56.2	38	0.9
*Reported in micrograms per deciliter (µg/dL)							
Source: NC Department of Health and Human Services. Children's Environmental Health Bank Lead Poisoning Prevention Program.							

Table 10. Children Ages 6 Months-6 Years Lead Screening Results, 2009

Year	County	Number Tested	Confirmed Blood Lead Level*	
			10-19	>20
2009	Forsyth	6,505	10	2
2008	Forsyth	5,836	6	3
2007	Forsyth	5487	12	0
2006	Forsyth	4,865	13	1
2005	Forsyth	4727	8	4
*Reported in micrograms per deciliter (µg/dL)				
Source: NC Department of Health and Human Services. Children's Environmental Health Bank Lead Poisoning Prevention Program.				

Table 11. Forsyth County Lead Investigations, 2009-2011

Level of Concern 5-7µg/dL (Investigations Offered (not required))					
		2009	**2010**	**2011**	
	Investigation	6	9	21	
	Confirmed lead levels	17	37	38	
Elevated Blood Lead Level 8-19µg/dL (Investigation Required)					
		2009	**2010**	**2011**	
	Investigation	6	17	16	
	Confirmed lead levels	13	16	18	
Poison ≥20µg/dL (Investigation Required)					
		2009	**2010**	**2011**	
	Investigation	2	1	1	
	Confirmed lead levels	2	1	1	
Source: Source: Forsyth County Department of Public Health. Environmental Health Division.					

FOOD- WATER, AND VECTOR-BORNE DISEASES

When the natural environment is contaminated with microbes, chemicals or animal vectors, a number of human diseases and syndromes can be caused or exacerbated. Several of these illnesses are required to be reported to health authorities. Common food-, water-, and vector- borne diseases are described in Table 12. Reported cases of food-, water-, and vector- borne diseases in humans in Forsyth County from 2008 to 2011 are detailed in Table 13.

Table 12. Food-, Water-, and Vector- Born Disease Description and Transmission

Disease	Agent, Transmission, Entry	Clinical Description
Campylobacter	Contaminated poultry/sometimes found in other meats, raw milk, and unchlorinated water & live animals, including pets, can be a source	An infection that may result in diarrheal illness of variable severity
Cryptosporidiosis	Direct transmission from another human via the fecal-oral route; a variety of wild and domestic animals can harbor; thrives in contaminated recreational or drinking water.	A gastrointestinal illness characterized by diarrhea, abdominal cramping, fever, nausea, vomiting and/or anorexia.
E. Coli (Shinga toxin-producing)	Food- or waterborne disease, spread by poor hygiene, undercooked meat, and contaminated water	An infection of variable severity characterized by diarrhea (often bloody) and abdominal cramps; asymptomatic infections also may occur and the organism may cause extraintestinal infections.
Hepatitis A	Food or water contaminated with feces; entry through mouth to intestine; fecal-oral transmission; most often by direct person-to-person spread; fecal contamination of food or water by a careless food handler or improperly managed sewage disposal.	An acute illness with a) discrete onset of symptoms and b) jaundice, dark urine or elevated serum aminotransferase levels
Listeriosis	Soil bacterium that infects and colonizes livestock and finds its way into various foods, particularly unpasteurized dairy products, processed and raw meats, and raw vegetables.	In adults, invasive disease caused by *Listeria monocytogenes* manifests most commonly as meningitis or bacteremia; infection during pregnancy may result in fetal loss through miscarriage or stillbirth, or neonatal meningitis or bacteremia. Other manifestations can also be observed.
Lyme Disease	Tick bite	A systemic, tick-borne disease with protean manifestations, including dermatologic, rheumatologic, neurologic, and cardiac abnormalities. The most common clinical marker for the disease is *erythema migrans* (EM), the initial skin lesion that occurs in 60%-80% of patients.
Rocky Mountain Spotted Fever	*Rickettsia rickettsii*, a bacterial pathogen transmitted to humans through contact with ticks	Rocky Mountain spotted fever (RMSF) is an illness caused by *Rickettsia rickettsii*. *Dermacentor* species of ticks are most commonly associated with infection, including *Dermacentor variabilis* (the American dog tick), *Dermacentor andersoni* (the Rocky Mountain wood tick), and more recently *Rhiphicephalus sanguineus* (the brown dog tick). Disease onset averages one week following a tick bite. Age-specific illness is highest for children and older adults. Illness is characterized by acute onset of fever, and may be accompanied by headache, malaise, myalgia, nausea/vomiting, or neurologic signs; a macular or maculopapular rash appears 4-7 days following onset in many (~80%) patients, often present on the palms and soles. RMSF may be fatal in as many as 20% of untreated cases, and severe, fulminant disease can occur.
Salmonellosis	Ingestion of raw or undercooked foods of animal origin (eggs, meat and poultry, unpasteurized milk/milk products from infected animals); or ingestion of raw or undercooked foods fecally contaminated by an infected animal or person; person to person via fecal –oral route.	An illness of variable severity commonly manifested by diarrhea, abdominal pain, nausea, and sometimes vomiting. Asymptomatic infections may occur, and the organism may cause extraintestinal infections.
Shigellosis	Person to person via fecal-oral route; spread via foods or drinks contaminated by an infected food handler or contaminated water. Food and waterborne outbreaks do with evidence of human fecal contamination in the chain of transmission	An illness of variable severity characterized by diarrhea, fever, nausea, cramps, and tenesmus. Asymptomatic infections may occur.

Source: CDC. Case Definitions for Infectious Conditions Under Public Health Surveillance. (NC DHHS. 2010 North Carolina Division of Public Health Communicable Disease Manual.

Table 13. Reported Cases of Food-, Water-, and Vector-Borne Diseases in Humans, 2008-2011

Disease	2008	2009	2010	2011
Campylobacter	24	28	33	22
Cryptosporidiosis	8	10	4	1
E. Coli (Shiga toxin-producing)	10	2	2	3
Hepatitis A	4	2	3	1
Listeriosis	1	3	2	0
Lyme Disease	1	0	1	0
Rocky Mountain Spotted Fever	0	0	0	0
Salmonellosis	47	49	40	57
Shigellosis	5	1	9	14
Source: Forsyth County. Department of Public Health. 2011 Communicable Disease Report.				

Rabies

Rabies is a vaccine preventable disease found in humans and animals. The rabies virus infects the central nervous system causing disease in the brain and eventually death. Rabies can only be acquired by coming into contact with the saliva, brain, or nervous system tissue of an infected animal. This can happen when one is bitten by a rabid animal, handling a pet that has been attacked by a rabid animal, or cleaning a dead rabid animal killed while hunting. Nationally only one to two human deaths from rabies occur a year. Exposure to rabies is considered an urgent situation, as once symptoms begin to appear it is too late to start treatment and the disease is almost always fatal. North Carolina law require owners of pets, such as dogs, cats, and ferrets, to have their pets vaccinated against rabies beginning at four months of age. Rabies most often occurs in wild animals, in particular skunks, bats, foxes and raccoons. Raccoon rabies is found in raccoon populations in every North Carolina county (19). Table14 below indicates the incidence of reported rabies cases in Forsyth from 2007-2011.

Table 14. Forsyth County Reported Rabies Cases in Animals, 2007-2011

Year	Bat	Bobcat	Cat	Cow	Coyote	Dog	Equine	Fox	Raccoon	Skunk	Total
2011	1	0	0	0	0	0	0	5	7	6	19
2010	5	0	0	0	0	0	0	4	6	5	20
2009	0	0	0	0	0	1	0	3	9	1	14
2008	0	0	0	0	1	0	0	8	17	6	32
2007	1	0	0	0	0	0	0	2	6	3	12

Source: NC DHHS Public Health. Communicable Disease Control Branch. Rabies Facts and Figures.

WASTE MANAGEMENT

Solid Waste

For the 2010-2011 fiscal year, Forsyth County reported to the Solid Waste Management Division of the NC Department of Environment and Natural Resources (DENR) that 431,028.54 tons of waste was l and filled in the County's name. Total calculated waste was 410,291.74 tons, equivalent to a 1.17 per capita rate. This is a 2% increase from the 1991-1992 fiscal year per capita rate of 1.14 tons per person. Forsyth County disposed of 351 tons of white goods such as refrigerators, ranges, water heaters, freezers, unit air conditioners, washing machines, clothes dryers, and other domestic and commercial appliances during the 2010-2011 fiscal year as well (20). Table 15 details tons of waste disposed in Forsyth County from 2006-2011.

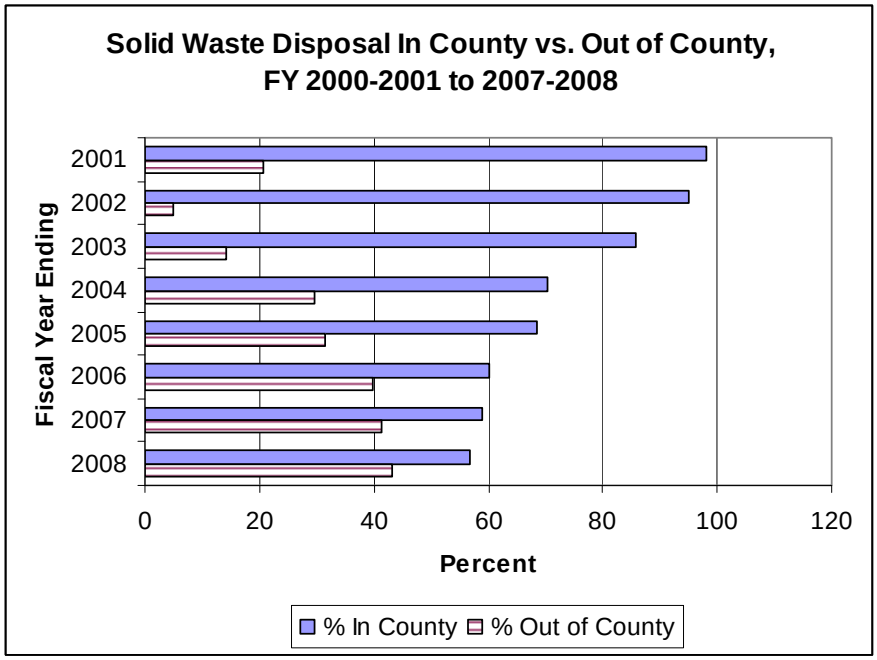
Table 15. Forsyth County Solid Waste Disposal

County	Population	MSW Tons Managed	MSW Tons Disposed				
	July 2010	1991-1992	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
Forsyth	351,798	304,290	538,108	508,310	412,824	438,807	410,292

Source: NC DENR. Solid Waste Management Annual Report FY 2010-2011

Solid waste has also seen changes in the percent of solid waste tons disposed in county and out of county. Since Fiscal Year 2000-2001, the percent of waste that has been disposed in county has decreased, increasing the percent of waste disposed out of county as seen in Figure 11 below (21).

Figure 11. Solid Waste Disposal In County vs. Out of County



Source: Winston-Salem/Forsyth County Utility Commission. 10 Year Solid Waste Management Plan.

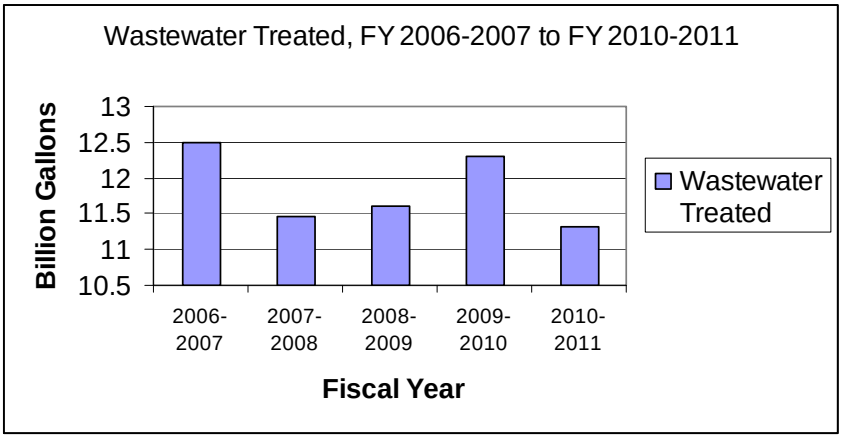
Recycling

In the 2004-2005 fiscal year, the proportion of all waste that is recycled or recovered was 11%. This proportion saw a 44% increase by the 2010-2011 fiscal year when it reached 16%. This represents an increase to 0.20 tons per capita in FY2004-2005 to 0.23 tons per person in FY 2010-2011 (21).

Wastewater

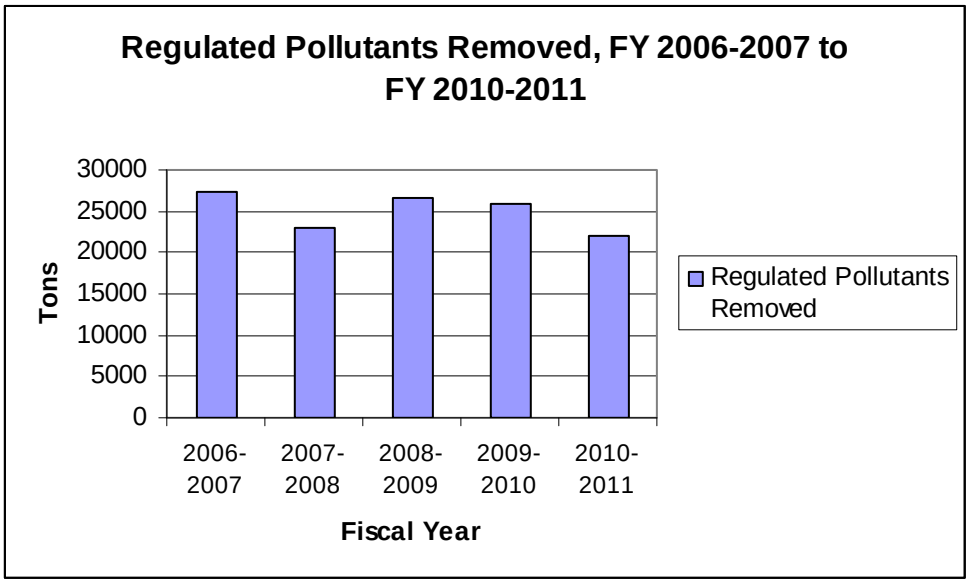
The Winston-Salem/Forsyth County Utility Commission's Wastewater Collection and Treatment System Performance Report for fiscal year 2010-2011 indicated that its two wastewater treatment plants (WWTP), Archie Elledge and Muddy Creek, have a combined treatment capacity of 51 million gallons per day. Over the 2010-2011 fiscal year 11.327 billion gallons of wastewater was treated at the two plants. The Utility Commission met or exceeded requirements to both the North Carolina Clean Water Act and the National Pollutant Discharge Eliminate System (NPDES). Residual biosolids produced by the water treatment plant are treated and disposed through anaerobic digestion and then followed by a combination of Thermal Biosolids Drying or burial in a lined landfill. Neither WWTP nor the Thermal Biosolids Drying facility had violations of their permits during the 2010-2011 fiscal year. Both WWTPs had a safety factor of 3.79, meeting the minimum requirements of the State of North Carolina's Division of Water Quality. The treatment processes removed 22,075.3 tons of egulated pollutants for the 2010-2011 fiscal year, while sanitary sewer overflows (SSO) accounted for 0.0008% of wastewater collected. SSO is the release of raw or partially untreated sewage with the potential to contaminate water systems. SSO were caused by grease the majority of the time, while roots, debris, pipe or equipment failure, and vandalism were accounted as other causes. The total number of SSO was approximate to the prior fiscal year, while the total volume decreased 95% when comparing 2010-2011 to 2009-2010 (22). Figures 12 and 13 show the amount of wastewater treated and pollutants removed from Fiscal Year 2006-2007 until 2010-2011.

Figure 12. Wastewater Treated, FY 2006-2007 to FY 2010-2011



Source: Winston-Salem /Forsyth County Utility Commission. Statistics and Reports: Wastewater Performance Report, 2010-11.

Figure 13. Regulated Pollutants Removed, FY 2006-2007 to FY 2010-2011

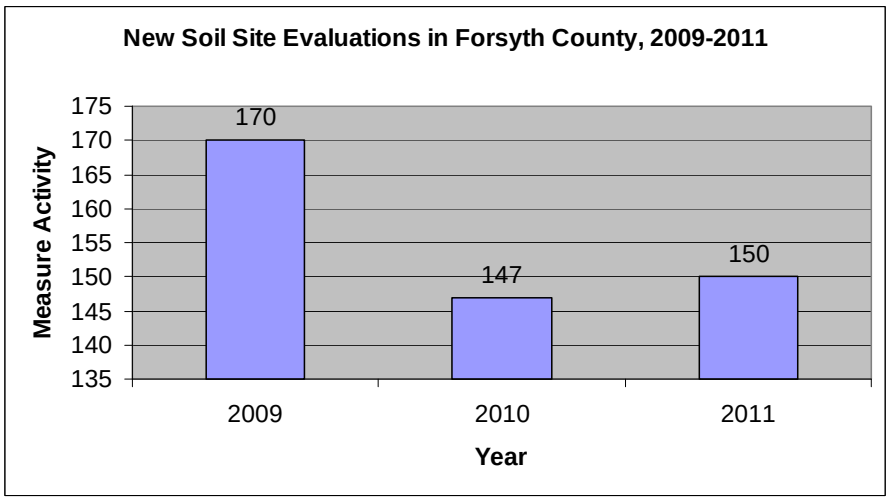


Source: Winston-Salem /Forsyth County Utility Commission. Statistics and Reports: Wastewater Performance Report, 2010-11.

Septic Systems

In areas that are not serviced by public or community sewers, a septic tank system must be used. The first step in determining if a lot is suitable for such a system is the soil/site evaluation which is performed by the local health department and determines if the lot has the ability to support a septic tank system. An evaluation is also used when there is an existing house and septic tank system, but may require in increase in size (for example due to the addition of bedrooms) (23). Soil/Site evaluations are necessary for clean water and property protection. A properly functioning septic system ensures that wastewater is purifies before being reused at that location or in a nearby well, stream or river (24). Figure 14 charts the number of new soil/site evaluations from 2009-2011.

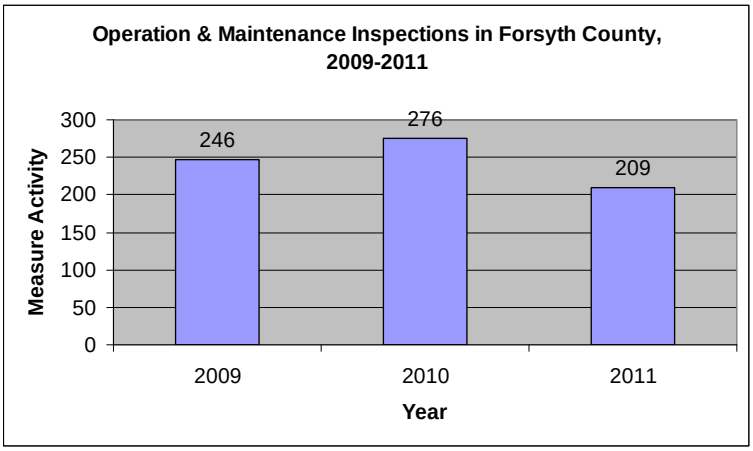
Figure 14. New Soil/Site Evaluations, 2009-2011



Source: Forsyth County Department of Public Health. Environmental Health Division.

Septic tank systems are also subject to routine operation and maintenance inspections. These inspections check the septic tank and pump tank's sludge levels, as well as if the system is properly functioning. The inspections insure sewage is maintained below the ground's surface to eliminate harmful bacteria and viruses from coming into contact with people or animals to cause disease (25). Figure 15 shows the number of operation and maintenance inspections completed from 2009-2011.

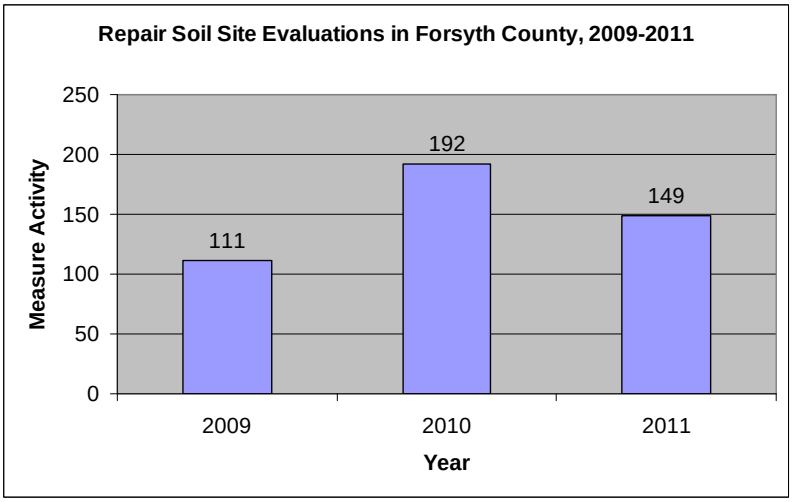
Figure 15. Operation & Maintenance Inspections, 2009-2011



Source: Forsyth County Department of Public Health. Environmental Health Division.

Septic tank systems may require a Repair Soil Site evaluation if problems arise in which: sewage/ effluent is discharged from the system onto the surface of the ground, surface waters, or directly into groundwater; sewage/effluent is backing up into the home, facility, drains or septic tank; sewage/ effluent is within 3 inches of the finished grade over the system; or it becomes necessary to have septic tank pumped more than once per month to avoid preceding issues from occurring (26). Figure 16 shows the number of repair soil/site evaluations from 2009-2011.

Figure 16. Repair Soil/Site Evaluation, 2009-2011



Source: Forsyth County Department of Public Health. Environmental Health Division.

CONTAMINATION/HAZARDOUS EVENTS

Toxic Release Inventory

The EPA measures the disposal and release of more than 650 chemicals that are considered toxic. The Toxic Release Inventory (TRI) also tracks how facilities manage chemicals in the forms of recycling, energy recovery, and treatment. The TRI is a part of the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 whose primary purpose is to inform citizens of toxic chemical releases in their areas under the Act's Section 313. Additional data on waste management and source reduction activities was added to the TRI under the 1990 Pollution Prevention Act. The TRI reported 34 chemicals amounting to approximately 793,168 pounds that were disposed of or released in Forsyth County in 2010, as detailed in Table 16. From 2007-2010 there has been in overall decline in total chemicals released, while the top chemical released was certain glycol ethers from 2007-2010 as detailed in Table 17 (27).

Table 16. TRI On-site and Off-site Reported Disposed of or Otherwise Released (in pounds), for All Industries, for All Chemicals, Forsyth County, North Carolina, 2010

	Chemical	Total On- and Off-site Disposal or Other Releases
1	ACETALDEHYDE	24,993.48
2	AMMONIA	43,774.00
3	ANTIMONY	1
4	ANTIMONY COMPOUNDS	0
5	ARSENIC COMPOUNDS	0
6	BENZO(G,H,I)PERYLENE	0.000081
7	CADMIUM COMPOUNDS	755
8	CERTAIN GLYCOL ETHERS	377,567.00
9	CHLORINE	20
10	CHROMIUM	2,139.31
11	CHROMIUM COMPOUNDS(EXCEPT CHROMITE ORE MINED IN THE TRANSVAAL REGION)	755
12	COBALT	1
13	COPPER	4,810.50
14	COPPER COMPOUNDS	755
15	CYANIDE COMPOUNDS	250
16	DIOXIN AND DIOXIN-LIKE COMPOUNDS	0.0071098
17	ETHYLENE GLYCOL	0
18	HYDROCHLORIC ACID (1995 AND AFTER "ACID AEROSOLS" ONLY)	47,603.21
19	HYDROGEN FLUORIDE	31.5
20	LEAD	32.321
21	LEAD COMPOUNDS	1,285.50
22	MANGANESE	875.784
23	N,N-DIMETHYLFORMAMIDE	1,037.99
24	N-BUTYL ALCOHOL	162,784.00
25	N-METHYL-2-PYRROLIDONE	835
26	NICKEL	335.491
27	NICKEL COMPOUNDS	791.429
28	NICOTINE AND SALTS	56,723.00
29	NITRATE COMPOUNDS	0
30	NITRIC ACID	0
31	POLYCYCLIC AROMATIC COMPOUNDS	36.91
32	PROPYLENE	0
33	TOLUENE	64,220.00
34	ZINC COMPOUNDS	755
	Total	793,168.43

Source: US EPA. Toxic Release Inventory. TRI Explorer.

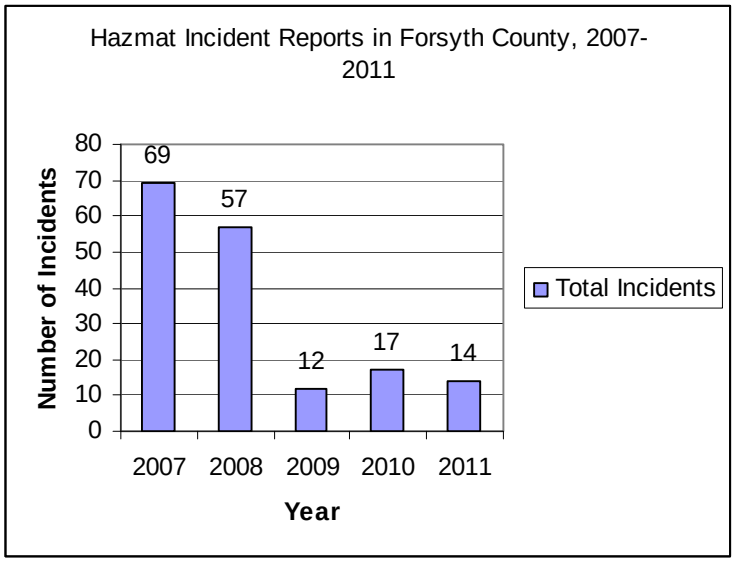
Table 17. Toxic Release Inventory, 2007-2010

Year	Number of Chemicals	Total Amount Released	Highest Chemical Released	Highest Chemical Released Total Amount
2007	41	850,176.74	CERTAIN GLYCOL ETHERS	344,746.00
2008	41	781,631.02	CERTAIN GLYCOL ETHERS	295,832.00
2009	33	763,104.41	CERTAIN GLYCOL ETHERS	344,481.00
2010	34	793,168.43	CERTAIN GLYCOL ETHERS	377,567.00
Source: US EPA. Toxic Release Inventory. TRI Explorer.				

Toxic Substance Incidents

The National Toxic Substance Incidents Program (NTSIP) collects and combines information from various sources to protect people from the harm of spills and leaks of toxic substances. It is modeled after the Hazardous Substances Emergency Events Surveillance (HSEES) Program (28). According to the Office of Hazardous Materials Safety, there were 169 incidents in Forsyth County North Carolina between January 1, 2007 and December 31, 2011 reported by the US Department of Transportation. These incidents occurred in Winston-Salem, Kernersville, High Point, and Rural Hall (29). Figure 17 below shows the number of incidents per year in Forsyth County from 2007-2011.

Figure 17. Hazmat Incident Report, Forsyth County, 2007-2011



Source: PHMSA. Office of Hazardous Materials Safety. Incident Reports Database Search.

Brownfields

A brownfields site is an abandoned, idled or underused property with some form of environmental contamination which has hindered its redevelopment. The North Carolina Brownfields Program, under the Division of Waste Management, is a state attempt to overcome the redevelopment barrier associated with these sites' contamination issues. Under the Brownfields Property Reuse Act of 1997, the Department of the Environment and Natural Resources (DENR) can work with prospective developers to put these brownfields sites back to reuse (30).

As of September 30, 2010 there were a total of 17 brownfields sites with finalized brownfield agreements or were active eligible participants in Forsyth County. Of those 17, 11 were projects with finalized brownfields agreements, described in Table 18, in which the projects have completed the public notice phase of the brownfields process and have either a signed agreement in place or are waiting for the agreement to be executed. There were 5 sites identified as active eligible projects, described on Table 19, which are eligible for a brownfields agreement under the Brownfield Property Reuse Act statutory criteria. The developers for the eligible projects are working with DENR in some stage of data gathering, analysis or agreement negotiation. One site, SPATCO (Southern Pump and Tank Co.), in Winston-Salem is listed as pending eligibility meaning it is in the initial stage of entering the NC Brownfields Program, but does not meet requirements to be eligible for a brownfields agreement (31).

Site and Perspective Developer	Description
A GREAT ESCAPE 1806 Funtime Blvd. Winston-Salem Forsyth County PD: A Great Escape LLC	Prospective developer wants to purchase this approximately 5-acre abandoned amusement park (miniature golf and go cart track), which is located on edge of a former municipal landfill, refurbish it, and re-open it with same use.
AIRPORT EXXON 3305 North Liberty St. Winston-Salem Forsyth Co. PD: Mrs. Becky Flowers	The Property consists of 0.56 acres and was first developed in 1989. The site has previously been used as an auto repair facility, a retail tire store and most recently as a small engine repair facility. Soil and groundwater contamination exist at the Brownfields Property as a result of past operations conducted there. Prospective Developer has redeveloped the Brownfields Property as a convenience store/gas station.
CENTRAL PARK LANDFILL Salem and Main Streets Winston-Salem Forsyth Co. PD: Salem Recreational Fields	Former municipal landfill for the City of Winston-Salem. Site is 7.23 acres in size, and has been used as a city park since the 1950s. Low levels of chlorinated solvents, with no surficial soil contamination. PD intends to redevelop the site for soccer and a softball field for the adjoining Salem Academy and College so their current fields can be used for additional building space. A passive methane collection system will be installed prior to installation of the recreational fields.
FOOD LION Waughtown & Sprague Streets Winston-Salem Forsyth Co. PD: Food Lion, Inc.	A new large supermarket placed on the site of an abandoned grocery store in urban Winston-Salem. Project had strong community support as a quality of life issue as the community had no supermarket. Land use restrictions for chlorinated solvent contamination in groundwater. Brownfield Assessment determined the source to be nearby drycleaner.
GATEWAY AT OLD SALEM 1198 S. Broad Street Winston-Salem Forsyth County PD: Southeast Gateway Ventures	Project size is approximately 51 acres. The property is planned for mixed-use redevelopment including offices, commercial/retail space, residences, a YWCA , a private school and parking. Contamination is from a former Duke Power Plant substation (PCBs, PAHs in soil) and groundwater contamination from a number of sources, mainly petroleum but with a few chlorinated solvents. Cleanup of contamination at the Duke Power facility under the Inactive Hazardous Sites Program is almost complete. The Duke Power site comprises only a portion of this large brownfields redevelopment project.
HANESBRANDS THEATRE 201 N. Spruce St. Winston-Salem Forsyth Co. PD: The Arts Council	The Brownfields Property comprises approximately 0.46 acres and is located at 201 North Spruce Street, Winston-Salem, Forsyth County, North Carolina. Its previous uses have included automotive sales, service and repair businesses, and most recently an AC Delco automotive parts and service store. Groundwater at the site is contaminated with low levels of chlorinated solvents from past activities at the site. Prospective Developer plans to redevelop the site as a multi-purpose venue that can be configured to include a 300-seat theater and associated practice rooms, classrooms and office space, and that hosts events including theater, music and dance performances, film screenings, workshops, parties, fundraisers, lectures and readings.
PIEDMONT TRIAD RESEARCH PARK #1 **CAMEL CITY CLEANERS/MGP** 401 East Third Street Winston-Salem Forsyth Co. PD: PTRP Holdings, LLC	The Property consists of approximately 1.27 acres located at 415 East Third Street in Winston-Salem, Forsyth County, North Carolina. The site was most recently used as a dry-cleaning facility and was originally developed in the late 1800s as a manufactured gas plant. Soil and groundwater contamination are present on the site due to past activities conducted on or in the vicinity of the site. In conjunction with the development of the planned Piedmont Triad Research Park, Wake Forest University Health Sciences, through BRF-A1a, LLC, intends to redevelop the subject property as a bio-technology research and office facility.

Site and Perspective Developer	Description
PIEDMONT TRIAD RESEARCH PARK #2 Various properties east and south of downtown Winston-Salem Winston-Salem Forsyth County PD: PTRP Holdings, LLC	The Brownfields Property comprises approximately 49.02 acres in Winston-Salem. The land, initially used residentially and then industrially, has been in use for more than 100 years. Site soil and groundwater are contaminated from past operations as a R. J. Reynolds Tobacco Company cigarette manufacturing facility. Prospective Developer intends to redevelop the Brownfields Property with bio-technology research facilities, offices, retail outlets, public open areas, high-density residences, performance/concert halls, hotels, community centers, swimming pools, parking and schools.
SALEM UNIFORM 4015 N. Cherry Street Winston-Salem Forsyth County PD: Winston Weaver Co. Inc.	2.53-acre site that has been vacant for many years. Was leased out from 1967-83 to Salem Uniform and from 1983-86 to Cintus Corporation who purchased the assets for Salem Uniform. During a Limited Site Assessment for petroleum USTs, high levels of PCE were discovered, probably from dry cleaning solvents. PD is currently leasing space, but would like to improve it for use for fertilizer storage and other commercial usage.
SUN CHEMICAL 1100 Fairchild Road Winston-Salem Forsyth PD: Warhal Properties, LLC	The property consists of 5.26 acres and was formerly used as an ink manufacturing facility. The property was abandoned in the 1990s. Groundwater and soil vapor at the site are contaminated with chlorinated solvents from past site operations. The property has been renovated and redeveloped for office and warehouse use and plumbing systems fabrication.
WEST END VILLAGE Properties on N. Broad, W. Fourth, W. Fifth, North Green, N. Spring Streets and Brookstown Avenue, Winston-Salem Forsyth County PD: West End Ventures, LLC	The Property is located in western downtown Winston-Salem, Forsyth County, North Carolina, comprises approximately eight (8) acres and is surrounded primarily by commercial development. It is bordered by West Fourth Street to the north, West Second Street to the south, North Broad Street to the east and land in commercial use to the west. The Property was mainly residential until around the 1960s to 1970s, after which time most of the site underwent commercial redevelopment in the form of offices, retail businesses and service businesses. Groundwater and soil are contaminated at the Property from past site uses. Prospective Developer has committed itself to redevelopment of the Property for no uses other than mixed commercial and/or high-density residential purposes.
Source: NC DENR. Division of Waste Management. Brownfields Program: Project Inventory.	

Table 19. Active Eligible Projects as of September 2010

HANESBRANDS INDUSTRIAL FACILITY 700 South Stratford Road Winston-Salem, Forsyth Co. PD: 700 South Stratford, LLC	**STRATFORD METAL FINISHING** 807 S. Marshall Street Winston-Salem, Forsyth County PD: City of Winston-Salem
PIEDMONT TRIAD RESEARCH PARK CENTRAL DISTRICT Various properties south of Third St and north of Bus I-40 Winston-Salem, Forsyth Co. PD: PTRP Holdings, LLC	**TFI FINISHING BUILDING WEST** 1200 Patterson Avenue Winston -Salem, Forsyth Co. PD: City of Winston-Salem
PIEDMONT TRIAD RESEARCH PARK SOUTHERN DISTRICT Various properties south of Bus I-40 Winston-Salem, Forsyth Co. PD: PTRP Holdings, LLC	
Source: NC DENR. Division of Waste Management. Brownfields Program: Project Inventory.	

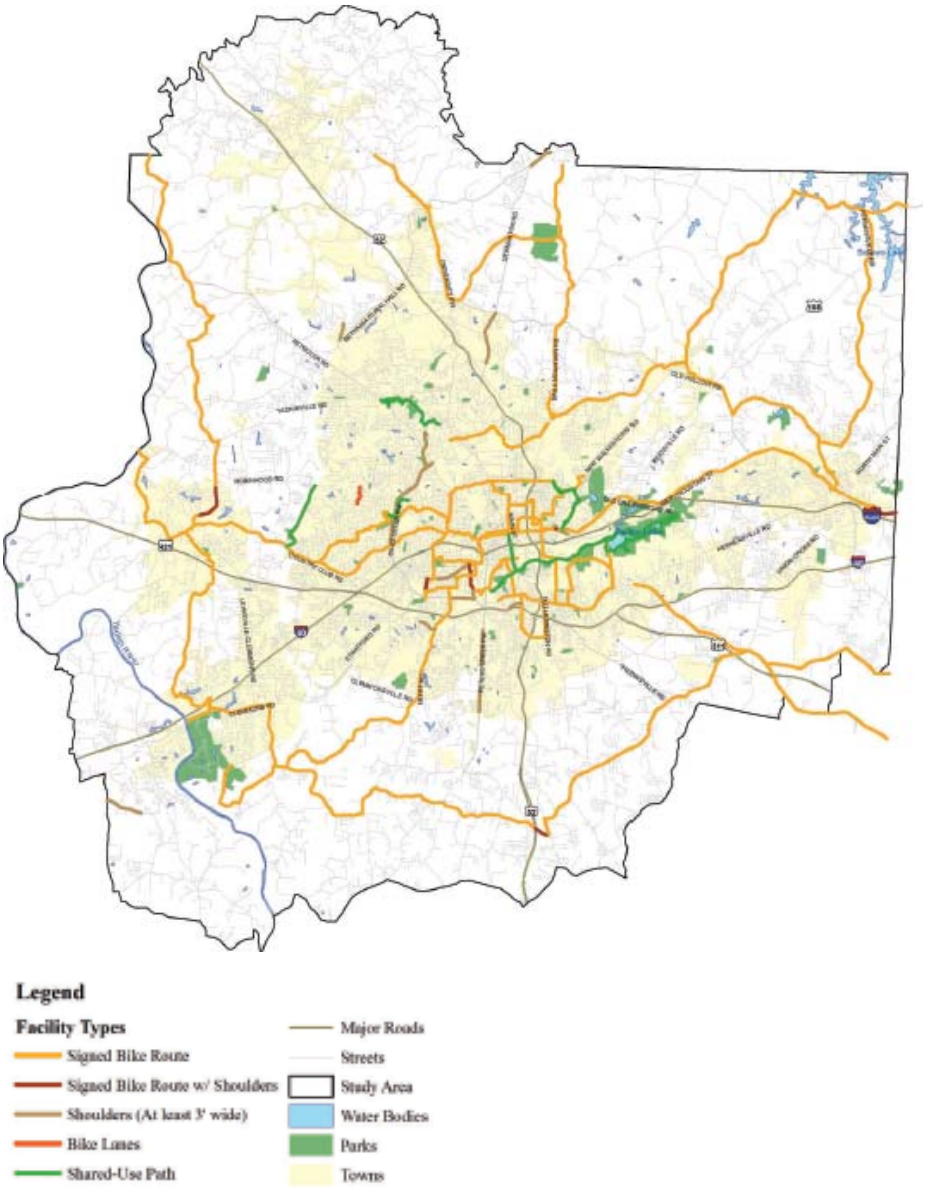
THE BUILT ENVIRONMENT

The built environment encompasses the man-made resources and infrastructures that support human activity. In comparison to natural resources, the built environment includes buildings, roads, parks, restaurants, grocery stores, and other designs that affect or influence the health of residents. The build environment can influence health outcomes such as diet and physical activity (32).

Cycling, Parks, and Greenways

Several bicycle and pedestrian counts in May 2011 revealed 351 pedestrians and 115 bicyclists were in Winston-Salem. More than 70 miles of roads are designated as bike routes in Winston-Salem and Forsyth County as seen in Figure 18(6).

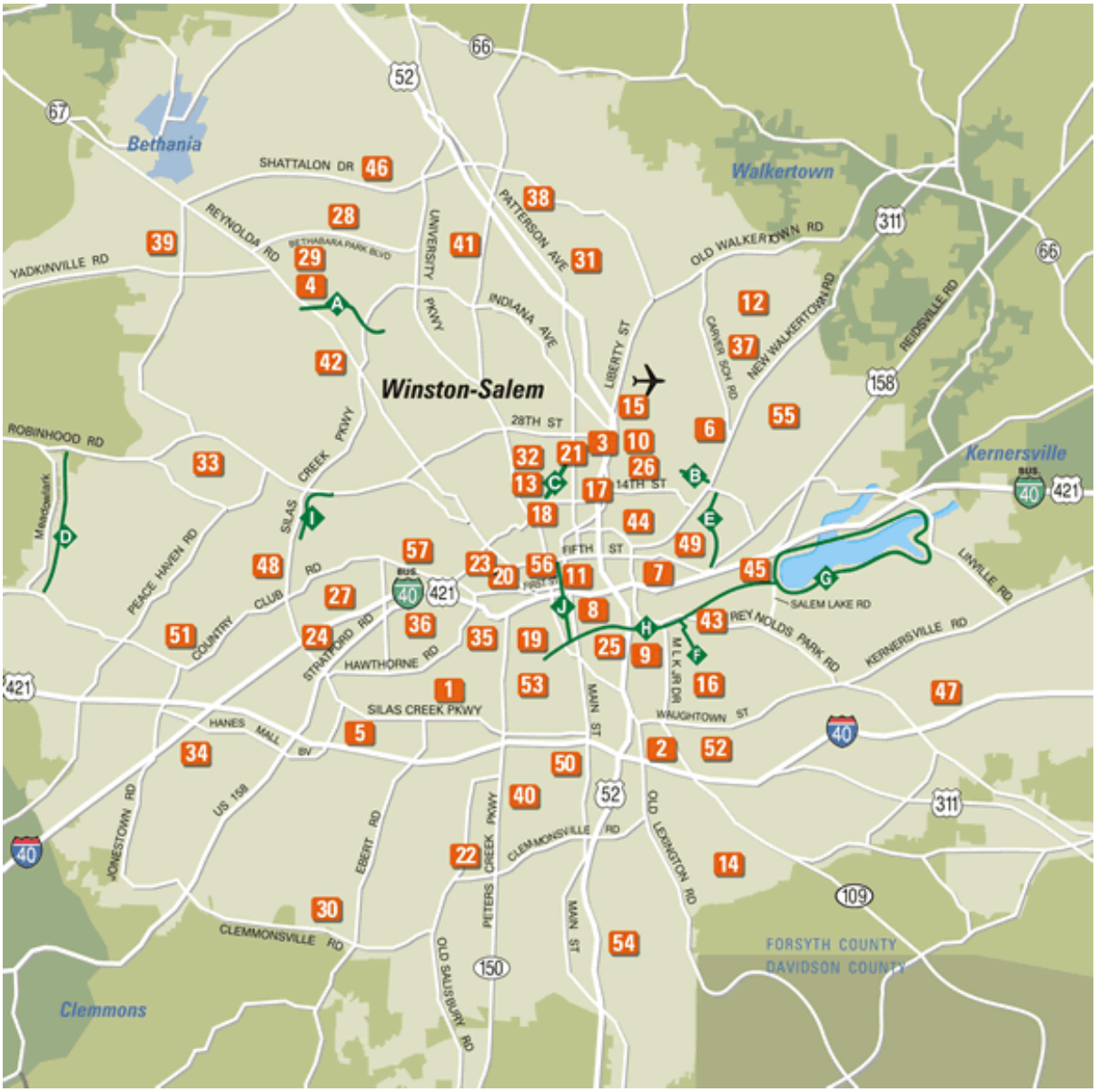
Figure 18. Existing Bike Routes in Winston Salem



Source- City of Winston-Salem Bike Plan. Comprehensive Bicycle Master Plan. .

In addition to bike routes, there were 10 greenways with 23 miles, with another 8 in development and prioritizes 25 miles of greenway projects (5;33). Greenways are linear open space corridors that can connect people to destinations. Greens can be used through walking, jogging, skating, and biking, with the majority of greenways built on banks of river, streams and lakes. Winston-Salem's greenways incorporate paved trails, unpaved trails, boardwalks, and bridges (33). Winston-Salem's parks and greenways are shown below in Figure 19.

Figure 19. Winston-Salem Parks and Greenways



1. Ardmore, 1021 Melrose St., 4 ac.
2. Beeville, 2800 Bungalow St., 6.3 ac.
3. Blum/Blanding, 2401 Ivy Ave., 18.5 ac.
4. Bethabara Park, 4451 Old Town Dr., 30.15 ac.
5. Bolton, 1590 Bolton St., 35.5 ac.
6. Bowen/Thomas, 2350 Bowen Blvd., 17.5 ac.
7. Brushy Fork, 1860 E. First St., 4.3 ac.
8. Central, 801 Salem Ave., 12.1 ac.
9. Civitan, 1341 Diggs Blvd., 27.5 ac.
10. Clark-Mikens, 1230 E. 17th St., 1 ac.
11. Corpening Plaza, 100 W. 2nd. St, 2.36
12. Crawford, 4226 Oak Ridge Dr., 8.3 ac.
13. Drayton Pines, 1029 W. 14th St., 7.80 ac.
14. Easton, 3599 Tyler Dr., 27 ac.
15. Fairview, 1690 E. 19th St., 2.1 ac.
16. Forest, 1184 Tower St., 8.9 ac.
17. Fourteenth St., 2020 E. 14th St., 6.9 ac.
18. Gateway Commons, 1580 Oak Street, 10.51 ac.
19. Granville, 700 Granville Dr., 6.2 ac.
20. Grace Court, 931 W. 4th St., 1.22 ac.
21. Greenway, 2701 Greenway Ave., 3.2 ac.
22. Griffith, 1471 W. Clemmonsville Rd., 6.8 ac.
23. Hanes, 1406 W. Northwest Blvd., 34.8 ac.
24. Hanestown, 411 Olive St., 2.4 ac.
25. Happy Hill, 1201 Alder St., 23.7 ac.
26. Harambee Park, 1515 E. 14th St., 1.0 ac
27. Hathaway, 301 Anita Dr., 17.9 ac.
28. Hine Soccer Complex, 5895 Bethabara Pk. Rd., 26 ac.
29. Historic Bethabara, 2163 Bethabara Rd., 115.96 ac.
30. Hobby, 2301 W. Clemmonsville Rd., 91.5 ac.
31. Jerry King, 4700 Ogburn Ave., 20.2 ac.
32. Kimberley, 2001 Pittsburg Ave., 26.3 ac.
33. Leinbach, 3511 Sally Kirk Rd., 9 ac.
34. Little Creek, 600 Foxcroft Dr., 14.7 ac.
35. Lockland, 401 Lockland Ave, 1.86 ac.
36. Miller, 400 Leisure Lane, 39.5 ac.
37. Helen W. Nichols, 3521 Carver School Rd., 8.3 ac.
38. Oak Summit, 406 Oak Summit Rd., 16.2 ac.
39. Old Town, 4550 Shattalon Dr., 16.6 ac.
40. Parkland, 1660 Brewer Rd., 30.2 ac.
41. Piney Grove, 4725 Indiana Ave., 15.5 ac.
42. Polo Park, 1850 Polo Rd., 13.6 ac.
43. Reynolds Park, 2450 Reynolds Park Rd., 222 ac.
44. Rupert Bell, 1501 Mt. Zion Pl., 19 ac.
45. Salem Lake, 1001 Salem Lake Rd., 1,465 ac.
46. Sara Lee Soccer, 5656 Shattalon Dr., 48 ac.
47. Sedge Garden , 401 Robbins Rd., 21 ac
48. Shaffner, 900 Yorkshire Rd., 46.6 ac.
49. Skyland, 1890 New Walkertown Rd., 17.8 ac.
50. South Park, 190 W. Lemly St., 6.2 ac.
51. South Fork, 4403 Country Club Rd., 14.9 ac.
52. Sprague, 1350 E. Sprague St., 18.5 ac.
53. Washington, 1490 S. Broad St., 75.3 ac.
54. Weston, 3998 Southdale Dr., 15.9 ac.
55. Winston Lake, 2801 New Walkertown Rd., 467 ac.
56. Winston Square Park, 310 N. Marshall, 1.05 ac.
57. Whitaker, 470 Dartmouth Road 10.77 ac.

A. Bethabara Greenway
2.7 miles, paved/natural
- Mill Creek, Historic Bethabara, Reynolda Commons to Crown Oaks Apts. Bikes allowed.

B. Bowen Branch Greenway
.3 miles, paved
- Brushy Creek from Bowen Blvd. to Highway 311. Bikes and skates allowed.

C. Gateway Commons Greenway
.8 mile, paved
- Peter's Creek from Northwest Blvd. to Glenn Ave. Bikes and skates allowed.

D. Muddy Creek Greenway
- 2.91 miles, paved
- Muddy Creek between County Club and Robinhood Rds. Entrance off of Meadowlark Road. Bikes and skates allowed.

E. Newell/Massey Greenway
- 1.2 miles paved
- Brushy Fork from Waterworks Rd. to Old Greensboro Rd. Bikes and skates allowed.

F. Peachtree Greenway
- .6 miles, paved
- behind Reynolds Park Golf Course. Bikes and skates allowed.

G. Salem Lake Trail
- 6.5 miles unpaved
- around Salem Lake. Bikes allowed. (Trail users please sign in at Fishing Station)

H. Salem Creek Greenway
- 4.5 miles, paved
- Salem Creek from Peters Creek Pkwy. to Salem Lake. Bikes and skates allowed.

I. Silas Creek Greenway
- .81 mile, paved/unpaved
- along Silas Creek from Yorkshire to Robinhood roads. Bikes and skates allowed

J. Strollway
- 1.2 miles, paved/gravel
- from Downtown 4th St. to Salem Ave., Old Salem

Source: City of Winston-Salem. Parks and Greenways.

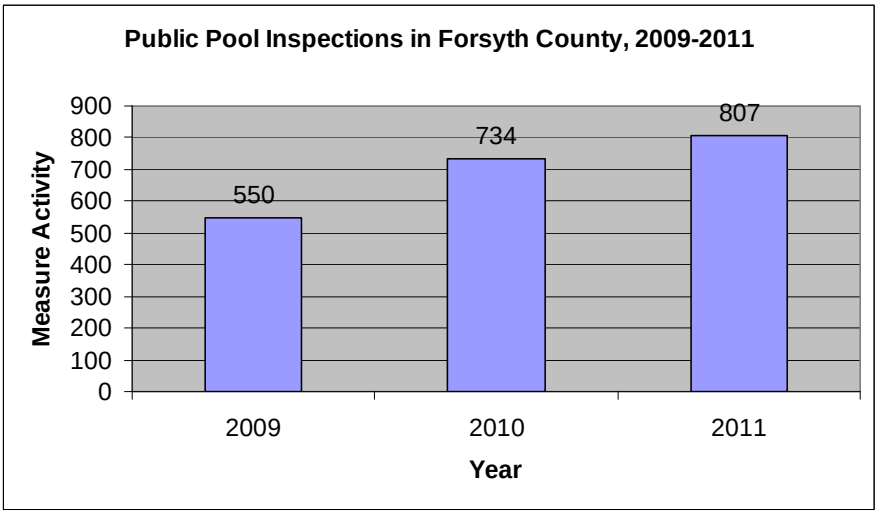
Transportation Systems

Transportation access will influence air quality as well as a part of a healthy community. According to Forsyth Futures between 2007 and 2010 the Winston-Salem Transit Authority (WSTA) averaged 2,784,326 riders a year on its fixed routes. On average ridership increased by 4% each year and the trend continues based on ridership figures from January to April 2011. The Piedmont Authority for Regional Transportation (PART) increased routes in Forsyth County from one in 2003 to seven presently. The increase in routes has lead to increases in annual ridership from 26,241 in 2003 to 271,255 riders in 2007 (5). In addition to public transportation, private transportation also has an impact on community health. In 2008 vehicles in Forsyth County produced about three million tons of carbon dioxide. In 2011 133,627 individual workers drove alone, or approximate 83% of workers, in Forsyth County (34).

Pools

The Division of Environmental Health carriers out a pool inspection program to enforce state public swimming pool regulations by permitting and inspecting all public swimming pools in the county (35). The Environmental Health Division also investigates complaints concerning the operation of public swimming pools. Pools that are open from April 1 and close on or before October 31st are required to have at least one inspection during their period of operation, while other pools are required to be inspected at least twice a year. During a pool inspection, water quality is tested and compliance with safety standards is evaluated (36). Figure 20 below shows the number of public pool inspections from 2009-2011

Figure 20. Public Pool Inspections, 2009-2011



Source: Forsyth County Department of Public Health. Environmental Health Division.

Food Environment

Access to foods is another component of the built environment through grocery store access and restaurant locations. The lack of access to healthy food choice can impact health outcomes. In 2006 2.9% of households in Forsyth County had no car and had to travel at least one mile to the nearest store, while 10.77% of low income households were at least one mile from the nearest store. There was a 5.79% decrease in the number of grocery stores between 2007 and 2008, equivalent to a reduction of 4 grocery stores, totaling 65 grocery stores in 2008. There was also a 33.33% reduction in the number of convenience stores that did not sell gas between 2007 and 2008 for a total of 20 in 2008, down 10 from 30 in 2007. The number of convenience stores that sold gas increased by 5.06% during the same time period, for a total of 166 in 2008, up from 158 in 2007. The number of stores authorized to receive Supplemental Nutrition Assistance Program, known as SNAP, benefits also increased from 185 in 2008 to 226 in 2009. SNAP redemptions also increased from 221,082 in 2008 to 296,618 in 2009. The total number of fast food establishments decreased 3.84% from 286 in 2007 to 275 in 2008 (37).

Sources:

1. National Center for Environmental Health. About the Program.
2. NC Community Health Assessment Process Phase 3. (2012). pdf/2012GuideBookPhases
3. Centers for Disease Control and Prevention ATSDR. Air.
4. EPA Air Quality Planning and Standards.
5. Forsyth Futures. Making Progress Report: Environmental Sustainability 2012.
6. Forsyth County Office of Environmental Assistance & Protection.
7. Centers for Disease Control & Prevention. Aero-Allergens.
8. Forsyth County Environmental Assistance and Protection. Indoor Air Quality.
9. Centers for Disease Control and Prevention Healthy Places: Water Quality.
10. Forsyth County Environmental Assistance and Protection: Water Quality Program.
11. Ground Water Protection Council. North Carolina Ground Water Conditions.
12. NC DENR. Division of Water Resources. Public Water Supply.
13. NC DENR. Private Wells Frequently Asked Questions.
14. Forsyth County Department of Public Health. Environmental Health. Permitting and Inspections.
15. Winston-Salem /Forsyth County Utility Commission. Statistics and Reports.
16. NC Division of Public Health's State Laboratory of Public Health. Environmental Inorganic Chemistry.
17. NC Department of Health and Human Services. Lead Poisoning.
18. Centers for Disease Control and Prevention Lead.
19. NC DHHS. Division of Public Health. Communicable Disease Control Branch. Diseases and Topics: Rabies.
20. NC DENR. Solid Waste Management Annual Report FY 2010-2011.
21. Winston-Salem/Forsyth County Utility Commission. 10 Year Solid Waste Management Plan.
22. Winston-Salem /Forsyth County Utility Commission. Statistics and Reports: Wastewater Performance Report, 2010-11.
23. Forsyth County Department of Public Health. Environmental Health. Wastewater/Septic Systems: New Construction.
24. Forsyth County Department of Public Health. Environmental Health. Wastewater/Septic Systems: Taking the Mystery Out of Your Soil/Site Evaluation.
25. Guilford County Department of Public Health. On-Site Wastewater.
26. Forsyth County Department of Public Health. Environmental Health. Wastewater/Septic Systems: System Problems and Repairs.
27. US EPA. Toxic Release Inventory (TRI) Program.
28. Centers for Disease Control and Prevention . Agency for Toxic Substances and Disease Registry. National Toxic Substance Incidents Program.
29. PHMSA. Office of Hazardous Materials Safety. Incident Reports Database Search.
30. NC DENR. Division of Waste Management. Brownfields Program: Program Background. .
31. NC DENR. Division of Waste Management. Brownfields Program: Project Inventory.
32. County Health Rankings & Roadmaps. Built Environment. .
33. City of Winston-Salem. Parks and Greenways.
34. County Health Rankings. 2011 Measures by County, North Carolina
35. Forsyth County Department of Public Health. Environmental Health
36. NC DENR. Section .2500 Public Swimming Pools.
37. United States Department of Agriculture. Your Food Environment Atlas: Forsyth County.