State of the Environment 2009

Orange County
Commission for the Environment

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The Board of Commissioners established the Environment & Resource Conservation Department on June 22, 1998 and authorized the Lands Legacy Program on April 4, 2000.

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Printed copies of the 2009 SOE can be viewed at public libraries within the County or at the ERCD office.
For further information about the report please contact the ERCD at (919) 245-2590.

Cover photos by Rich Shaw. From left to right: Pickards Mountain, Eno River, Lewis' Heartleaf, Stone Currie Farmland on Old 86, Bolin Creek at Adams Preserve

Splendid Clubtail (Gomphus lineatifrons)

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What is the state of our environment?

Addressing this question from the global perspective, the Global Footprint Network (GFN) and the World Wildlife Fund report that *humanity uses the equivalent of 1.3 planets to provide the resources we use and to absorb our waste*.

Stepping down to the national level, we learn from the GFN that *if everyone lived the lifestyle of the average American we would need **five** planets.*

The *Ecological Footprint* was developed in 1990 by Mathis Wackernagel and William Rees at the University of British Columbia as a measure of humanity's demand on the planet's natural resources. It translates how much land area and water volume a human population requires to produce the resources it consumes and to absorb its wastes. The *Footprint* puts into simple terms the number of planets needed to support our activities and lifestyles.

For Orange County, this edition of the *State of the Environment Report (SOE)* provides a more detailed look at a variety of environmental indicators that are grouped into three key categories: Air Resources, Biological Resources and Water Resources . The indicators were selected to monitor and evaluate the progress the County and its citizens are making to protect, preserve, conserve and manage our environmental resources.

Both the *Ecological Footprint* and the SOE environmental indicators share the fundamental intent to assess our demands and impacts on environmental resources, inspire and inform public policy and practices to manage our ecological assets more efficiently and provide recommendations for personal and organizational actions that will lead toward a more robust environment.

This edition of the State of the Environment report continues the goals and format of the 2002 and 2004 documents, but with one key difference: this 2009 report is primarily a digital publication, accessible through the Orange County Website at http://www.co.orange.nc.us/ercd/2009_SOE_index.asp.

We encourage you to contribute to our local effort to conserve the Earth's resources by reading this report online. If you are interested in evaluating and decreasing the size of your own *Personal Ecological Footprint*, there is an interactive and informative quiz available at the Global Footprint Network website at http://www.footprintnetwork.org. You can find many other ideas on the final pages of this report.

Sincerely,

Michelle Kempinski and Johnny Randall, Co-Chairs
Commission for the Environment

PURPOSE

The Orange County
Commission for the Environment
presents the
2009 State of the Environment to:

- Describe the current status of Orange County's natural environment
- Provide measures to monitor and evaluate progress toward a cleaner, healthier environment
- Highlight the major environmental challenges facing the County
- Recommend actions to confront these challenges

Orange County's 2009 State of the Environment

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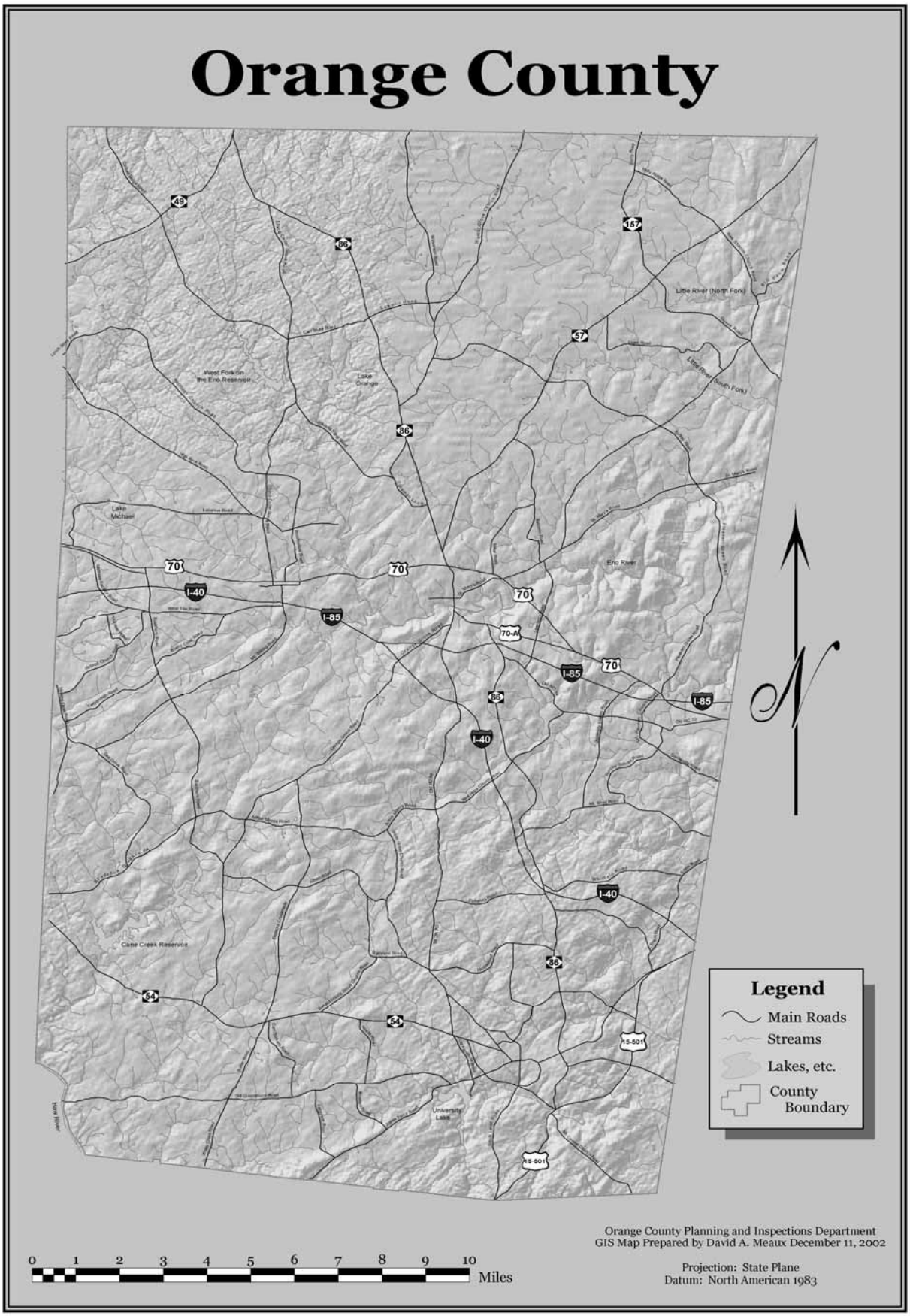
Figure 1: Map of Orange County



Source: Figure 1— Orange County Planning Department, prepared December 11, 2002

Overview

The Orange County Commission for the Environment (CFE) and the Orange County Environment & Resource Conservation Department (ERCD) have created this report to provide an updated analysis of the County's natural environment and to make recommendations that will help the County create and implement effective environmental policies.

While Orange County has been foremost among the region's counties in promoting planned growth over indiscriminate sprawl, the County's natural environment remains susceptible to serious degradation from the steady, long-term conversion of natural land to urban and suburban infrastructure. The public needs to understand the strategies available to protect our water, air and biological resources while also planning for future growth.

In preparing this report, the CFE has used a set of key **environmental indicators** first adopted for the 2002 report[1]. These measurable **indicators** reveal trends in the County's environment, alert us to potential impacts on human health and natural resources and suggest areas where additional information, research and monitoring are needed.

The environmental indicators are grouped into three categories: Air Resources, Biological Resources and Water Resources. CFE members with expertise in each of these areas formed separate committees to study the accumulated data. These committees have identified the critical issues listed on the next page followed by highlighted recommendations drawn from the body of the document.

The report also includes an overview of Orange County's land conservation efforts through its award winning Lands Legacy Program. Over the first eight years of the program, the County has been successful in working with landowners and other conservation partners to protect many special properties with a variety of important natural and cultural value.

And finally, the end of the report provides information to help those who want to play a role in protecting and improving the natural environment that we enjoy here in Orange County, North Carolina.

[1] Although the indicators remain largely the same since their introduction in 2002, this 2009 edition includes two additional indicators, combines two indicators, has removed three indicators altogether and has more accurately renamed seven indicators.

CRITICAL ISSUES

- **GREENHOUSE GAS EMISSIONS**
  Between 2006 and 2007, Orange County conducted a Greenhouse Gas (GHG) emissions inventory. Despite the County's current and proposed measures for reducing its GHG emissions, emissions have only decreased by 3 percent since 2005. With projected population growth and land use changes, GHG emissions could increase by 53% by 2030.

Traffic congestion on I-40

Development in Chapel Hill

- **LOSS OF BIODIVERSITY**
  Habitat for Orange County's native flora and fauna, ecosystems and natural communities continues to be destroyed or significantly degraded as a result of conversion of natural land cover to suburban, urban and transportation uses.

  Protection efforts are not keeping pace with the loss of biological diversity associated with habitat loss and degradation.

- **LACK OF INFORMATION ABOUT GROUNDWATER RESOURCES**
  While many residents of Orange County rely on groundwater, little information is available concerning groundwater quantity or quality across the county.

- **IMPACT OF DROUGHT ON WATER QUANTITY**
  Water resources in the area can become threatened during periods of extended drought. The Orange-Alamance Water System is already dependent on purchasing water to meet their current customer demand.

Cane Creek Reservoir during the 2008 drought OWASA photo

HIGHLIGHTED RECOMMENDATIONS

AIR RESOURCES	Pages
1. Orange County should assess and implement the Greenhouse Gas Inventory and Action Plan targets for greenhouse gas reductions and create an action plan for ground-level ozone.	9-10
2. With the adoption and enforcement of new, tighter federal ozone standards by early 2010, the County will likely return to nonattainment status despite stringently following the NC State Implementation Plan (SIP) as recommended.	13-14
3. Orange County should work with nearby jurisdictions to integrate County plans with regional goals and objectives for an intermodal transportation system to meet projected travel demand that reduces congestion and reliance on single occupancy vehicles.	19-20

BIOLOGICAL RESOURCES	Pages
1. Orange County should re-visit the goal of permanently protecting at least 10% of the county's land area (25,600 acres) by the year 2010. This would require an additional 12,700 acres to be protected by year's end. New goals should be set for 2015 and 2020.	27-28
2. Orange County should continue efforts to protect significant natural areas, large tracts of "prime forest" (mature hardwood and mixed hardwood-pine forests) and remnant "Piedmont savannas" using a variety of voluntary conservation measures.	33-34
3. Orange County should develop a comprehensive conservation plan that addresses threats to natural areas and populations of rare species; connectivity among protected areas; and coordination with neighboring counties and conservation partners.	27-28
4. Orange County should incorporate the State's newly-authorized Wildlife Conservation category into the local Present Use Value taxation program.	35-36

WATER RESOURCES	Pages
1. While the per capita usage of potable water has decreased in recent years, overall water consumption has increased nearly 50% since 1985. Conservation of water resources should continue to be a priority for Orange County.	47-48
2. In order to monitor the effect of drought on local groundwater supplies, Orange County should create a network of observation wells. This would permit the dissemination of information concerning the quantity of groundwater present in storage in the County.	47-48
3. Efforts should be made to further the knowledge of residents about the quality of groundwater in the County. This could include information regarding the overall good nature of the groundwater, as well as the potential for naturally occurring concentrations of arsenic and radon in areas of the County. Additionally, citizens should be informed of ways to protect groundwater, including the need to properly abandon out-of-use wells, the appropriate use and maintenance of septic systems, the appropriate disposal of potentially hazardous material and the location of known groundwater contamination incidents.	53-54

DEMOGRAPHICS

Residential growth is the most fundamental factor affecting the pattern of development in Orange County. As has been the case for many years, the County continues to experience dramatic population growth (Figure 2). From 1980 to 2007, the County's population grew from 77,055 to 127,344, a 65.3 percent increase (2.4 percent average annual growth rate). In contrast, during the same time period, North Carolina grew by 54 percent and the United States expanded at a rate of 33 percent. Many people are attracted to Orange County for its central location in the Triangle region as well as its high quality of life.

All of the municipal and unincorporated areas report significant increases in population. The unincorporated population did decrease slightly between 2000 and 2007 but this is due to the loss of five square miles of unincorporated land area to annexations. Table 1 compares the populations throughout the County and the growth rates over time. The greatest rate of increase occurred in the Orange County portion of Mebane[2] with a 245 percent increase in population from 1980-2007 as well as the fastest rate of growth for 2000-2007 at 94 percent. Carrboro had the second highest rate at 144 percent over 26 years. Although Chapel Hill (41 percent) remains the dominant residential and commercial center in the County, unincorporated areas also contain a large portion of the population (38 percent). This rural population poses challenges in both the planning and provision of public services.

Figure 2: Population Trends in Orange County, 1930-2007

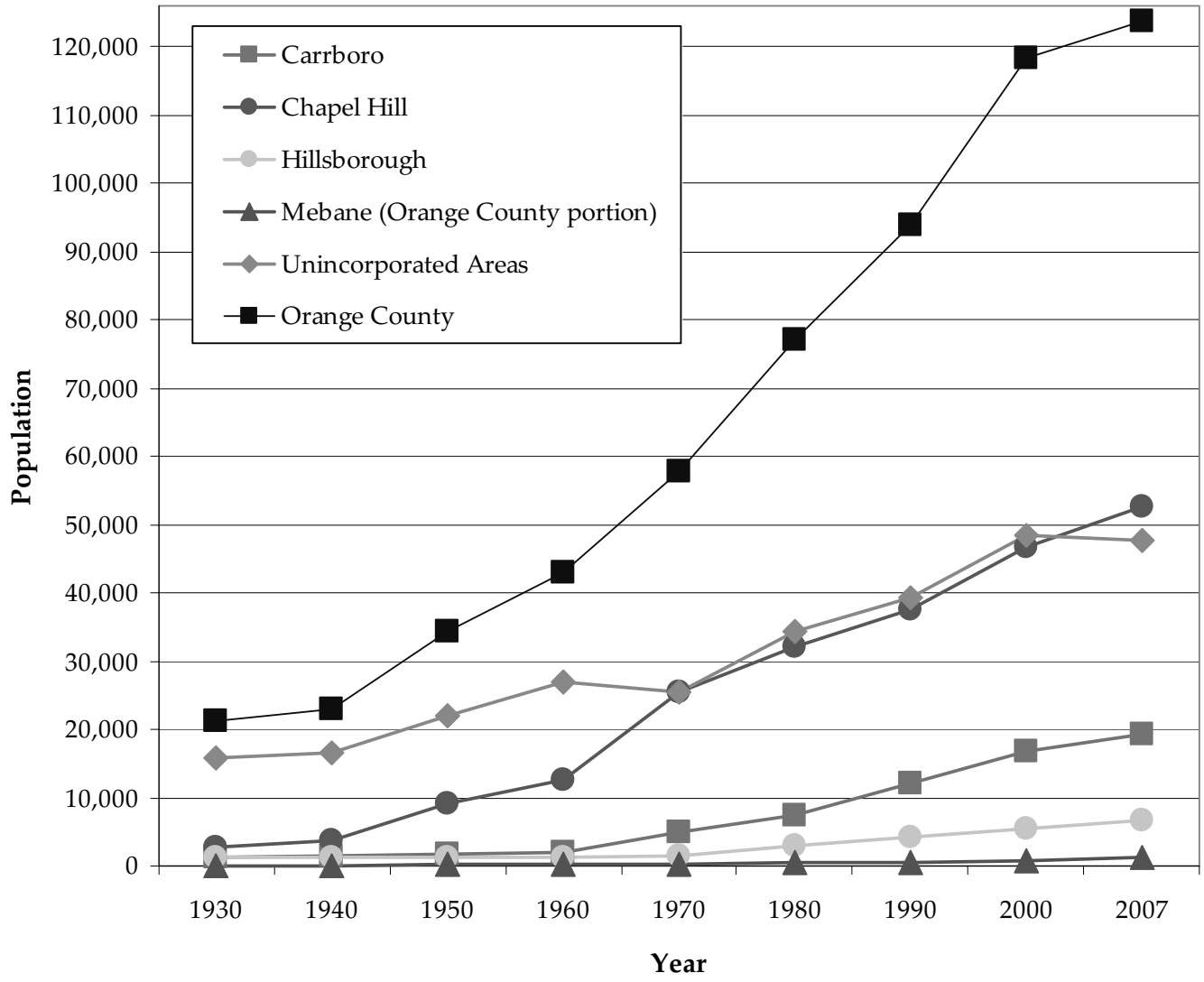


Table 1: Municipal and Unincorporated Populations, 1980-2007

	1980 Census	1990 Census	2000 Census	2007 Estimate	% Change 1980-1990	% Change 1990-2000	% Change 2000-2007	% Change 1980-2007
Carrboro								
Population	7,336	12,134	16,782	19,178	65.4%	38.3%	14.3%	161.4%
Land area (sq. mi.)	2.47	3.53	4.47	6.30	42.9%	26.6%	40.9%	155.1%
Persons per sq. mi.	2,970	3,437	3,754	3,044	15.7%	9.2%	-18.9%	2.5%
Chapel Hill (within Orange County)								
Population	32,038	37,596	46,798	52,668	17.3%	24.5%	12.5%	64.4%
Land area (sq. mi.)	12.37	15.98	18.37	19.53	29.2%	15.0%	6.3%	57.9%
Persons per sq. mi.	2,590	2,353	2,548	2,697	-9.2%	8.3%	5.9%	4.1%
Hillsborough								
Population	3,019	4,263	5,446	6,584	41.2%	27.8%	20.9%	118.1%
Land area (sq. mi.)	2.16	3.55	4.58	5.30	64.4%	29.0%	15.7%	145.4%
Persons per sq. mi.	1,398	1,201	1,189	1,242	-14.1%	-1.0%	4.5%	-11.1%
Mebane (within Orange County)								
Population	379	485	675	1,308	28.0%	39.2%	93.8%	245.1%
Land area (sq. mi.)	0.2	0.25	0.57	1.74	25.0%	126.0%	205.3%	770.0%
Persons per sq. mi.	1,895	1,940	1,184	752	2.4%	-38.4%	-36.5%	-60.3%
Unincorporated Areas								
Population	34,283	39,373	48,526	47,606	14.8%	23.2%	-1.9%	38.9%
Land area (sq. mi.)	382.80	376.69	372.01	367.13	-1.6%	-1.2%	-1.3%	-4.1%
Persons per sq. mi.	90	105	130	130	16.7%	24.8%	-0.6%	44.8%
TOTAL COUNTY								
Population	77,055	93,851	118,227	127,344	21.8%	26.0%	7.7%	65.3%
Land area (sq. mi.)	400	400	400	400	0.0%	0.0%	0.0%	0.0%
Persons per sq. mi.	193	235	296	318	21.7%	26.0%	7.6%	65.0%

[2] Note: Only a small portion of Mebane's incorporated area is located in Orange County.
Sources: Figure 2 and Table 1 — U.S. Census Bureau and North Carolina State Demographics

Chapel Hill Transit riders using the bike rack. Choosing public transit over single occupancy vehicles reduces greenhouse gas emissions.

A portion of the Latta dairy farm was protected in 2007 through an agricultural conservation easement.

Triangle traffic on I-40

AIR RESOURCES

In Orange County, air quality and the related impacts on climate change stands out as a pressing environmental issue as county and regional populations continue to expand. Declining air quality can affect the health of all county residents and damage local ecosystems. County emissions also contribute to regional air quality issues like ground-level ozone and international problems like climate change (global warming).

The North Carolina Department of Environment and Natural Resources—Division of Air Quality (NCDAQ) currently produces the only local inventory of air emissions, dividing sources into five major categories based on how they are released into the atmosphere:

- **Area sources** are small stationary sources such as gas stations, dry cleaners and repair shops that alone are not very large, but combined can be significant sources. NCDAQ typically estimates these emissions from per capita or per employee emissions information.
- **Biogenic** emission sources are living organisms such as trees, plants and livestock. In air quality modeling, emissions from biogenic sources are viewed as relatively constant from year to year.
- **Mobile sources** include automobiles and trucks. The NCDAQ's estimates are based on estimated vehicle miles traveled within Orange County.
- **Nonroad mobile sources** come from equipment such as lawn mowers, outboard engines, agricultural equipment and construction machines.
- **Point sources** are large stationary sources like factories and electric power plants. Currently, there are only a few emission point sources in Orange County.

The NCDAQ collects information on the kinds of pollutants released into the air including Carbon Monoxide (CO), Hazardous Pollutants, Nitrogen Oxide (NOx), Particulate Matter (PM), Sulfur Dioxide (SO_2) and Volatile Organic Compounds (VOCs). These pollutants contribute to respiratory illnesses such as asthma; aggravate existing heart and lung diseases; form acid rain; impair visibility; contribute to global warming; and pollute aquatic systems. Improving air quality remains a significant concern for Orange County and the entire Triangle region. In particular, reducing the amount of ground-level ozone is one of the greatest challenges for the area. Ground-level ozone is not emitted directly, but rather formed from NOx, VOCs and other pollutants during a photochemical reaction in the atmosphere. In 2004, the U.S. Environmental Protection Agency (EPA) designated Orange County and seven other neighboring counties as nonattainment areas under the EPA's revised ambient air quality standard for ozone. As of 2007 the Triangle is reclassified as being in attainment of the ambient standards as a maintenance area. However, recent regulation changes to a more stringent standard may return the area to the status of non-attainment.

The indicators in the air resources section track the types of pollutants emitted in Orange County and the human behaviors that affect the amount of pollutants released. **Emissions Estimates**, **Greenhouse Gas Emissions** and **Emissions from Point Sources** look at the pollutants emitted from all different sources and then specifically point sources. **Ozone Threshold Exceedances** shows the pattern of ozone exceedance days in the region. **Transportation Modes** discusses how people reach their place of work. **Commuting Patterns**, **Public Transit (Bus) Ridership** and **Daily Vehicle Miles Traveled** track how our transportation patterns in Orange County affect air pollution trends.

AIR RESOURCES

Emissions Estimates

Why the indicator was selected

Tracking trends in air pollutant emissions is critical for assessing air quality impacts and for developing strategies to improve air quality. Emissions of nitrogen oxides (NOx), gases formed when fuel is burned at high temperatures in vehicles and industry and volatile organic compounds (VOCs), hydrocarbon compounds such as volatile fuels and solvents, are the primary contributors to ground-level ozone, and the main pollutants of concern in Orange County and the Triangle. Carbon monoxide (CO), a colorless, odorless gas that forms during the incomplete combustion of carbon and hydrocarbons and has its own set of health effects, can also indicate the presence of organic compounds that contribute to ozone formation, although to a lesser extent.

How the indicator was measured

CO, NOx and VOCs are projected along with other pollutant estimates for Orange County. The North Carolina Division of Air Quality (NCDAQ) estimates emissions by looking at the make-up of the county and inserting these data in models. For example, NCDAQ takes information about vehicle miles traveled (VMT) on county roads and inserts these data into the U.S. Environmental Protection Agency's (EPA) MOBILE6.2 model to predict road vehicle emissions. The EPA's NONROAD2002a model is used for nonroad emission projections while the county's population and industry statistics are used to estimate area sources such as gas stations, dry cleaners and repair shops. The NCDAQ also tracks point sources from individual producers such as industrial facilities. Biogenic source emissions are calculated by estimating pollutants released by trees, cattle and other living organisms.

The trend in Orange County

IMPROVING

Since the 2004 SOE, NCDAQ has adopted "BaseG" VISTAS/ASIP's (Visibility Improvement—State & Tribal Association of the Southeast and the Association for Southeastern Integrated Planning) modeling effort for measuring air quality. Any changes in the projections reflect the use of this model. Figure 3 shows the overall trends in emission estimates and Table 2 gives the predicted emissions for CO, NOx and VOCs. Overall, the models predict that Orange County will see continued reductions in NOx emissions over the next 12 years. This projected reduction depends on the accuracy of EPA and NCDAQ estimates regarding new vehicle emission controls, types of cars in use, future growth, travel patterns and other variables. Orange County may differ from a typical North Carolina county in several ways, including the overall levels of growth, the number of interstate vehicle miles traveled (VMT) and local transportation patterns. An understanding of how these variations affect pollutant emissions is vital to achieving and maintaining healthy air quality.

Recommendations

To support a sustainable future, Orange County should:

- Assess and implement the current countywide greenhouse gas (GHG) emissions inventory target reductions and
- Monitor the 2035 Long-Range Transportation Plan from the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization, which provides traffic projections for long-range transportation planning and other information related to emissions.

Figure 3: Inventoried and Projected Emissions by Source, 1997-2018

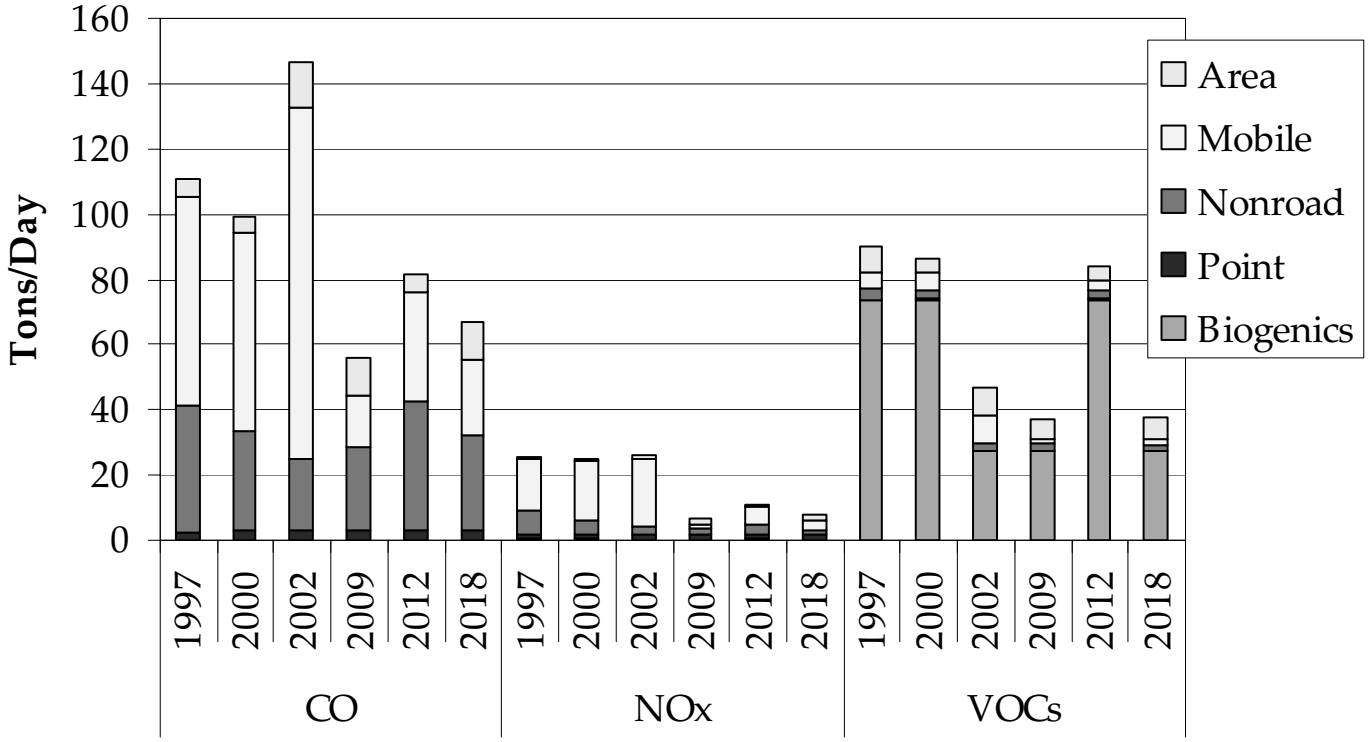


Table 2: Emissions in Tons per Day, 1997-2018

Pollutant		Estimated			Projected		
	Type	1997	2000	2002	2009	2012	2018
CO	Area	5.0	5.0	14.0	12.1	5.7	11.5
	Mobile	64.0	60.7	107.7	15.4	33.3	23.5
	Nonroad	38.8	30.5	22.3	26.0	39.3	29.2
	Point	2.7	3.2	2.8	2.8	3.2	2.9
	Biogenics	-	-	-	-	-	-
	Total	**110.5**	**99.4**	**146.7**	**56.3**	**81.5**	**67.1**
NOx	Area	0.8	0.4	1.5	1.6	0.5	1.8
	Mobile	15.5	18.8	20.6	1.1	5.7	2.7
	Nonroad	7.3	3.7	2.5	2.1	2.8	1.3
	Point	1.6	1.6	1.5	1.5	1.6	1.5
	Biogenics	0.5	0.5	0.3	0.3	0.5	0.3
	Total	**25.7**	**25.0**	**26.3**	**6.3**	**11.1**	**7.6**
VOCs	Area	7.8	4.5	8.5	6.5	4.3	6.5
	Mobile	5.0	5.2	8.6	1.1	2.5	1.8
	Nonroad	3.8	2.8	2.5	2.4	2.8	1.9
	Point	n/a	0.4	0.2	0.2	0.5	0.3
	Biogenics	73.6	73.6	27.1	27.1	73.6	27.1
	Total	**90.2**	**86.5**	**46.9**	**37.2**	**83.7**	**37.6**

Source: Figure 3 & Table 2 — NCDENR Division of Air Quality -VISTAS/ASIP modeling effort BaseG

AIR RESOURCES

Emissions from Point Sources

Why the indicator was selected

Emissions from point sources in Orange County are relatively small compared to emissions from other sources. Yet it is important to track point sources over time because there can be concentrated impacts in one immediate area or cumulative impacts on a surrounding region.

How the indicator was measured

The North Carolina Division of Air Quality (NCDAQ) tracks the number of point sources discharging pollutants in Orange County. Carbon monoxide (CO), hazardous pollutants (includes over 180 kinds of dangerous compounds), nitrogen oxides (NOx), particulate matter of varying sizes (PM), sulfur dioxide (SO_2) and volatile organic compounds (VOCs) are important pollutants to track because of their potential effects on human health and local ecosystems. PM includes particles such as dust, dirt, soot, smoke and liquid droplets and is defined by the size of its diameter. PM10 is less than or equal to 10 micrometers, PM2.5 is less than or equal to 2.5 micrometers and all sizes are included in the total amount of suspended particulate matter (TSP). There has been great concern in recent years about PM2.5 because these fine particles penetrate deeper into the lungs. SO_2 is a gas that is released when fuels such as coal and oil are burned.

The trend in Orange County

MIXED

The number of facilities reporting emissions decreased from 18 in 1999 to 8 in 2006, the most recent data available. In general, this reduction in facilities is related to decreases in most pollutant emissions. Figure 4 shows the trend in selected point source pollutants while Table 3 gives the actual data from this time period. As Table 3 indicates, SO_2 and VOCs were substantially reduced between 1999 and 2002 as the number of point source facilities was reduced by 66%. However, overall emissions have increased since 2002 even though the number of point sources has decreased. The figures reflect a reduction in CO and NOx, but these levels still remain a concern. Estimates of point source emissions of particulate matter also imply a considerable decline. However, TSP and PM10 have been shown to be poor indicators of the health impact of particulate matter and concern has shifted to PM2.5. Emission and ambient measurements for PM2.5 did not begin until 1999 and since then have remained steady with slight fluctuations. Future tracking of PM2.5 emissions is critical.

Recommendations

To support a sustainable future, Orange County should:

- Review potential localized impacts of these sources, including any ambient modeling studies done as part of the relevant state permits.

Figure 4: Annual Point Source Air Pollution by Pollutant, 1993-2007

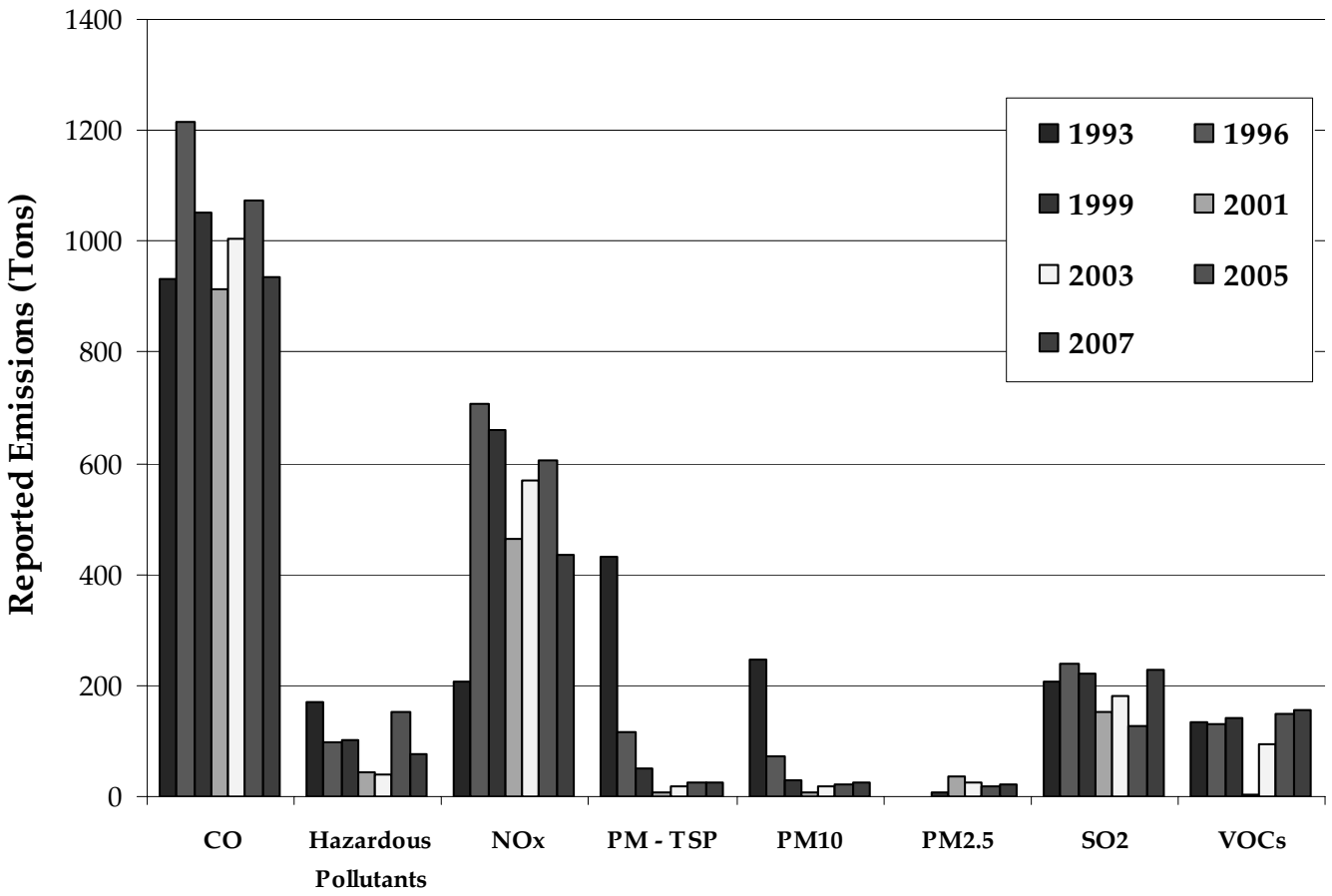


Table 3: Point Source Air Pollution, 1993-2007

	1993		1996		1999		2002		2007	
Pollutant	Facilities Reporting	Annual Output (tons)	Facilities Reporting	Annual Output (tons)	Facilities Reporting	Annual Output (tons)	Facilities Reporting	Annual Output (tons)	Facilities Reporting	Annual Output (tons)
CO	10	932.0	10	1,216.0	12	1,051.0	4	1,020.6	3	936.7
Hazardous Pollutants	5	169.0	12	99.0	10	102.0	4	23.8	3	77.7
NOx	11	206.0	11	706.0	13	661.0	4	527.5	3	433.6
PM (TSP)	13	432.0	17	115.0	15	51.0	6	31.4	4	26.4
PM10	12	247.0	16	74.0	15	28.0	6	23.4	4	24.4
PM2.5	-	-	-	-	4	8.0	4	13.3	3	22.3
SO_2	7	208.0	8	238.0	11	220.0	4	148.7	2	229.8
VOCs	12	133.0	12	129.0	10	143.0	4	71.0	3	156.6
# of facilities reporting at least one pollutant	**20**		**21**		**18**		**6**		**4**	

Source: Figure 4 & Table 3 —NCDENR Division of Air Quality

AIR RESOURCES

Ozone Threshold Exceedances

Why the indicator was selected

Ground-level ozone pollution is a major concern in Orange County. This harmful pollutant is created through a chemical reaction between sunlight and nitrogen oxides (NOx) and volatile organic compounds (VOCs) emitted by motor vehicles, industries, biogenics and other sources. Ground-level ozone may cause permanent lung damage, trigger health problems and harm plants and ecosystems. (This should not be confused with "useful" ozone, the ozone layer, which is located in the upper atmosphere and protects us from the sun's harmful radiation.)

How the indicator was measured

Based on U.S. Environmental Protection Agency (EPA) monitoring protocols for urban areas, the North Carolina Division of Air Quality (NCDAQ) currently does not operate an ozone monitor in Orange County. Because urban non-attainment status is assessed at the Metropolitan Statistical Area (MSA) level, Orange County's official ozone status is generated by assessments of the ten ozone monitors spread throughout the Triangle area. Statistics from individual monitoring stations surrounding Orange County provide a general profile of ozone levels in our area. The monitor locations are seen in Figure 6. Without a monitor, the county cannot track actual ozone levels within its borders.

The trend in Orange County

INDETERMINATE

In April 2004, the EPA designated Orange County and seven other counties comprising the Triangle MSA as a non-attainment area under the federal standard for ozone. This designation came with the switch to a more protective 8-hour average standard instead of the previous 1-hour average. The EPA changed the standard because research has shown that longer periods of exposure to ozone, even at lower levels, have negative health effects. As a result, this standard from 1997 to 2007 was based on levels above 0.08 parts per million (ppm) over an 8-hour period (the 2008 standard is 0.075 ppm) instead of above 0.12 ppm over a 1-hour period. To designate nonattainment areas, the EPA looks at the fourth highest daily measurement within a MSA in each year and averages these values over a three-year period. In 2007, the Triangle was upgraded to a "maintenance area." A maintenance area is an area that has been redesignated to attainment for the 8-hour ozone standard. A change of designation to non-attainment status may be required in the next year due to the more stringent standards.

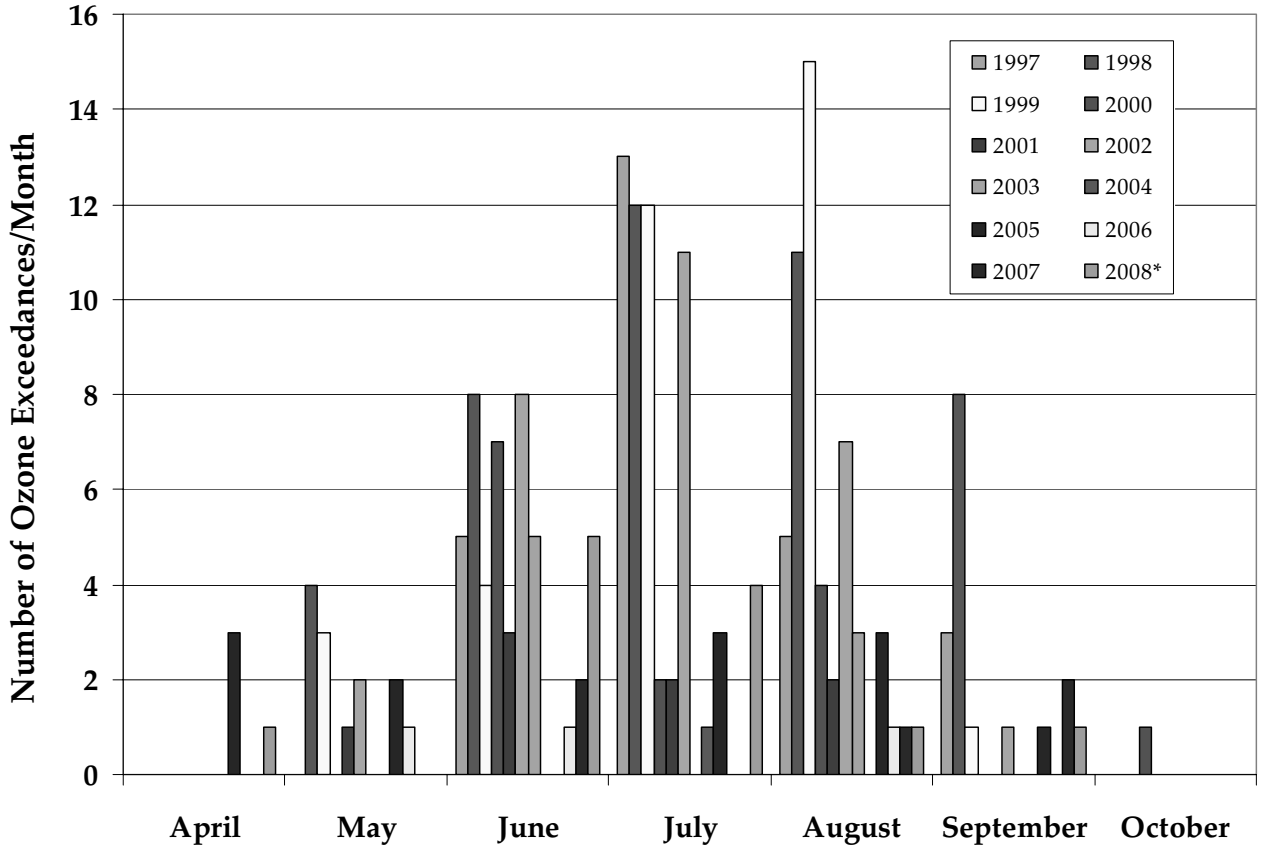
Figure 5 shows the variation experienced in the number of nonattainment days from 1995 to 2008. These variations are most likely related to hot weather extremes favorable for ozone-generating reactions. The majority of exceedance days occur during the summer months.

Recommendations

To support a sustainable future, Orange County should:

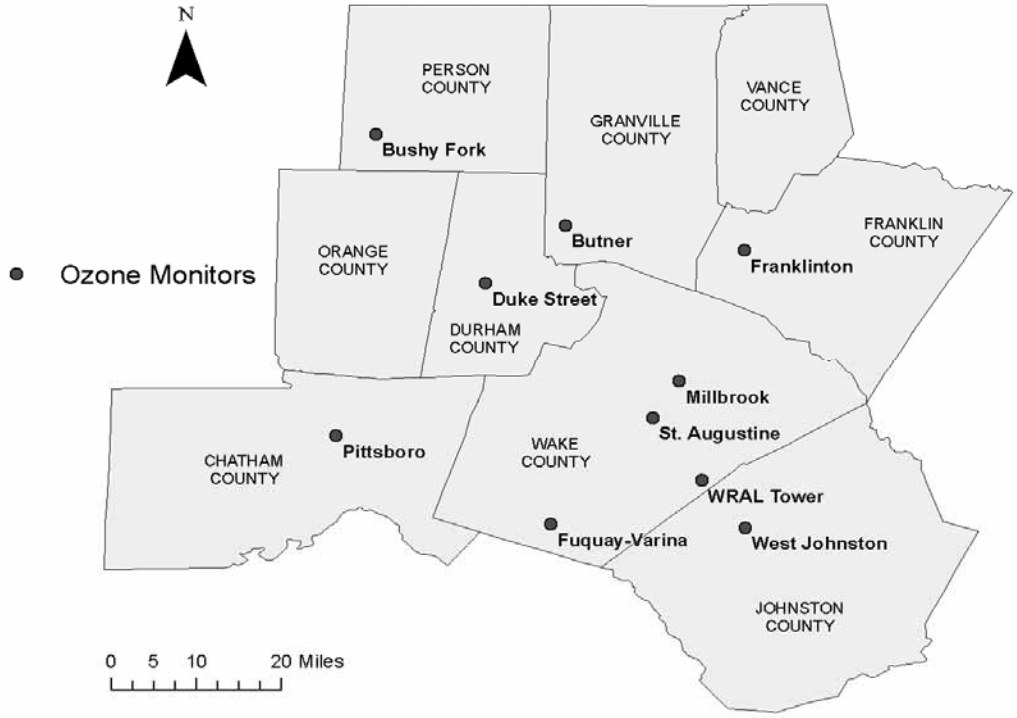
- Stringently follow the NC State Implementation Plan (SIP) to maintain the ozone standard through 2017 in order to remain in attainment;
- Work towards the installation of an ozone monitor and continue to ask employees to take steps to mitigate ozone levels on exceedance days; and
- Develop an ozone action plan that is consistent with the Greenhouse Gas Action Plan.

Figure 5: Monthly Trends in Ozone Exceedance Days in the Triangle Region, 1997-2008



* 2008 data is preliminary. It has not yet been reviewed and approved by the EPA.

Figure 6: Ozone Monitor Locations in the Triangle Region



Source: Figures 5 & 6 — NCDENR Division of Air Quality— Planning Unit

AIR RESOURCES

Transportation Modes

Why the indicator was selected

Automobile use in Orange County is directly related to air quality because vehicle exhaust contributes a substantial portion of air pollutants to the atmosphere. Therefore, it is important to encourage alternatives to the prevailing single-occupancy automobile. In particular, there are a number of unique aspects of Orange County's employment base, population distribution and commuting/ movement patterns that offer more innovative opportunities in alternative transportation. Tracking the types of transportation modes can be used to gauge the success of policies that support alternative modes of transportation.

How the indicator was measured

The statistic presented here represents the journey-to-work in and out of Orange County. The U.S. Census Bureau provides means of transportation to work data from the 1990 and 2000 census results and the American Community Survey provides data estimates for the years between censuses.

The trend in Orange County

IMPROVING

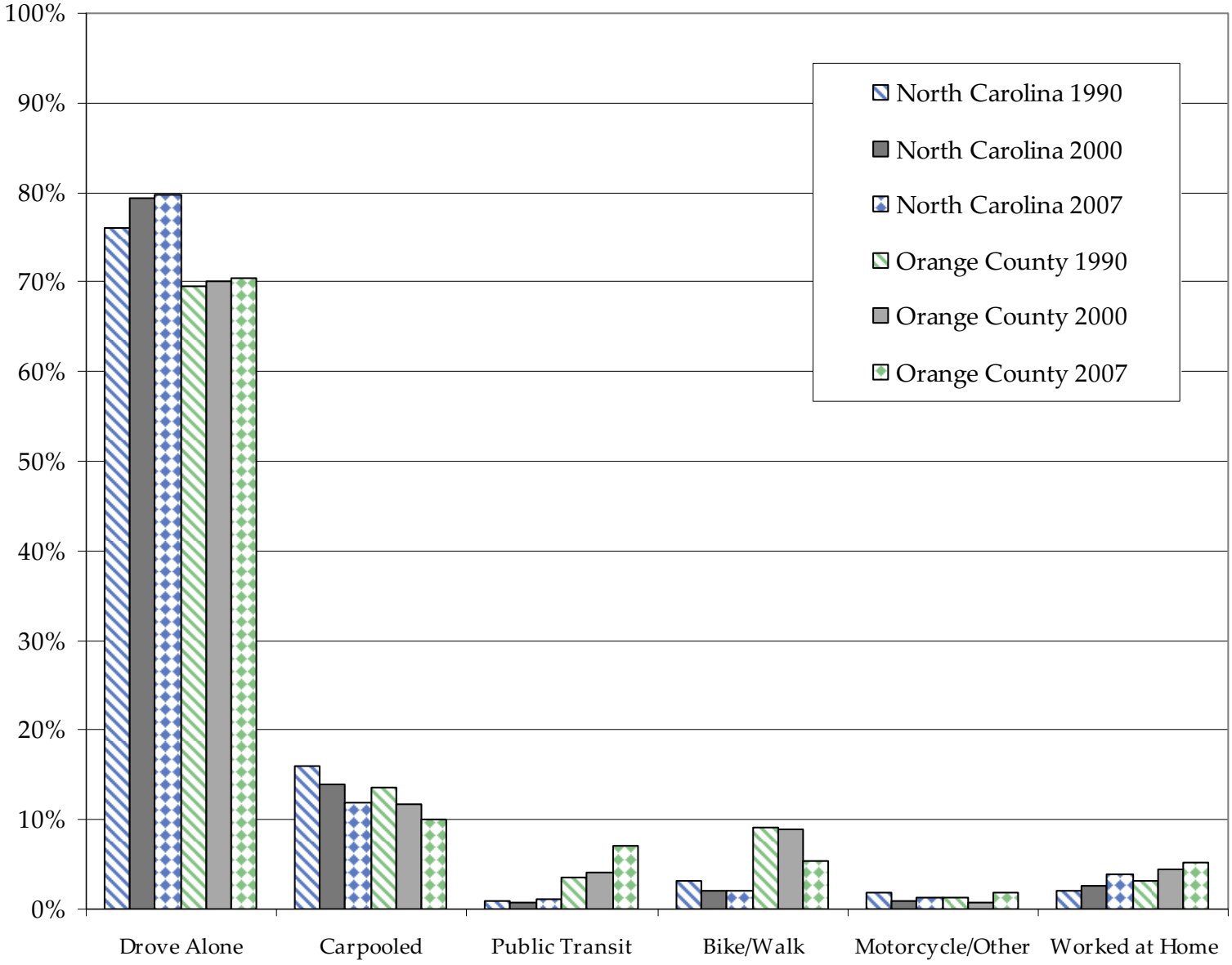
As seen in Figure 7, the single-occupancy automobile is by far the dominant mode of transportation to work for Orange County citizens. However, a comparison of the data for Orange County to North Carolina as a whole reveals unique trends in the county. The percentage of workers driving alone and the number of carpoolers is lower in Orange County than in North Carolina. The number of people using public transit, walking/biking and working at home is significantly higher than the state average (though only a small portion of total commuting trips) and may have increased further since the fuel price escalation of 2008. Further investigation is necessary to determine the reason for the difference between Orange County and the State's use of alternative modes of transportation and the extent to which this difference may be attributed to Chapel Hill's fare-free transit system, the relative dominance of the University of North Carolina at Chapel Hill (UNC-CH) as an employer in Orange County and/or other factors.

Recommendations

To support a sustainable future, Orange County should:

- Expand and enhance its public transportation and car-pooling systems and
- Work to reduce vehicle trips altogether by increasing telecommuting, co-locating jobs and residences and developing walkable, bicycle-friendly and mass transit-oriented communities.

Figure 7: Means of Transportation to Work in Orange County and North Carolina between 1990 and 2007



Sources: Figure 7 — U.S. Census Bureau and the American Community Survey

AIR RESOURCES

Commuting Patterns

Why the indicator was selected

The amount of time that people spend traveling to work correlates directly to air emissions. Because the dominant mode of transportation is the single-occupancy vehicle, statistics on travel time and commuting can indicate how much people contribute to air pollution.

How the indicator was measured

In the 1990 and 2000 censuses and the 2006 American Community Survey, the U.S. Census Bureau obtained data on travel time to work for workers 16 years and older as well as on the number of people commuting out of their county of residence. From these data, calculations were made to determine the number of in- and out-commuters in Orange County.

The trend in Orange County

WORSENING

As seen in Table 4, commuting time for Orange County workers continues to increase. Figure 8 confirms that both the number of in-commuters (workers from other counties) and out-commuters (Orange County workers going to other counties) continues to rise as well. Tables 5 and 6 detail the extent of these changes between 1990 and 2006, the most recent period for which data is available.

Table 4: Change in Average Travel Time to Work

Year	Average Travel Time in Minutes	Percent Change	
1980	18.5	n/a	
1990	18.9	1980-1990	2.16%
2000	22	1990-2000	16.40%
2006	22.5	2000-2006	2.27%

Recommendations

To support a sustainable future, Orange County should:

- Study commuting patterns in Orange County and develop strategies to improve them;
- Encourage and offer incentives for regional employers to promote telecommuting and carpooling to take cars off the road; and
- Improve transportation efficiency: promote more public transportation, ride sharing and alternative transportation such as bicycles and walking.

Figure 8: Percentage of Employed Persons "In-" or "Out-Commuting" in Orange County between 1990 and 2006

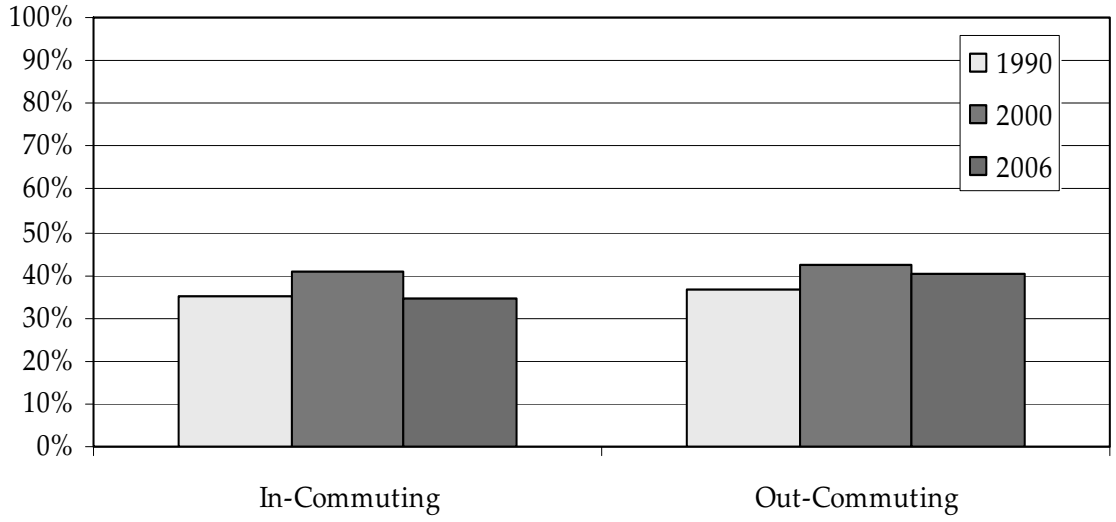


Table 5: Change in "Out-Commuting" in Orange County Between 1990 and 2006

	1990 Census	2000 Census	2006 Estimate	% Change 1990 to 2000	% Change 2000 to 2006	% Change 1990 to 2006
Number of Orange County Residents Who Work	49,915	65,009	65,079	30.2%	0.1%	30.4%
Number of Orange County Residents Working in Other Counties	18,324	27,563	26,105	50.4%	-5.3%	42.5%
Percent of Orange County Residents Working in Other Counties	36.7%	42.4%	40.1%	15.5%	-5.4%	**9.3%**

Table 6: Change in "In-Commuting" in Orange County Between 1990 and 2006

	1990 Census	2000 Census	2006 Estimate	% Change 1990 to 2000	% Change 2000 to 2006	% Change 1990 to 2006
Number of People Working in Orange County	48,621	59,147	59,544	21.6%	0.7%	22.5%
Number of Orange County Workers Living in Other	17,030	24,094	20,570	41.4%	-14.6%	20.8%
Percent of Orange County Workers Living in Other	35.0%	40.7%	34.5%	16.3%	-15.1%	-1.3%

Sources: Tables 4, 5, & 6 and Figure 8 — U.S. Census Bureau and American Community Survey

AIR RESOURCES

Public Transit (Bus) Ridership

Why the indicator was selected

Choosing public transportation over single-occupancy vehicles improves the quality of life for people and the environment by reducing traffic congestion, air pollution and fossil fuel usage; saving money; and promoting a more sustainable lifestyle. Public transit ridership tends to increase with rising gas prices and downturns in the economy. However, as public transit has become more socially acceptable and riders realize how convenient, cost-effective and environmentally sound it can be, they tend to continue riding even after fuel prices and the economy return to normal. Buses are the most prolific form of public transportation in the Triangle area. Four agencies Triangle Transit, Chapel Hill Transit, Orange Public Transit and Duke Transit's Robertson Scholar's Express Bus have bus routes that serve Orange County residents.

How the indicator was measured

Bus ridership is measured by the number of trips traveled by bus. A trip is defined as each time a passenger boards a bus. Trip figures are important for forecasting travel demand, determining trends and creating routes, among other reasons. Each of the four transit agencies generates and maintains its own trip numbers. Every time a passenger boards a bus the driver clicks a button adding that rider as one trip. These figures are then used to calculate monthly and annual ridership. Table 7 shows annual ridership since 2003 for each of the transit agencies. Only routes that serve Orange County are incorporated in these numbers.

The trend in Orange County

IMPROVING

Overall bus ridership has increased steadily since 2003. CH Transit saw a 40% increase in ridership in 2002 with its move to a fare-free system (not shown in Figure 9) and an increase of 15% between 2007 and 2008. Triangle Transit experienced a 25% jump in ridership between 2007 and 2008, a result of increased service hours for the 500/550 route and greater demand likely due to the spike in gas prices. Demand was significant enough from 2004-2006 for Triangle Transit to add two additional routes in Orange County, the 420 from Hillsborough to Chapel Hill and the 500/550 from Raleigh to Chapel Hill. About 26,000 passengers, or a third of the population that Chapel Hill Transit's routes serve, ride CH Transit buses. It is expected that bus ridership for all four agencies grew further during 2008-2009. There is coordination between the four transit agencies to improve the linkages between Triangle Transit, OPT and CH Transit and to provide service to all of Orange County's communities.

Recommendations

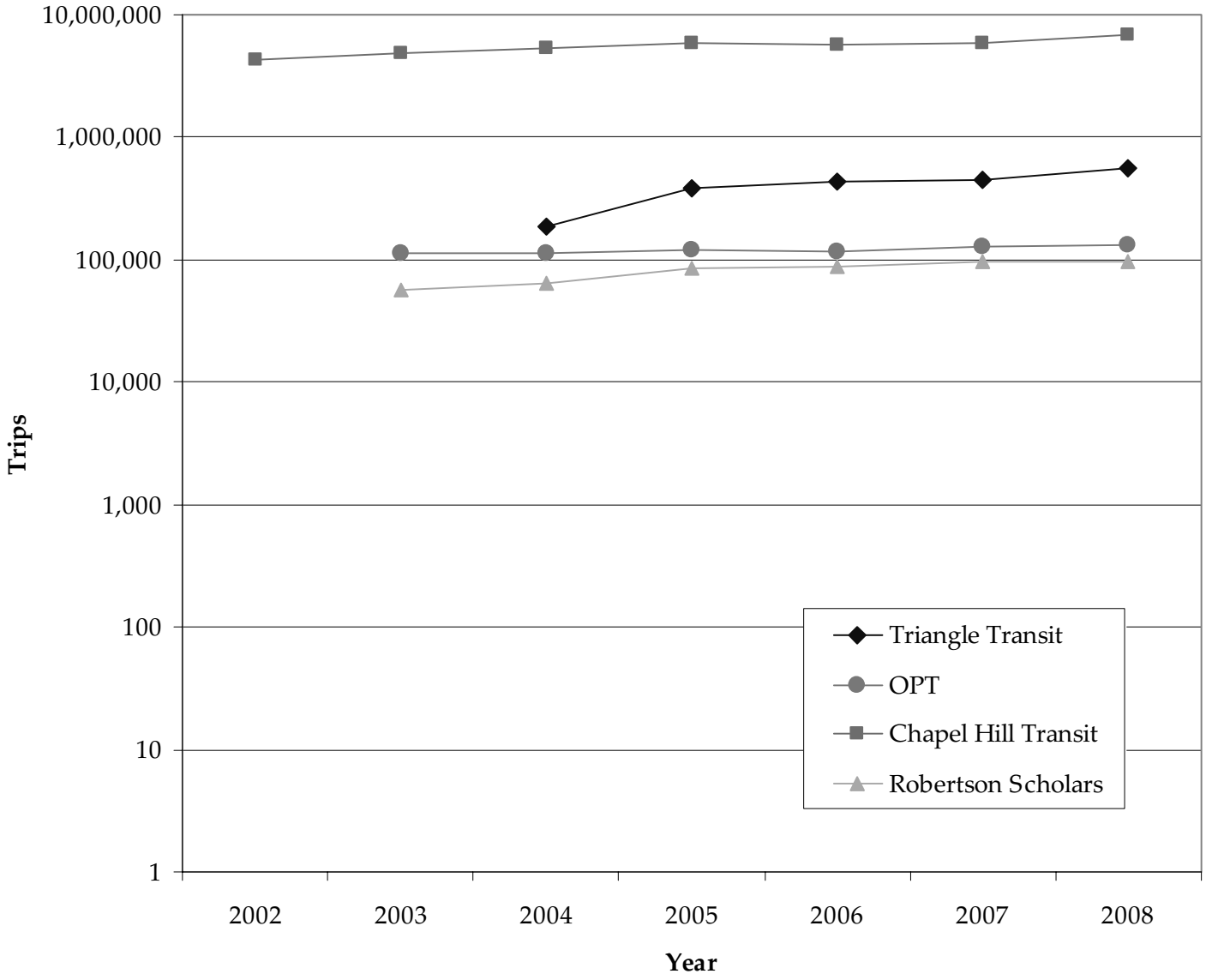
To support a sustainable future, Orange County should:

- Expand the availability and use of public transportation throughout the county to provide better access between employment centers, shopping and service locations and other key points of interest;
- Improve public education and advertising of existing transit services;
- Work with nearby jurisdictions to integrate Orange County plans with regional goals and objectives for an intermodal system to meet projected travel demand that reduces congestion and reliance on single-occupancy vehicles; and
- Improve coordination of all public transit routes and services within Orange County and the Triangle Region.

Table 7: Bus Ridership, 2002-2008

Service Provider	2002	2003	2004	2005	2006	2007	2008
Triangle Transit	-	-	185,850	382,747	433,654	451,512	491,358
OPT	-	113,545	113,198	118,991	116,988	128,006	133,892
Chapel Hill Transit	4,287,068	4,833,800	5,364,580	5,923,812	5,692,490	5,918,138	6,817,804
Robertson Scholars	-	56,969	63,838	86,111	87,710	97,391	97,391
TOTAL	**4,287,068**	**5,004,314**	**5,727,466**	**6,511,661**	**6,330,842**	**6,595,047**	**7,540,445**

Figure 9: Annual Bus Ridership, 2002-2008



Sources: Table 7 & Figure 9 — Public Transit Providers

AIR RESOURCES

Daily Vehicle Miles Traveled

Why the indicator was selected

Daily vehicle miles traveled (DVMT) represent vehicle use on public roads by residents and non-residents of Orange County. The analysis of these data over time is a critical factor in estimating the contribution of vehicle emissions to the degradation of air quality within the county. The number of road lane miles represents the overall capacity of the transportation system. Additional lane miles can result in greater DVMT and thus increased vehicle emissions. However, new lane miles that allow freer flow of traffic can potentially reduce emissions and congestion.

How the indicator was measured

The North Carolina Department of Transportation (NCDOT) collects traffic data to estimate statistics such as DVMT shown in Table 8. Vehicle miles are divided into rural and urban. Within these large categories, the mileage is broken down into type of road. Per capita DVMT are calculated by dividing total annual miles driven by the total county population. NCDAQ modeled the DVMT projections for 2010 and 2018. Compiled by NCDOT based on the total mileage of state maintained roads, "lane miles" count a mile of four-lane road as four miles and consider widening of existing roads as new lane miles. "Lane miles" are not distinguished by road type.

The trend in Orange County

WORSENING

Table 8 shows that both the rural and urban DMVT continue to rise in the county. Urban DVMT correspond to miles traveled primarily by local residents while rural DVMT are associated with travelers passing through the county, non-residents. Figure 10 shows that DVMT projections into the future are predicted to increase at a steady rate. Based on past trends—expected population and job growth and development patterns—there will likely be ongoing increases in DVMT unless comprehensive measures are enacted to reduce single-occupant trips. Orange County should not again experience the dramatic rise in DVMT seen between 1990 and 2000 after the completion of Interstate 40 in 1988 added a large number of interstate miles to Orange County's road network. Table 9 shows how the overall lane mileage of our local road system grew steadily over the last 22 years. However, while the amount of actual pavement grew only gradually in that period, the DVMT increased at a much greater rate.

Recommendations

To support a sustainable future, Orange County needs to:

- Develop innovative strategies to address the issues involved in rising vehicle miles. Cooperate with others to develop and refine an integrated transportation-impacts model, by combining transportation demand and emissions models, to investigate the possible impacts of trip-reduction measures, road construction and development proposals, transit improvements, increases in employment and other factors that will come into play over the next decades and
- Track DVMT and state maintained road lane miles along with other transportation measures to provide a comprehensive picture of the impact of vehicle use on air quality, land and water resources and the overall environment.

Figure 10: Change in Daily Vehicle Miles Traveled, 1990-2018

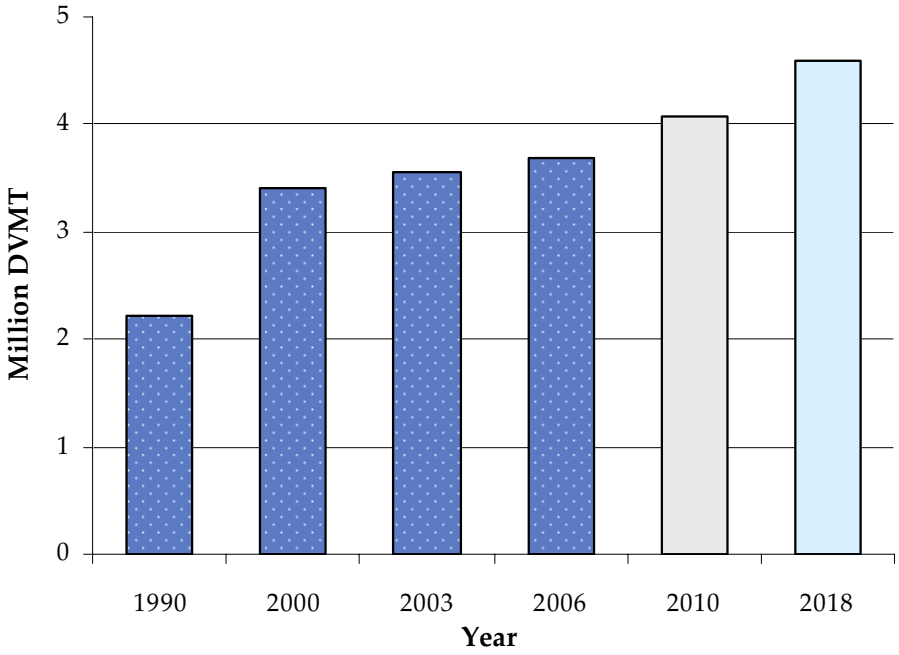


Table 8: Daily Vehicle Miles Traveled, 1990-2018

Road Type	Measured				Projected[3]	
	1990	2000	2003	2006	2010	2018
Rural (non-residents)						
Total	**1,501,850**	**2,410,300**	**2,452,400**	**1,878,730**	**2,050,120**	**2,313,545**
Arterial	75,700	196,100	192,150	115,490	126,026	142,219
Collector	569,300	647,630	678,090	606,830	662,189	747,275
Interstate	745,550	1,417,590	1,414,490	1,042,550	1,137,658	1,283,839
Local	111,300	148,980	167,670	113,860	124,247	140,212
Urban and Small Urban (residents)						
Total	**726,280**	**1,001,400**	**1,112,570**	**1,810,410**	**2,030,205**	**2,291,071**
Arterial	558,040	754,080	445,200	641,770	754,965	851,972
Collector	35,890	41,500	388,590	77,190	84,232	95,055
Freeway	53,660	57,420	61,600	351,460	383,512	432,790
Interstate	21,070	114,320	109,200	618,760	675,207	761,966

Table 9: Total State Maintained Road Lane Miles, 1985-2007

Year	Lane Miles	Percent Change	
1985	1,602	n/a	
1990	1,678	1985-1990	4.7%
1995	1,710	1990-1995	1.9%
2000	1,750	1995-2000	2.3%
2003	1,788	2000-2003	2.2%
2007	1,807	2003-2007	1.1%

[3] 2006 Estimate and 2010 and 2018 Projections from North Carolina Office of State Budget and Management
Source: Figure 10 and Tables 8 & 9 — NC Department of Transportation

AIR RESOURCES

Ongoing Concern: Greenhouse Gas Emissions

Greenhouse gas emissions contribute to climate change. The Earth's temperature is regulated by a natural system known as the "greenhouse effect" whereby a delicate balance of naturally-occurring gases traps some of the sun's radiation near the earth's surface. This radiation heats the atmosphere and creates the conditions which make life on earth possible. The most common naturally-occurring greenhouse gases (GHG) are carbon dioxide, water vapor, methane, nitrous oxide and ozone. Greenhouse gas production is represented by the carbon dioxide equivalent (eCO_2), a common measure that expresses all GHG production as the number of tons of eCO_2 produced by energy use and waste production in a community.

In 2009, *A GHG Emissions Inventory and Forecast* report was completed for Orange County. In that study, Orange County chose a 2005 baseline year, as the initial measure of its current total GHG and 2030 as the target year for reducing emissions. A baseline emission was determined from all areas of local government operations (i.e. buildings, streetlights, transit systems, vehicle fleets, wastewater treatment facilities and waste generated by government operations) and from energy and waste related community activities (i.e. residential, commercial and institutional buildings, motor vehicles, waste streams and industry within local control). Refer to Table 11 and Figure 11. Then potential reduction target emission scenarios were created, expressed as a percentage of the baseline emission to meet the target year. Growth forecasts are made to allow communities to take into account increases in GHG production when choosing a reduction target. Setting of specific targets are forthcoming by the County's elected boards.

The 2009 GHG report presented Orange County with three scenarios to reduce GHG emissions: a business-as-usual (BAU) option, a mid-level reduction level and an aggressive reduction level. If the business-as-usual (BAU) option were chosen GHG emissions would increase by approximately 53% between 2005-2030. (Measures implemented before 2005 resulted in a reduction of 94,118 tons of GHG or a decline of about three percent from 2005 levels.) Currently planned measures to be in place by 2030 will result in a slight decrease in GHG production (approximately six percent) from the BAU scenario in 2030; however, these measures will be insufficient to offset the 53% percent overall increase (Table 10). To date the county has made many changes in order to reduce future emissions including a large variety of recycling programs, leaf collection, fueling some vehicles with biodiesel, providing bicycle facilities, adopting various ordinances, establishing an Urban Services Boundary, providing daylighting in new schools, purchasing hybrid vehicles over conventional vehicles and supporting Chapel Hill Transit's fare-free system, among others. Establishing a reduction target helps local governments to quantify their commitment to reducing GHG emissions and sets a concrete, measurable goal for the government and community to strive towards. By establishing emission reduction targets and officially adopting these targets through council resolutions, the county will fulfill Milestone #2 of the Cities for Climate Protection (CCP) Five Milestone Framework, adopt an emissions reduction target for the forecast year.

To support a sustainable future, Orange County should:

- Assess and implement the current countywide greenhouse gas (GHG) emissions target reductions and
- Monitor the 2035 Long-Range Transportation Plan from the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization, which provides traffic projections for long-range transportation planning.

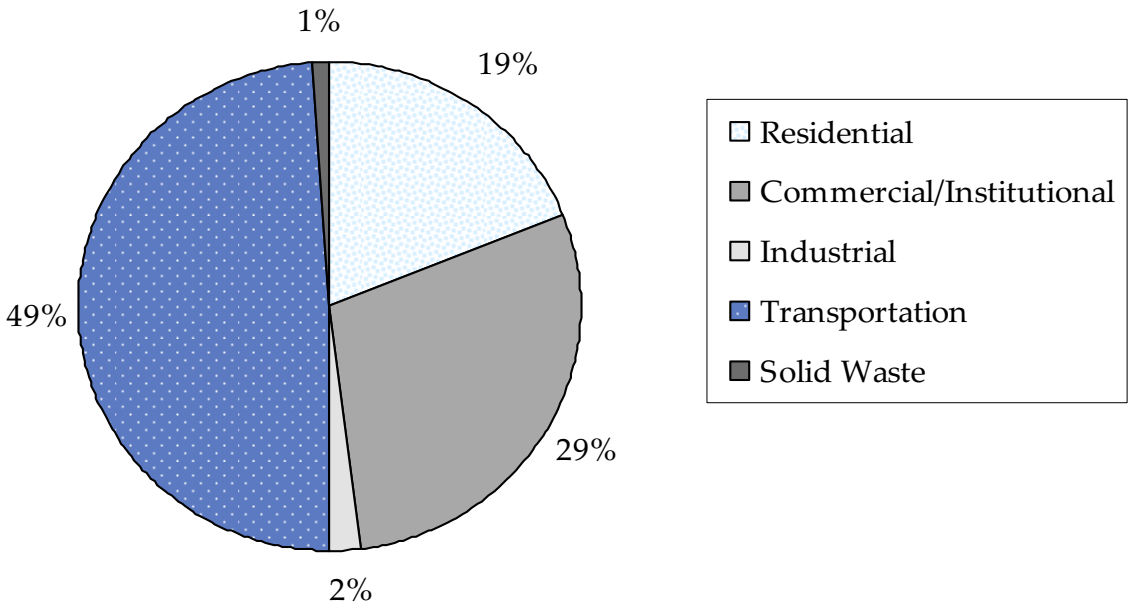
Table 10: Energy Use
(based on 2005 Base Year data)

Year & Scenario	GHGs (Tons)	Difference from Baseline
2005	2,496,505	-
2005 Without Measures	2,871,399	3%
2030: BAU	4,402,043	59%
2030: Currently Planned Measures	4,246,562	53%

Table 11: Greenhouse Gas Emissions by Sector (tons)

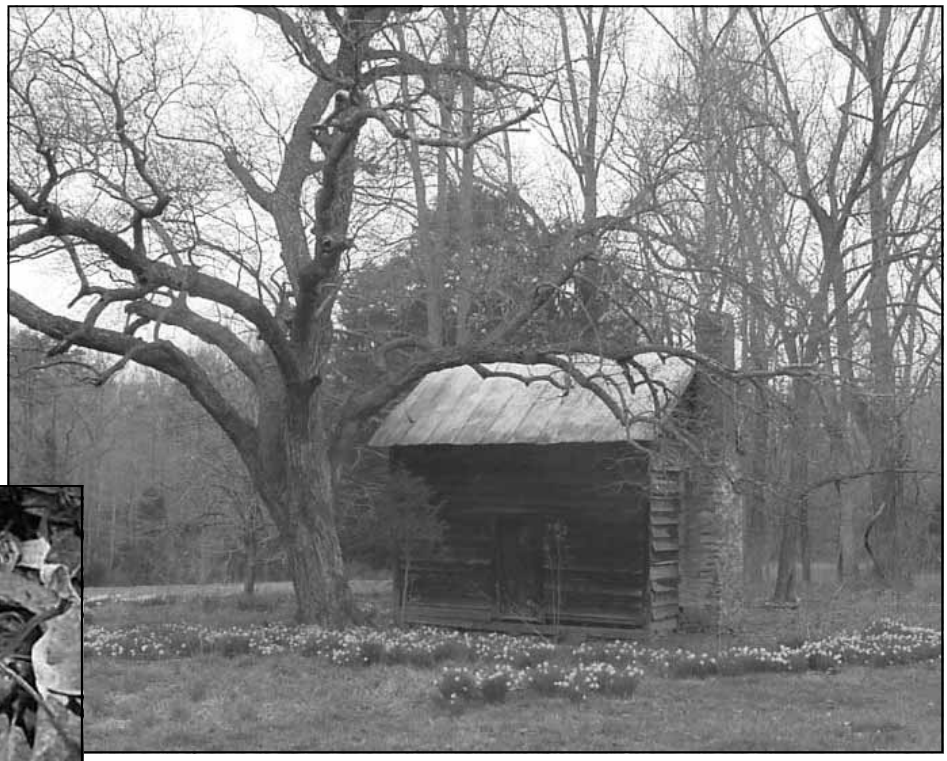
Sector	Energy (MMbtu)	GHGs (tons)	GHGs (%)
Residential	3,905,632	527,996	19%
Commercial/Institutional	5,637,049	812,943	29%
Industrial	243,009	40,542	2%
Transportation	15,850,531	1,356,984	49%
Solid Waste	-	38,816	1%
Total	**25,636,221**	**2,777,281**	**100%**

Figure 11: Percent of Greenhouse Gas Emissions by Sector



Source: Tables 10 & 11 and Figure 11 —Orange County Greenhouse Gas Inventory (2009)

Log cabin on the Breeze Farm, which was protected with an agricultural conservation easement in 2008.



Lewis' Heartleaf Preserve was acquired in 2005.

A conservation easement was granted to Orange County on the Keith Arboretum (near Pickards Mountain) in 2006.

These images represent some of the special places that were protected through Orange County's Lands Legacy Program.

The owners of Fickle Creek Farm protected their farm with a conservation easement in 2007.

BIOLOGICAL RESOURCES

Orange County is home to a wealth of biological resources within a variety of natural communities, from the forested hills known as "monadnocks" (such as Occoneechee Mountain) to the bottomland swamp forests of the Triassic Basin (such as Mason Farm Biological Reserve). Encroaching development, however, can devour valuable natural areas and fragment the landscape, disrupting the ecosystems of native plants and animals. Therefore it is critical for Orange County to monitor the conditions of and protect its most significant natural areas and individual species.

Significant developments in protecting Orange County's biological elements have occurred since the last *State of the Environment* report. Among these was a 2004 update of the county's inventory of natural heritage sites in cooperation with the North Carolina Natural Heritage Program. New to the inventory was the identification of important "macrosites"[4] in less developed areas of the county and the inclusion of some highly important river habitats as new Natural Heritage sites.

Another integral element in the protection of local biological resources is Orange County's Lands Legacy Program. Started in April 2000, Lands Legacy is administered by the Environment & Resource Conservation Department (ERCD). The department works with willing landowners to acquire land or to protect private land through conservation easements. ERCD often collaborates on projects with local land trusts and other conservation partners. Since the Lands Legacy Program was started, Orange County has acquired 977 acres of new land for parks and preserves and protected another 1,550 acres of farmland and natural land with conservation easements. Further information on the Lands Legacy program is given on pages 63 through 65.

The Biological Resources section of this report highlights data from the 2004 natural heritage inventory and reports on the progress made by Lands Legacy and others to protect important resource lands in Orange County. The **Acres of Protected Land** indicator shows the many different types of land protection efforts ongoing in the county. The **Acres of Protected Natural Heritage Sites** indicator is a subset of the protected land figures. This indicator tracks the protection of those lands recognized as highly important natural areas by the North Carolina Natural Heritage Program. The **Prime Forest** indicator displays some of the notable changes in forest cover in the county from 1988-2008. The **Acres within the Present Use Value Program** tracks the amount of land receiving special tax treatment as agricultural, forest or horticultural land. Finally, the **Status of Rare Plants and Animals** presents the current information maintained by the Natural Heritage Program on individual species.

[4] Macrosites are broad, natural habitats with relatively little or no human alteration.

BIOLOGICAL RESOURCES

Acres of Protected Land

Why the indicator was selected

Lands that are protected from future development have both intrinsic value and are community assets that provide innumerable benefits for the people of Orange County. Large, undisturbed, natural areas protect our air and water quality, provide habitat for native plants and animals and serve as recreational and scenic areas for county residents. The most effective method of protecting land for conservation purposes is to acquire it fee-simple, outright (by purchase or donation) or by working with the owners to restrict its future development potential. Conservation easements[5] have been used by several landowners in Orange County to ensure long-term protection of important natural and cultural resources on their property.

How the indicator was measured

ERCD maintains a database of protected lands in Orange County. Table 12 lists the different entities working to protect land over the past few decades and Figure 13 shows the amount of land considered to be permanently or partially protected[6].

The trend in Orange County

IMPROVING

The active collaboration of local governments, residents and non-profit organizations is needed to protect important natural resource lands in Orange County. The County became a full partner in this effort when it established the Lands Legacy Program in 2000. Over the past four years (2004-08) another 2,700 acres were protected, including 189 acres for Eno River State Park, 997 acres by Orange County and 272 acres by Triangle Land Conservancy. An additional 750 acres of prime farmland were protected with conservation easements. In total there are 23,173 acres of protected land in Orange County, which is approximately 9% of the total land area (Figure 12). Currently, 13,023 acres of those protected lands (or 5% of the county) are considered permanently protected. Many important natural and cultural resource lands remain completely unprotected.

Recommendations

To support a sustainable future, Orange County should:

- Revisit the goal of permanently protecting at least 10% of the county's land area (25,600 acres) by the year 2010. Achieving this goal would require an additional 12,700 acres to be protected in the next year. Set new goals for 2015 and 2020;
- Continue to collaborate with its conservation partners (e.g., land trusts, Duke University, UNC-Chapel Hill, State of NC, OWASA) and private landowners to conserve high-priority natural areas and wildlife habitats including rivers and streams, floodplains, steep slopes, prime forests and wildlife corridors; and
- Develop a comprehensive conservation plan for achieving a continuous network of protected open space throughout the county, which addresses a) threats to important natural areas and wildlife habitat, b) connectivity between protected areas, c) coordination with neighboring counties and d) sustainable management of critical natural resources.

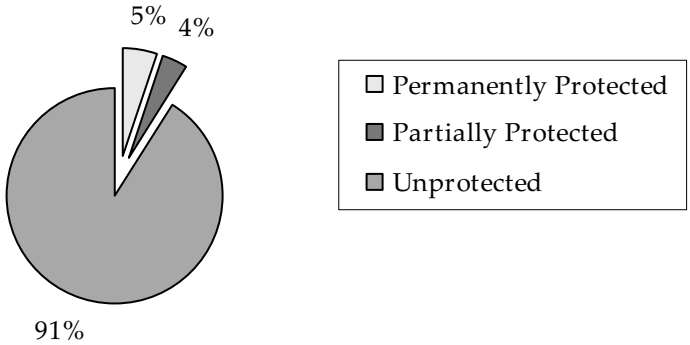
[5] Conservation easements are voluntary, legal agreements between the landowner and a nonprofit conservation organization or a local government. Under the agreement the landowner gives up certain rights to develop the land in the future.

[6] Permanently protected lands are those properties most likely to remain protected from future development. They include all lands protected by conservation agreements (e.g., easements) and lands owned by conserva tion entities. Partially protected lands are intended to remain undeveloped, but lack binding agreements for their permanent protection (e.g., Duke Forest, UNC-Chapel Hill's Mason Farm Biological Reserve and several local government parks and open space properties).

Table 12: Total Acres of Protected Land in Orange County as of 2008

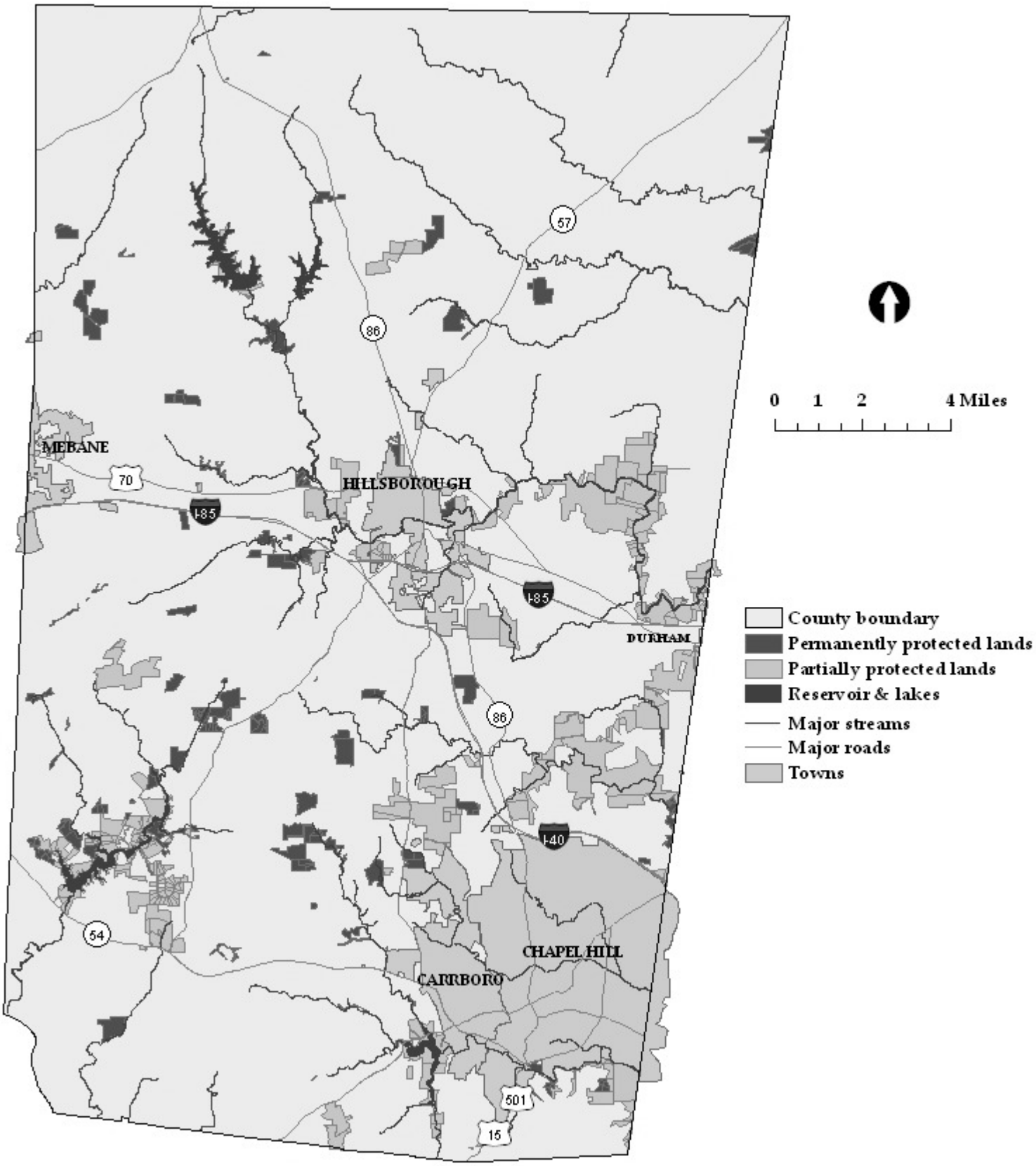
PERMANENTLY PROTECTED LANDS			Acreage by Acquisition Period					
Organization		Protection	Pre-	1981-	1991-	2001-	2005-	TOTALS
Name	Type	Method	1981	1990	2000	2004	2008	
Botanical Garden Foundation	Nonprofit	Fee-simple		17	77			94
		Easement			23		92	115
Town of Carrboro	Local Govt.	Fee-simple				27		27
Conservation Trust for NC	Nonprofit	Easement			143			143
Eno River Association	Nonprofit	Fee-simple			17	28	117	162
Orange County (Lands Legacy)	Local Govt.	Fee-simple			63	135	59	257
		Easement			8	648	791	1,558
Orange Water and Sewer Authority	Utility Provider	Fee-simple	73	1,983	1,300	275	74	3,705
		Easement			164	209		373
Eno River State Park	State Govt.	Fee-simple	800	800	374	1,148	189	3,311
Town of Hillsborough (Reservoir)	Local Govt.	Fee-simple			726			726
Town of Mebane (Reservoir)	Local Govt.	Fee-simple	258					258
Occoneechee Mountain State Natural Area	State Govt.	Fee-simple			96		66	162
Mid-Atlantic Mitigation	For Profit	Easement					30	30
State of NC (NC State University)	State Govt.	Fee-simple				133	136	269
State of NC (Clean Water Management Trust Fund)	State Govt.	Easement					193	193
State of NC (Ecosystem Enhancement)	State Govt.	Easement					221	221
State of NC (Eno River State Park)	State Govt.	Easement				2	4	6
Triangle Land Conservancy	Nonprofit	Fee-simple		5	428	35	262	730
		Easement		9	348	284	10	651
US Army Corps of Engineers	Federal Govt.	Fee-simple	98					98
US Fish & Wildlife Service	Federal Govt.	Easement		45				45
		SUBTOTAL	**1,229**	**2,859**	**3,767**	**2,924**	**2,244**	**13,023**
PARTIALLY PROTECTED LANDS								
Town of Carrboro	Local Govt.	Fee-simple		28	67	1	96	192
Town of Chapel Hill	Local Govt.	Fee-simple	131	152	133	255	4	675
City of Durham	Local Govt.	Fee-simple			11		11	22
Town of Hillsborough	Local Govt.	Fee-simple		52	44		96	192
Draper-Savage Foundation (Moorefields)	Nonprofit	Fee-simple		85				85
Orange County (Lands Legacy)	Local Govt.	Fee-simple	331	33	38	404	147	953
Duke University	Private	Fee-simple	2,419	397	2,175	71	40	5,102
Private Homeowners Associations	Nonprofit	Fee-simple	70	239	562	265	106	1,242
Classical American Homes Preservation	Nonprofit	Fee-simple			263			263
University of NC at Chapel Hill	Public	Fee-simple	200	1,093	90		41	1,424
		SUBTOTAL	**3,151**	**2,079**	**3,383**	**996**	**541**	**10,150**
TOTAL ACRES OF PROTECTED LAND			**4,380**	**4,938**	**7,150**	**3,920**	**2,785**	**23,173**

Figure 12: Percent of all Land in Orange County that is Protected



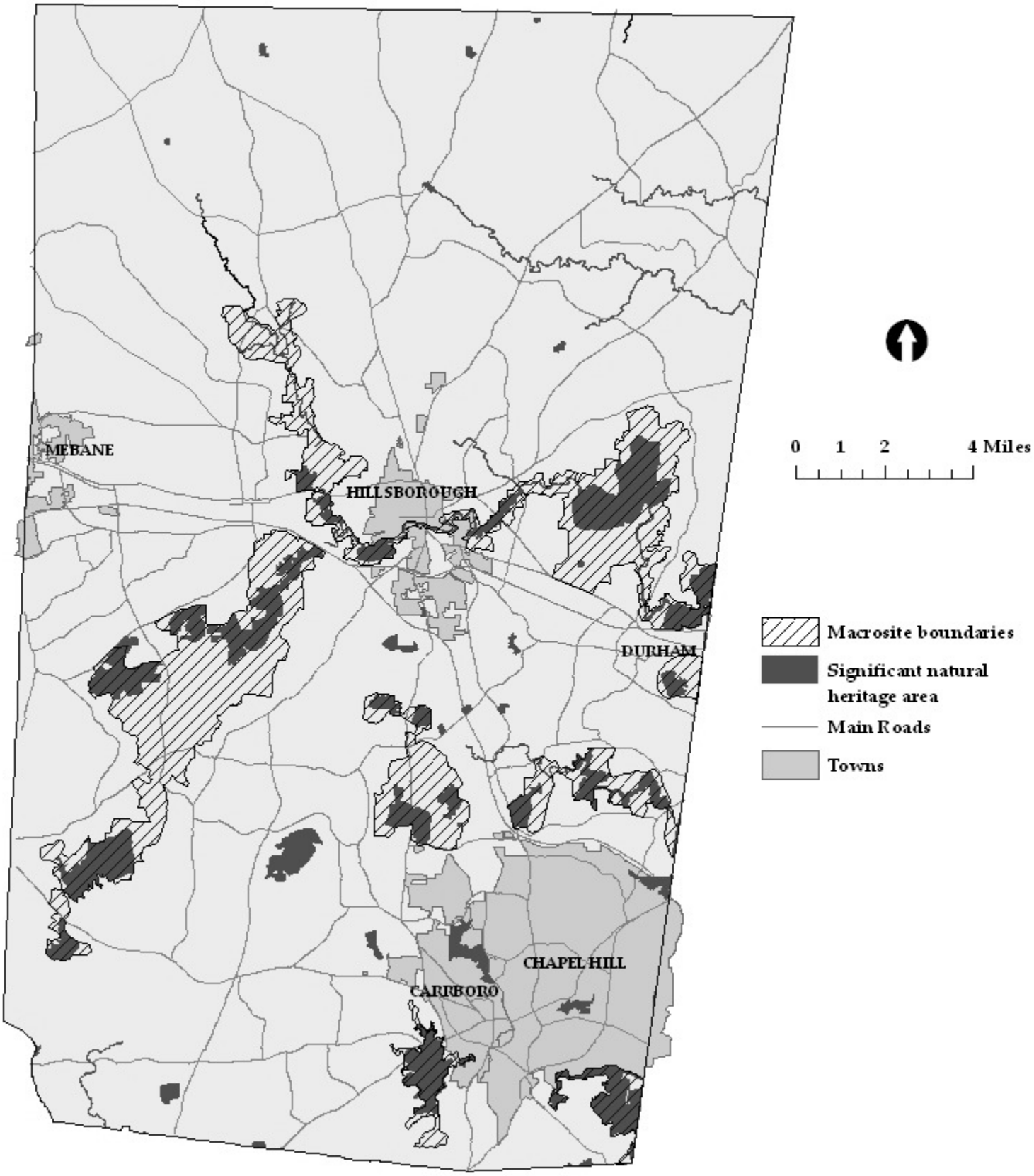
Source: Table 12 and Figure 12 — Orange County ERCD

Figure 13: Protected Lands as of 2008



Source: Figure 13— Orange County ERCD, prepared April 16, 2009

Figure 14: Natural Heritage Sites as of 2008



Source: Figure 14 — Orange County ERCD, prepared April 15, 2009

BIOLOGICAL RESOURCES

Acres of Protected Natural Heritage Sites

Why the indicator was selected

Natural areas provide habitats for native plant and animal species and can also serve as recreational and scenic places for Orange County residents. The first *Inventory of the Natural Areas and Wildlife Habitats of Orange County, North Carolina* was published in 1988. That inventory identified significant natural areas (also known as "Natural Heritage sites") recognized by the North Carolina Natural Heritage Program. Many sites include unique and exemplary habitats that are critical to support rare animals, plants and ecosystems. An update to the 1988 Inventory was completed in 2004, resulting in changes to many site boundaries. Some Natural Heritage sites were reduced in size due to development activities while other sites were enlarged.

Orange County, through its Lands Legacy Program, works with its conservation partners to monitor and protect Natural Heritage sites. Site management is, however, currently beyond the scope of the Program.

How the indicator was measured

Table 13 provides an overview of the Natural Heritage sites that have been permanently or partially protected over time in Orange County. Data were collected from organizations active in land conservation throughout the county. Figure 14 shows where these important Natural Heritage sites are located within the county.

The trend in Orange County

IMPROVING

Since the last *State of the Environment* report (2004), another 700 acres of land within Natural Heritage sites were permanently protected, including natural areas located along New Hope Creek, Bolin Creek, Morgan Creek and the Eno River.

Figure 15 shows that just over half (61% or 6,206 acres) of the county's 10,149 acres of Natural Heritage sites are either permanently or partially protected. Approximately 3,950 acres of these natural areas remain unprotected and at risk to future development.

Recommendations

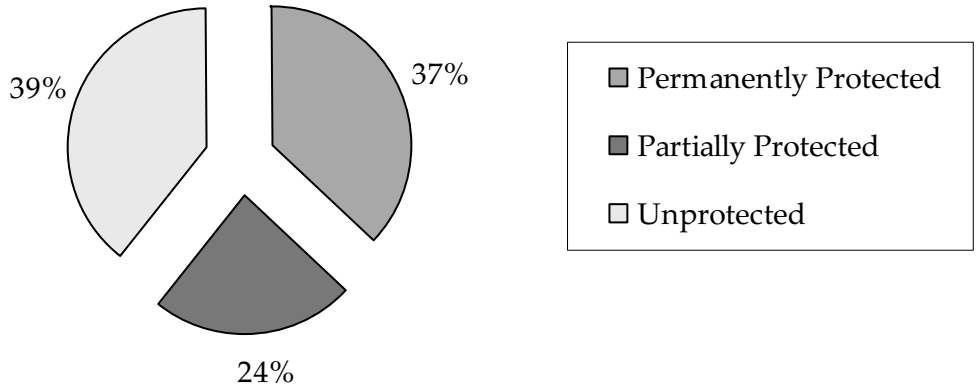
To support a sustainable future, Orange County should:

- Ensure that any Natural Heritage sites located on County-owned lands are protected with adequate ecosystem management and stewardship;
- Work with landowners and other partners to protect all Natural Heritage sites of national or state significance;
- Discourage or prohibit development that would cause adverse impacts to Natural Heritage sites; and
- Conduct more frequent updates to the county's inventory of natural areas and wildlife habitat and include previously unexplored areas of the county.

Table 13: Acres of Protected Natural Heritage Sites as of 2008

Permanently Protected Lands		Acreage by Acquisition Period					
Organization	**Type**	**Pre-1981**	**1981-90**	**1991-2000**	**2000-04**	**2005-08**	**TOTALS**
Botanical Garden Foundation	Nonprofit		16	75			91
Conservation Trust for NC	Nonprofit			141			141
Eno River Association	Nonprofit			1		4	5
Orange County (Lands Legacy Program)	Local Government			63	25	1	89
OWASA	Utility	29	984	158	3	12	1,186
Eno River State Park	State Government	579	371	267	595	2	1,814
Occaneechi Mountain State Natural Area	State Government			53		51	104
Triangle Land Conservancy	Nonprofit		5	198	89		292
US Army Corps of Engineers	Federal Government	82					82
	SUB TOTAL	**690**	**1,376**	**956**	**712**	**70**	**3,804**
Partially Protected Lands		**Acreage by Acquisition Period**					
Owner		**Pre-1981**	**1981-90**	**1991-2000**	**2000-04**	**2005-08**	**TOTALS**
Organization	**Type**						
Town of Chapel Hill	Local Government	3		36	20		59
City of Durham	Local Government			9			9
Town of Hillsborough	Local Government		27	2			29
Moorefields Foundation	Private		4				4
Orange County (Lands Legacy Program)	Local Government	67		63	50	7	187
Duke University (Duke Forest)	Private University	488	92	579	9		1,168
Classical American Homes Preservation Trust	Private			56			56
University of North Carolina at Chapel Hill	Public University	116	722	52			890
	SUB TOTAL	**674**	**845**	**797**	**79**	**7**	**2,402**
TOTAL ACRES OF PROTECTED NATURAL HERITAGE SITES							**6,206**
TOTAL ACRES OF NATURAL HERITAGE SITES IN ORANGE COUNTY							**10,149**

Figure 15: Percent of Protected Natural Heritage Sites as of 2008



Source: Table 13 and Figure 15 — Orange County ERCD

BIOLOGICAL RESOURCES

Prime Forest

Why the indicator was selected

Prime forests are defined as largely undisturbed tracts of hardwood forest and mixed hardwood-pine forest. These types of forests were prominent in the pre-European settlement landscape of Orange County and those that remain provide habitat for many indigenous plant and animal species that are restricted to hardwood forest habitats. In the past 25 years, the county has lost as much as 25% of its prime forest while many other forested areas have become fragmented to the point where they can no longer support or accommodate species diversity[7]. Mature forests dominated by oaks, hickories and other hardwoods are critical habitat for many native species such as the Wood Thrush and the Hooded Warbler. These forests also serve Orange County's human population by improving air quality, water quality and by mitigating flooding.

How the indicator was measured

Orange County first mapped the size and distribution of its prime forest using aerial photographs from 1988. Those data were further refined in 1999 to identify forested lands most suitable as wildlife habitat, defined as hardwood forests larger than 40 acres in land area. Updated versions of digitized forest cover were completed recently using aerial photography from 2003 and 2008. Figure 16 is a qualitative comparison of prime forest cover in 1988 and 2008.

The trend in Orange County

INDETERMINATE

In 1988, Orange County had about 71,000 acres of prime forest (28% of the total land area). New mapping and analysis of prime forest was not sufficiently accurate to estimate the loss of prime forest since 1988 but Figure 16 illustrates gross changes in prime forest cover between 1988 and 2008. Forest loss over this 20-year period has been largely due to commercial timber harvesting and new development.

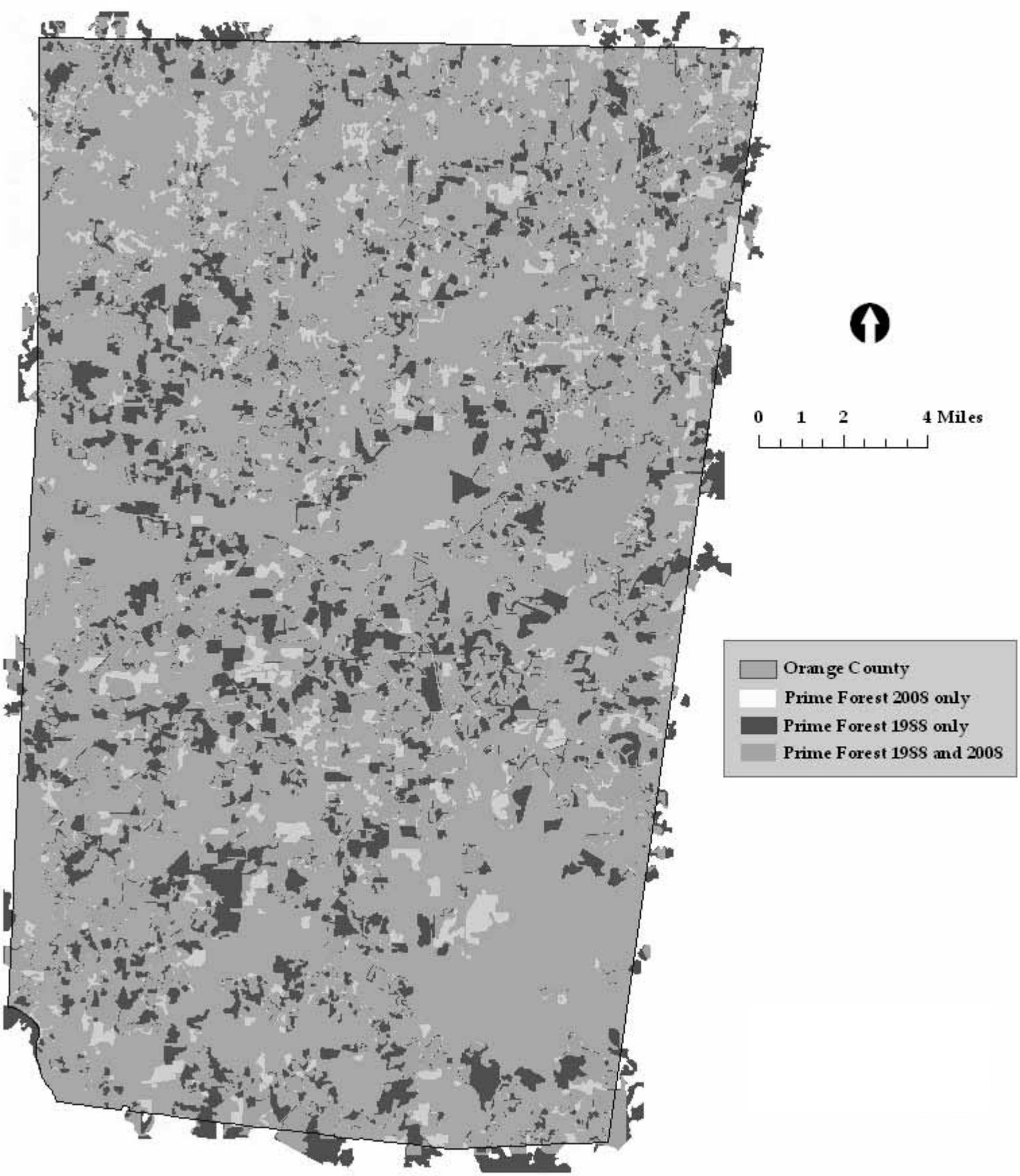
Recommendations

To support a sustainable future, Orange County should:

- Develop a more detailed and consistent methodology for monitoring changes in forest cover throughout the county and specifically the extant of mature hardwood forest;
- Encourage forest best management practices on both public and private land that minimize disruption and fragmentation of intact hardwood forests and harvesting in stream buffers and riparian habitats;
- Intensify efforts to protect significant portions of the remaining hardwood and mixed hardwood-pine forests. Primary means should include conservation easements and outright purchases of land with other partners; and
- Protect connectivity between protected forest tracts and buffer these sites from disturbance-generating activities (e.g., encroachment by invasive plant species and development).

[7] *A Landscape with Wildlife for Orange County, Parts 1 and 2* (Triangle Land Conservancy, 1997 & 1999)

Figure 16: Orange County Forest Cover Change from 1988 to 2008



Source: Figure 16 — Orange County ERCD, prepared May 11, 2009

BIOLOGICAL RESOURCES

Acres within the Present Use Value Program

Why the indicator was selected

The State of North Carolina authorizes Orange County and other local governments to reduce local property tax valuations for land classified as agricultural, horticultural and forestland (NCGS 105-277.2 *et seq*.). Taxing these "working lands" based on the **current** use (e.g., farming) rather than the **potential** use (e.g., residential development) helps to keep the land more affordable and productive. Lower taxes reduces the pressure to sell the land for development. The Present Use Value Program enables landowners to provide essential products for the community while also encouraging the preservation of undeveloped areas in Orange County.

How the indicator was measured

The Present Use Value (PUV) program is administered by the Orange County Tax Assessor's Office, which maintains a database of properties participating in the program. Table 14 lists the number of properties that have been enrolled in the PUV program since 1993. The table identifies land in the three categories—Agriculture, Forestry and Horticulture. A fourth category, *Wildlife Conservation*, was added by the General Assembly in July 2008. Enrollment in the program using the new Wildlife Conservation category will begin in 2010.

The trend in Orange County

DECLINING

Table 14 shows that about 40 percent of the land in Orange County is enrolled in the PUV program. Figure 17 shows that between 1993 and 2008, the acreage enrolled in the Agriculture and Forestry categories decreased (4,000 and 6,000 acres respectively) while the acreage within the Horticulture category increased. Horticulture use makes up only a small portion of the land enrolled in the program (less than 200 acres).

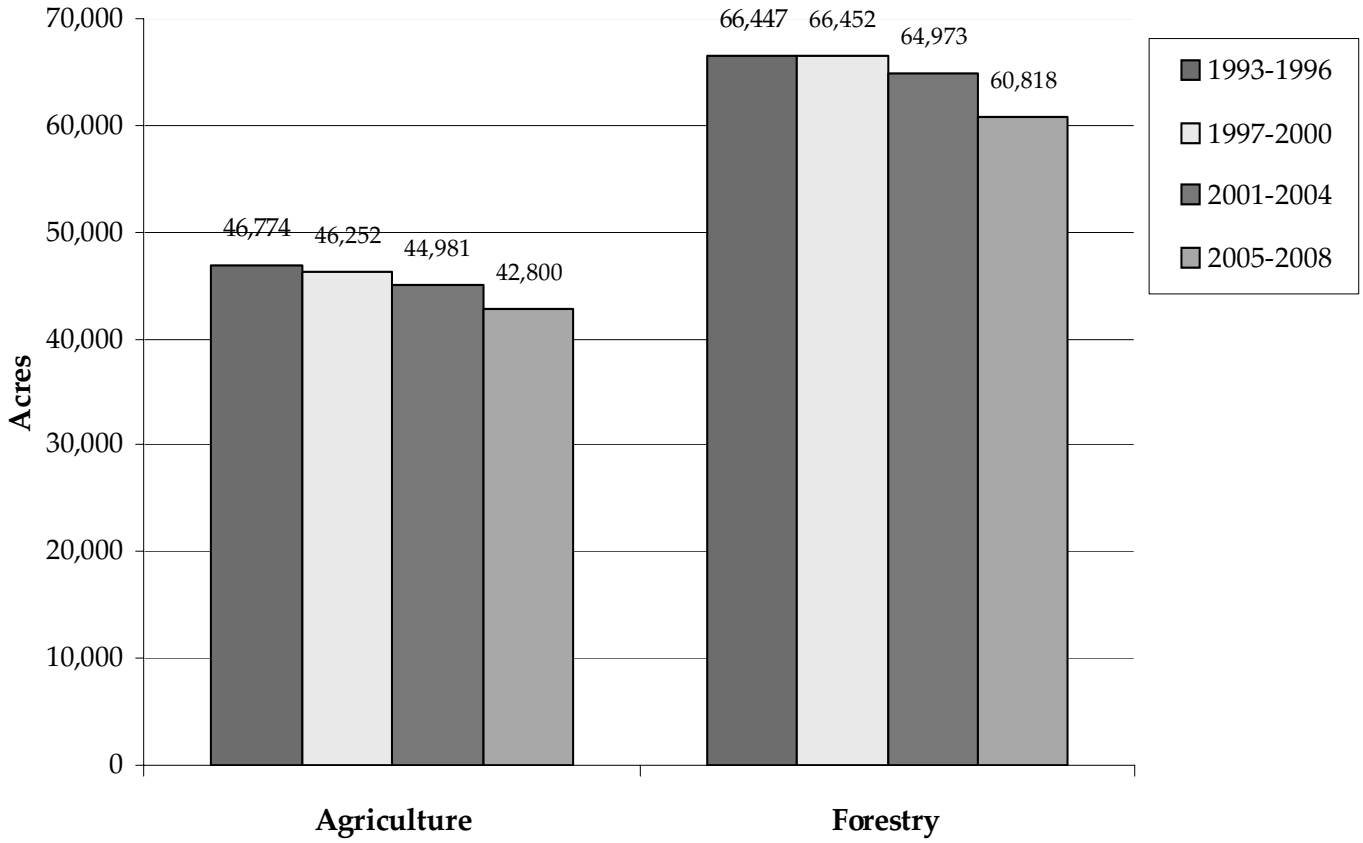
The PUV program provides farm and forest landowners with significant financial incentives to maintain the productivity and the rural nature of important resource lands. In 2002, Orange County supported state legislation that would allow farms and forestland protected by conservation easements to be exempt from having to pay deferred taxes if the land were withdrawn from the PUV program. The N.C. General Assembly enacted that change in 2008.

Recommendations

To support a sustainable future, Orange County should:

- Monitor enrolled lands to ensure their compliance with the PUV program;
- Incorporate the new Wildlife Conservation category in the PUV program and educate the public about this new opportunity; and
- Educate landowners about their eligibility for the PUV program.

Figure 17: Acres of Land in the Present Use Value Program, 1993-2008



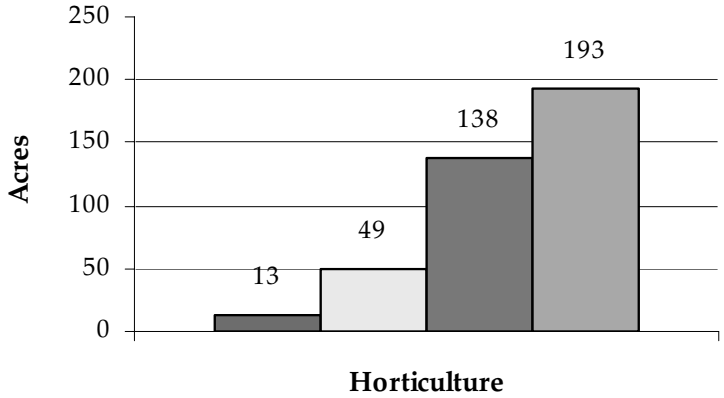


Table 14: Total Acreage in the Present Use Value Program, 1993-2008*

	1993-1996			1997-2000			2001 - 2004			2004-2008**		
Land Use	Number of Parcels	Acreage	% of Total Land	Number of Parcels	Acreage	% of Total Land	Number of Parcels	Acreage	% of Total Land	Number of Parcels	Acreage	% of Total Land
Agriculture	1,676	46,774	18.2%	1,721	46,252	18.0%	1,742	44,981	17.5%	1,799	42,311	16.5%
Forestry	1,931	66,447	25.9%	1,975	66,452	25.9%	2,096	64,973	25.3%	2,224	60,963	23.7%
Horticulture	2	13	0.0%	6	49	0.0%	17	138	0.1%	28	211	0.1%
County Totals	37,906	256,800	44.1%	41,670	256,800	43.9%	45,043	256,800	42.9%	50,969	256,800	40.3%

* Table 14 excludes land in the county that is not measured in acres such as subdivision plots. Some parcels are included in more than one category, such as both agriculture and forestry. The *State of the Environment* 2004 report presented incorrect data for this indicator. The data were corrected for this report. ** These data includes parcels through February 9, 2009.
Source: Figure 17 and Table 14 — Orange County Tax Assessor

BIOLOGICAL RESOURCES

Status of Rare Plants and Animals

Why the indicator was selected

Within an ecosystem there is a complex interrelationship among organisms. The loss of one species (plant or animal) can have a severe impact on the health and survival of other species. When one species is extirpated (eliminated) from a region, there is a loss of biodiversity, which results in a decrease in the number and diversity of species and ecosystems.

How the indicator was measured

The status of rare plants and animals throughout North Carolina is monitored by the North Carolina Natural Heritage Program (NHP). The NHP maintains a current list of important species for each county. The status of Orange County's rare plant and animal species is provided in Table 15.

Federal status is determined by the U.S. Fish and Wildlife Service as required under the federal Endangered Species Act (i.e., species of concern, threatened or endangered). State status is determined by the State Plant Conservation Program and the Endangered Wildlife Program of the North Carolina Wildlife Resources Commission. The far right-hand column of Table 15 (Last Observed) denotes when the species was last documented in Orange County. A **Historic** species was last observed more than 20 years ago. **Current** species have been spotted within the past 20 years. **Obscure** indicates the date the species was last observed is uncertain.

The trend in Orange County

INDETERMINATE (likely declining)

The development of land and its impacts to surrounding natural areas (i.e., habitat fragmentation, increased water runoff and contamination) results in the loss of habitat for native species. Since 2004, NHP has added five new species of nonvascular plants, four invertebrates (one insect and three mollusks) and seven vascular plants to their database of rare plant and animal species. In addition, NHP has reclassified the Carolina Fatmucket mollusk as an Eastern Lampmussel mollusk, removed the Pinewoods Shiner and Lewis's Heartleaf from the database and placed them on their watch list and removed the Small Whorled Pogonia due to lack of information.

Recommendations

To support a sustainable future, Orange County should:

- Support additional fieldwork to document and recommend management strategies to protect rare plant and animal species in the County;
- Understand and communicate that loss of habitat and the spread of invasive species are the major causes of native species extirpation and local extinction. Protect enough land in and around biologically significant areas and enough connections between these areas, to allow for the maintenance of native wildlife and plant populations and their functional relationships;
- Use only regionally native species for landscaping on County property; and
- Develop a method of monitoring non-rare indicator species as a way to measure the "state of biodiversity."

Table 15: Status of Orange County's Rare Plants and Animals as of 2008

	Common Name	Scientific Name	Federal Status	State Status	Last Observed
Assemblage	Colonial Wading Bird Colony	*none*	N	N	Current
Vertebrates	**Amphibians**				
	Four-toed Salamander	*Hemidactylium scutatum*	N	SC	Current
	Neuse River Waterdog	*Necturus lewisi*	N	SC	Current
	Birds				
	Sharp-shinned Hawk	*Accipiter striatus*	N	SR	Historic
	Bald Eagle	*Haliaeetus leucocephalus*	T	T	Current
	Red-cockaded Woodpecker	*Picoides borealis*	E	E	Historic
	Warbling Vireo	*Vireo gilvus*	N	SR	Current
	Fishes				
	Roanoke Bass	*Ambloplites cavifrons*	N	SR	Current
	Carolina Darter	*Etheostoma collis pop*	SC	SC	Historic
Nonvascular Plants	Closter's Brook-hypnum	*Hygrohypnum closteri*	N	SR	Historic
	A Thread Cedar Moss	*Cryphaea nervosa*	N	T	Current
	Hair Claw Moss	*Dichelyma capillaceum*	N	P	Current
	Welch's Fontinalis Moss	*Fontinalis welchiana*	N	T	Current
	A Liverwort	*Plagiochila ludoviciana*	N	T	Current
	Papillose Tortula	*Tortula papillosa*	N	P	Current
Invertebrates	**Crustacean**				
	Carolina Well Diacyclops	*Diacyclops jeanneli putei*	N	SR	Historic
	Carolina Ladle Crayfish	*Cambarus davidi*	N	SR	Current
	Insect		N		
	Golden Banded-skipper	*Autochton cellus*	N	SR	Historic
	Northern Oak Hairstreak	*Fixsenia favonius ontario*	N	SR	Current
	Giant Swallowtail	*Papilio cresphontes*	N	SR	Historic
	Splendid Clubtail	*Gomphus lineatifrons*	N	SR	Obscure
	Mollusk				
	Dwarf Wedgemussel	*Alasmidonta heterodon*	E	E	Current
	Triangle Floater	*Alasmidonta undulata*	N	T	Current
	Brook Floater	*Alasmidonta varicosa*	SC	E	Current
	Atlantic Pigtoe	*Fusconaia masoni*	SC	E	Current
	Yellow Lampmussel	*Lampsilis cariosa*	SC	E	Current
	Eastern Lampmussel	*Lampsilis radiata*	N	N	Current
	Chameleon Lampmussel	*Lampsilis sp.2*	N	SR	Current
	Eastern Creekshell	*Villosa delumbis*	N	SR	Obscure
	Carolina Creekshell	*Villosa vaughaniana*	SC	E	Current
	Green Floater	*Lasmigona subviridis*	SC	E	Current
	Creeper	*Strophitus undulatus*	N	T	Current
	Savannah Lilliput	*Toxolasma pullus*	SC	E	Current
	Notched Rainbow	*Villosa constricta*	N	SC	Current

N = None SR = Significantly Rare SC = Species of Concern E = Endangered T = Threatened P = Proposed

Table 15 continued: Status of Orange County's Rare Plants and Animals, 2008

Vascular Plants	Southern Anemone	*Anemone berlandieri*	N	SR	Current
	Bradley's Spleenwort	*Asplenium bradleyi*	N	SR	Current
	Prairie Blue Wild Indigo	*Baptisia minor*	N	T	Obscure
	American Barberry	*Berberis canadensis*	N	SR	Historic
	American Bluehearts	*Buchnera americana*	N	SR	Historic
	Douglass's Bittercress	*Cardamine douglassii*	N	SR	Obscure
	Bush's Sedge	*Carex bushii*	N	SR	Current
	Wood's Sedge	*Carex woodii*	N	SR	Historic
	Piedmont Horsebalm	*Collinsonia tuberosa*	N	SR	Historic
	Creamy Tick-trefoil	*Desmodium ochroleucum*	SC	SR	Historic
	A Witch Grass	*Dichanthalium annulum*	N	SR	Historic
	Eastern Shooting Star	*Dodecatheon meadia* var *meadia*	N	SR	Historic
	Smooth Coneflower	*Echinacea laevigata*	E	E	Historic
	Eastern Isopyrum	*Enemion biternatum*	N	SR	Historic
	Godfrey's Thoroughwort	*Eupatorium godfreyanum*	N	SR	Historic
	Large Witch-alder	*Fothergilla major*	N	SR	Current
	Pondberry	*Lindera melissifolia*	E	E	Historic
	Southern Loosestrife	*Lysimachia tonsa*	N	P	Historic
	Heller's Rabbit Tobacco	*Gnaphalium helleri* var *helleri*	N	SR	Historic
	Crested Coralroot	*Hexalectris spicata*	N	SR	Current
	Earle's Blazing Star	*Liatris squarrulosa*	N	SR	Historic
	Glade Milkvine	*Matelea decipiens*	N	SR	Historic
	Sweet Pinesap	*Monotropsis odorata*	SC	SR	Current
	Yellow Giant-hyssop	*Agastache nepetoides*	N	P	Current
	Grey Dogwood	*Cornus racemosa*	N	P	Current
	Narrow Leaf Aster	*Symphyotrichum laeve* var *concinnum*	N	P	Historic
	Smooth Blue Aster	*Syphyotrichum laeve* var *laeve*	N	P	Historic
	Wiry Panic Grass	*Panicum flexile*	N	SR	Historic
	Glade Wild Quinine	*Parthenium auriculatum*	N	SR	Historic
	Buttercup Phacelia	*Phacelia covillei*	SC	T	Current
	Purple Fringeless Orchid	*Platanthera peramoena*	N	SR	Current
	Indian Physic	*Porteranthus stipulatus*	N	SR	Historic
	Torrey's Mountain-mint	*Pycnanthemum torrei*	SC	SR	Current
	Water-plantain Spearwort	*Ranunculus ambigens*	N	SR	Historic
	Michaux's Sumac	*Rhus michauxii*	E	E	Historic
	Pursh's Wild-petunia	*Reullia purshiana*	N	SR	Historic
	Southern Skullcap	*Scutellaria australis*	N	SR	Historic
	Shale-barren Skullcap	*Scutellaria leonardii*	N	SR	Current
	Appalachian Golden-banner	*Thermopsis mollis sensu stricto*	N	SR	Historic
	Glade Bluecurls	*Trichostema brachiatum*	N	SR	Historic
	Chapman's Redtop	*Tridens chapmani*	N	P	Historic

N = None SR = Significantly Rare SC = Species of Concern E = Endangered T= Threatened P = Proposed

Significantly Rare—indicates the need for population monitoring and conservation action for species not currently listed as Endangered, Threatened or Special Concern. *Species of Concern*—species for which there was some evidence of vulnerability but for which there were not enough data to support listing as Endangered or Threatened. *Endangered*—a species that is in danger of extinction throughout all or a significant portion of its range. *Threatened*—a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Source: Table 15 — NC Natural Heritage Program.

BIOLOGICAL RESOURCES

Emerging Concern: Land Application of Biosolids

What are Biosolids?

The U.S. Environmental Protection Agency (EPA) defines sewage sludge as "*the solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a* [wastewater] *treatment* [facility]." Biosolids are produced from sewage sludge, primarily by reducing the level of living pathogens (i.e. live viruses, bacteria, protozoa and helminth worms) with anaerobic digestion in combination with heat. Although the terms biosolids and sewage sludge are often used interchangeably, biosolids are only that portion of sewage sludge that has undergone adequate treatment to permit their application to land. The EPA's Standards for the Disposal of Sewage Sludge "the *503 Rules*" define two classifications of biosolids based on pathogen content:

1. ***Class A*** biosolids, which have been treated to reduce pathogens to a very low level such that access to application sites does not need to be limited. They are the highest quality material with few regulatory constraints affecting their use. Treatments to produce Class A biosolids generally do not affect the content of metals or organic chemicals in the biosolids; however, Class A biosolids must meet one of the following pathogen reduction requirements:
    - The density of fecal coliform bacteria in the biosolids must be less than 1,000 most probable numbers (MPN) per gram of total solids on a dry-weight basis, or
    - The density of Salmonells species bacteria in the biosolids must be less than 3 MPN per gram of total solids on a dry-weight basis.
2. ***Class B*** biosolids have been treated to a lesser degree, to reduce pathogens to a level that is safe for application on land with an initial period of limited public access following the application. The pathogen content of Class B bio solids has been significantly reduced but this content does not need to be at very low levels. For this reason Class B biosolids have additional land use restrictions and land management practices where applied and are restricted to private agricultural land, forest lands, reclamation sites and other areas where there is limited potential for public exposure.

The most cost effective and most common means of biosolids disposal is land application (other common disposal options include incineration or solid waste landfill disposal)[8]. In North Carolina, State-level regulations and a State-level permitting process (managed by the Division of Water Quality within the N.C. Department of Environment and Natural Resources), are intended to reduce environmental and public health risks associated with the land application of biosolids. The degree of biosolids treatment determines the level of restrictions required during and after the land application process.

Biosolids and Orange County Land

Land application is a biosolids disposal technique widely used in Orange County with over 3,000 acres permitted to receive this waste material from OWASA, Hillsborough, Mebane, Durham, Cary and Burlington wastewater treatment facilities (refer to Figure 18 for a map of active application sites in Orange County). There are additional sites throughout the county that were formerly used for biosolids disposal and are now considered inactive sites (labeled as 'inactive sites' in Figure 18). Preliminary data compiled by the UNC-CH School of Public Health indicates that permitted application sites in the county are receiving upwards of 17 million gallons of biosolids per year, which equals an average rate of 5,000 gallons per acre per year.

In December 2006, the Orange County Health Department contracted with the School of Public Health to complete a pilot study of biosolids application sites and methods of measuring potential effects of these sites on public health and the environment. Past drought conditions and difficulty receiving landowner permission to sample on private property have presented significant challenges and caused delays in completing this study.

[8] EPA Biosolids information page http://www.epa.gov/OW-OWM.html/mtb/biosolids/index.htm#pubs.

Due to the additional expense of treating sewage sludge to Class A standards, not all wastewater treatment facilities applying biosolids to Orange County lands are producing Class A biosolids, thus the majority of biosolids being spread in Orange County are Class B. Therefore, carefully managed land application practices and isolation controls are critical to reduce the risk of adverse human health and environmental effects during and after land application of this waste material.

Orange County is the only county in North Carolina that maintains local oversight of biosolids application activities. In the early 1990s, the Orange County Board of Health implemented additional recommended practices and reporting requirements for several types of wastewater disposal, including the disposal of biosolids in the county. Initial inspections of biosolids application sites and practices, which were completed by the Orange County Environmental Health Services staff, revealed regular non-compliance with the permitted application procedures. Some of the utilities which generate biosolids continue to be reluctant to report their disposal activities in the county: thus their level of compliance with County and State regulations remains unknown[9].

Ongoing Concerns and Recommendations

A 2005 report from the N.C. Department of Health and Human Services discussed the risks to human health from biosolids and recommended that the State enact additional protective measures governing the land application of biosolids. These recommendations were based on reported health and odor complaints, identified groundwater contamination in areas of biosolids application and a review of current scientific studies of potential health effects related to the land application of biosolids. These recommendations include:

- Establishing a monitoring requirement for wells located in the vicinity of land application sites.
- Increasing (doubling) the current application setback distance requirements from adjacent properties.
- Developing a surveillance program to determine adverse health effects in humans and animals living near application sites.
- Develop specific environmental siting criteria, based on current scientific information, to control the location of application sites.

While several organizations have identified an extensive list of organic and inorganic pollutants found in biosolids, current EPA regulations require the State to monitor for only nine inorganic metal pollutants. In addition, there are currently no monitoring requirements to determine exposure levels to humans or grazing animals in and around application sites nor to monitor for the presence and concentration of pharmaceutical, organic, or inorganic wastewater contaminants in surface water, groundwater, or air in the vicinity of the disposal sites.

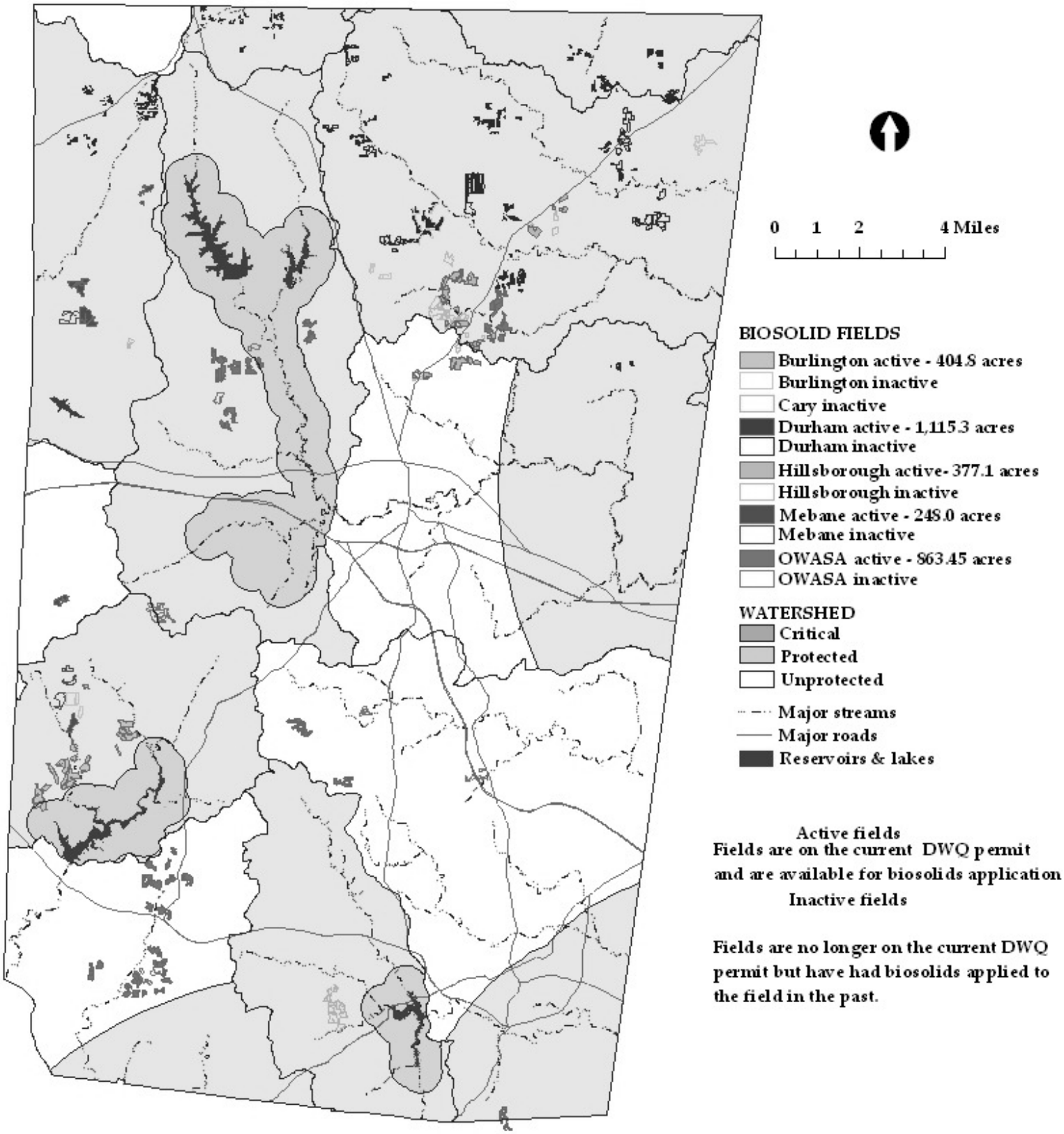
In an April 2009 memorandum, the CFE recommended to the Orange County Board of County Commissioners the formation of a multi-disciplinary task force to examine the environmental and public health issues related to biosolids application in the county. The following issues are of particular interest to the CFE and are recommended for further evaluation:

- The human health and environmental risks associated with the unknown composition and concentration of contaminants in biosolids being applied to land in Orange County.
- The lack of public information/notification for sites where biosolids are being applied.
- The question of whether N.C. counties should have the authority to apply additional controls and land use restrictions to sites receiving biosolids. Currently the biosolids application permitting process is governed by the State and the State's standards supercede County zoning regulations and protective practices.
- While the County's watershed zoning regulations prohibit the disposal of sewage sludge in critical areas of protected watersheds, due to a difference between the State's and the County's definition of these areas, lands are currently permitted to receive biosolids within portions of the County's critical areas of protected watersheds. Land application restrictions within these watersheds and critical areas are important to protect these sources of drinking water.
- Collins Creek is the only stream located outside of the urban areas of Chapel Hill and Carrboro which has recently been classified as 'impaired water' by the N.C. Division of Water Quality. This stream is located in a watershed that contains land permitted to receive biosolids. It is important to determine if biosolids are contributing to the decline of water quality in this stream.

[9] Orange County Health Director Memorandum regarding the Biosolids Program in Orange County (March 2008)

[*] Additional information on current research related to the chemical composition of sewage sludge and biosolids can be found at the EPA's website. The 2009 Targeted National Sewage Sludge Survey Report is located at http://www.epa.gov/waterscience/biosolids/tnsss-overview.html.

Figure 18: Biosolids Application Sites as of 2008



Sources: Figure 18 — Orange County ERCD and Environmental Health Department, prepared May 28, 2009

Canoeing on Cane Creek Reservoir

Freshwater mussel shell from New Hope Creek

Looking upriver on the Eno River
(Photo courtesy of the Eno River Association)

WATER RESOURCES

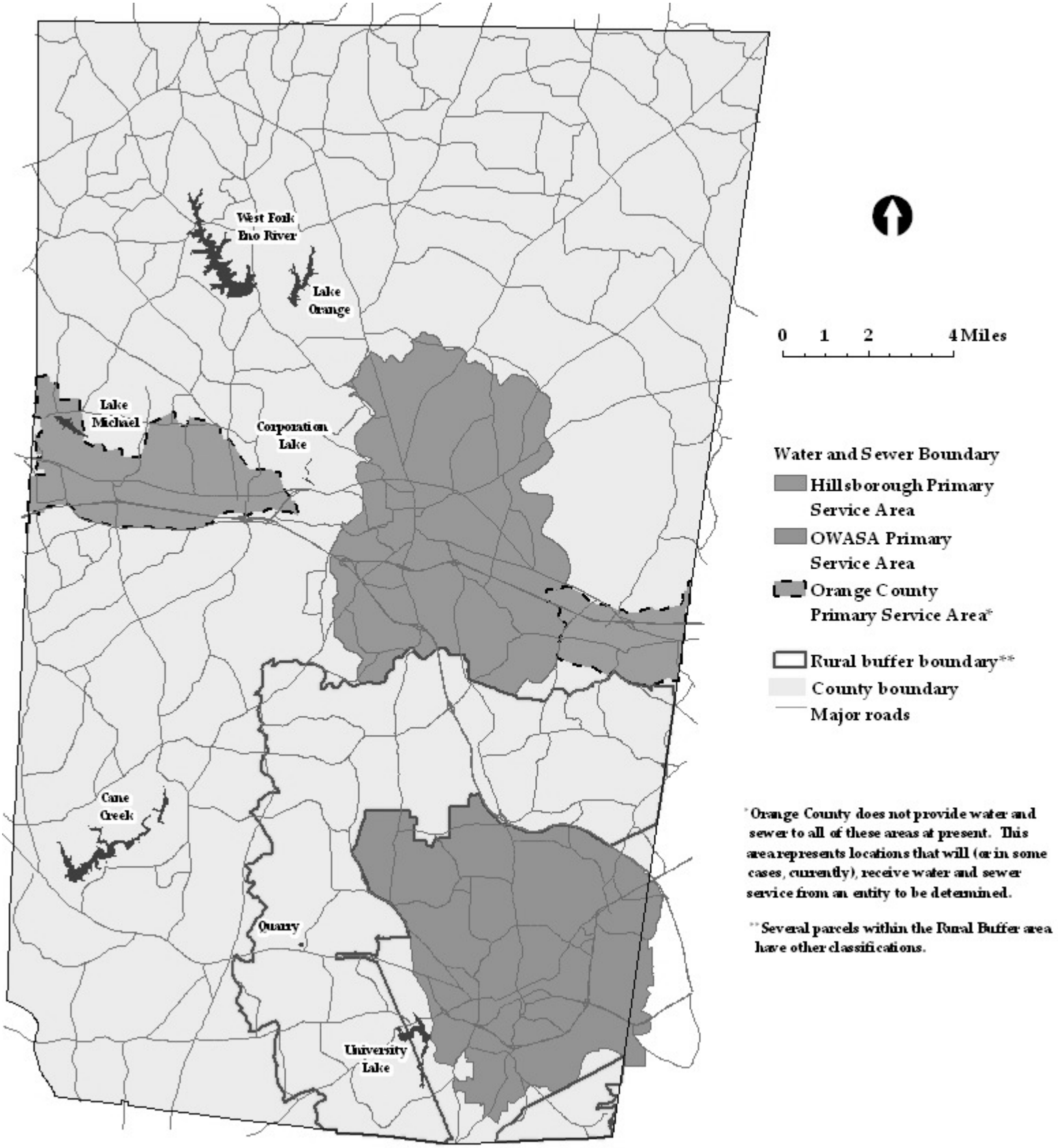
It is essential that the citizens of Orange County have access to an adequate supply of potable water whether it is groundwater or surface water provided by a water supplier. This concept is embraced by the Natural and Cultural Systems Element of the 2008 Orange County Comprehensive Plan, which includes a goal of having a "Sustainable quality and quantity of ground and surface water resources," (Goal 6). Most of the county's populace obtains their water from the Orange Water and Sewer Authority (OWASA), the Orange-Alamance Water System (OAWS), the City of Mebane, the Town of Hillsborough or the City of Durham. OWASA supplies water to the citizens of Chapel Hill, Carrboro and a portion of the county from two reservoirs, University Lake and Cane Creek Reservoir, with a former stone quarry to become available as a future storage facility (see Figure 19). OAWS supplies water to Mebane and surrounding rural areas while the City of Durham supplies water to a limited area of the eastern portion of the county along the I-85 corridor. OAWS obtains their water from the Eno River (via Corporation Lake), four water supply wells and, when needed, purchases water from the Town of Haw River (which purchases their water from the City of Burlington). OAWS also has the capability to purchase water from the City of Mebane, the City of Graham and the Town of Hillsborough via inter-connections. The Town of Hillsborough utilizes the West Fork Eno River Reservoir via Lake Ben Johnson to supply water to the residents of Hillsborough. The City of Mebane obtains their water from the Graham-Mebane Reservoir. Nearly 40 percent of the population of Orange County does not have access to surface water and is instead reliant on groundwater for their water.

The reliance on local surface water and groundwater has resulted in the County's adoption of a range of strategies and policies to protect these important sources of water. In 1981 critical areas in the Cane Creek, Upper Eno and University Lake watersheds were designated to reduce the threat of development to these surface water reservoirs (Figure 20). The County formed a Water Resources Committee in 1992 to begin to examine groundwater resources in Orange County. Subsequently, Orange County partnered with the United States Geological Survey (USGS) to complete three reports describing the county's hydrogeologic setting. This information is important for understanding the quantity and quality of groundwater available in the county. In 2005 the Water Resources Initiative which detailed several critical water resource issues, along with recommendations to address those issues, was developed by the Commission for the Environment and adopted by the Orange County Board of County Commissioners. Water resource protection measures which have been implemented include the updated well location and construction regulations adopted in 2008 by the Environmental Health Division of the County Health Department. The inspection of new wells, the repair and proper abandonment of existing wells and the minimum requirements for casing, materials and locating wells, are measures which protect the groundwater supply of county residents. Most recently, Orange County hired a Water Resources Coordinator in 2008 to work on surface water and groundwater resource issues affecting the county.

The citizens of Orange County have markedly reduced their consumption of municipal water as a result of the droughts of 2002 and 2007-2008. OWASA reports that per-household residential consumption of their water has decreased by more than 10 percent since 2001. The 2007 demand for OWASA water is less than 20 percent of what was projected in their 2001 Master Plan. This reduction in demand has caused local water utilities to revise their plans and projections for the future. Continued conservation and wise utilization of our precious water resources is important to prevent future water supply shortages.

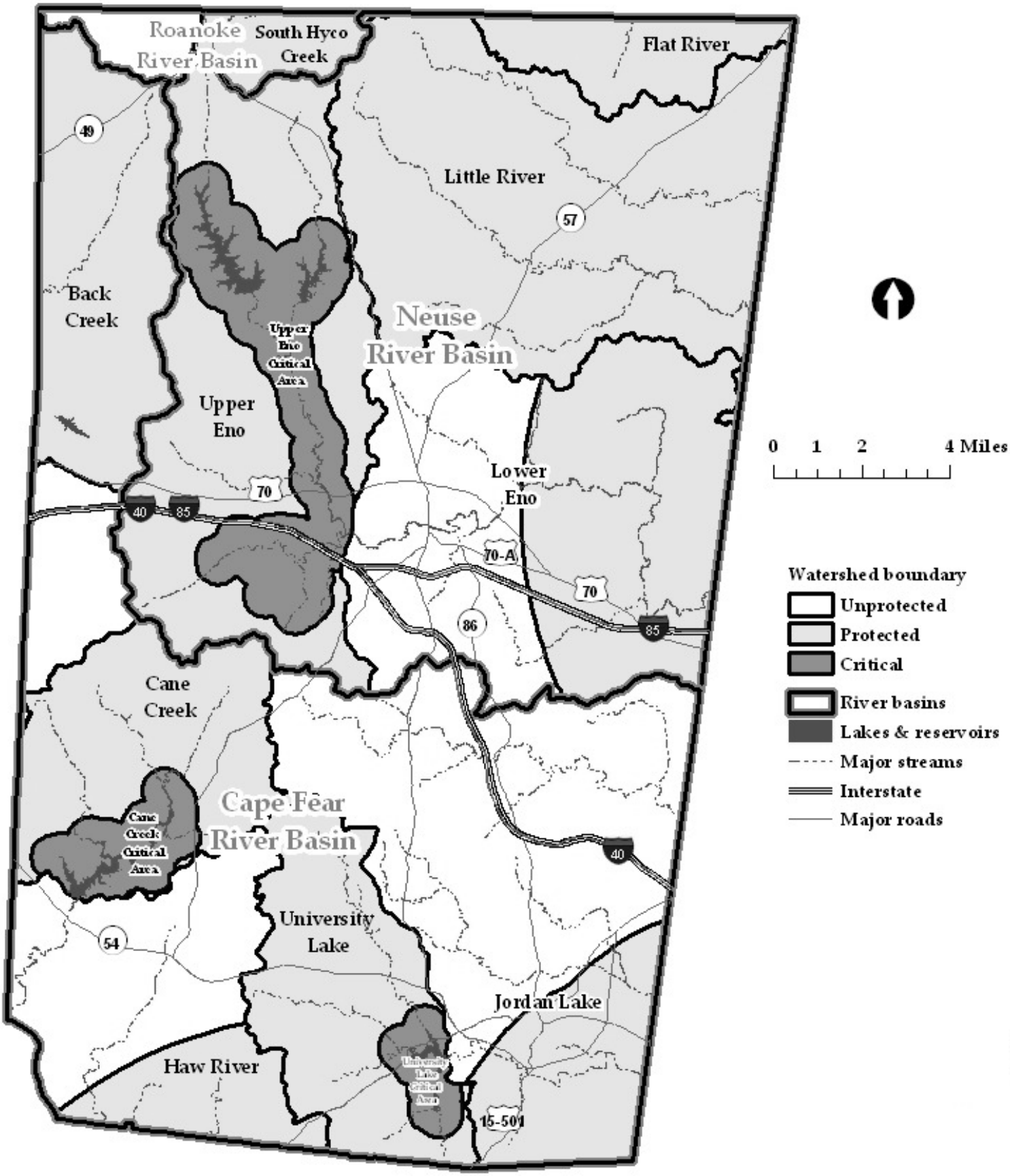
The water resources section of this report includes a number of important indicators to track the status of different aspects of surface water and groundwater usage, quantity, quality and impairment. When combined, these indicators serve as an accurate assessment of the state of water resources in Orange County.

Figure 19: Water and Sewer Primary Service Areas
Planning and Boundary Agreement, 2001



Source: Figure 19 —Orange County ERCD, prepared August 5, 2009

Figure 20: Orange County Watersheds



Source: Figure 20—Orange County ERCD, prepared April 15, 2009

WATER RESOURCES

Water Usage

Why the indicator was selected

Clean water is a necessary resource that is renewable but at times is limited. A reliable supply of clean water is vital for public health, agricultural production and economic growth. To continue to provide a healthy environment as well as support sustainable growth in agriculture and industry, the water resources of Orange County must be managed carefully and appropriately.

How the indicator was measured

The self-reported data used in this section were provided by NCDENR - Division of Water Resources (DWR) and the U.S. Geological Survey (USGS). Table 16 shows the amount of water used within the county over a 20-year period as measured in millions of gallons per day (mgd) and demonstrates usage by the source of water: ground or surface. Table 17 tracks the average amount of water used per person from 1985 to 2005, reporting usage in gallons per day per person (g/d/p). For this table, g/d/p is calculated by dividing the total average amount of water used per day by the current population and includes all residential, commercial and industrial uses, which were reported to the USGS and DWR by the individual water providers. Table 16 lists the reported uses of water and the changes in usage over time. It is important to note that approximately 40 percent of the domestic water supply within the county comes from individual (private) water supply wells and is probably not accurately represented in the self-reported information presented herein.

The trend in Orange County

INCREASING

As the urban areas within the county continue to grow, the number of people relying on municipal water supplies increases. Most of this water supply comes from surface water. The available data on per capita water usage reveals that the amount of water used per person increased from 124 g/d/p in 1985 to 145 g/d/p in 2000, a 17 percent increase, but then declined to 128 g/d/p in 2005. The observed increase from 1985 to 2000 would have been higher if Flynt Fabrics, which used 1 mgd, had not closed in 2000. Total water usage, as shown in Table 17, increased by 47 percent from 1985 to 2005, a significant increase. It is likely that this increase is mainly due to population growth during the same interval, which increased by 42 percent. Trends of groundwater usage over time are hard to track, given the lack of comprehensive data. It is expected that the ongoing growth in the number of water supply wells that are present in the county (Table 20) likely mirrors growth in groundwater consumption.

Recommendations

To support a sustainable future, Orange County should:

- Continue to educate local citizens about the importance of conserving groundwater and surface water. Water conservation measures are readily available online on the OWASA and Orange County web sites.
- Create a network of groundwater observation wells to monitor and publicize how groundwater levels are affected by drought or other climactic events and to further characterize the hydrogeologic system. It is important to monitor the status of this resource because a large proportion of county residents rely on groundwater.

Table 16: Reported Water Usage (mgd), 1985-2005

	1985			1990			1995			2000			2005			
Type of Use	G	S	ST	G	S	ST	G	S	ST	G	S	ST	G	S	ST	% of Total
Municipal and Community	0.00	7.52	7.52	0.00	9.49	9.49	0.25	10.50	10.75	0.52	12.44	12.96	0.32	11.51	11.83	78%
Industry	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0%
Crop Irrigation	0.00	0.80	0.80	0.08	0.74	0.82	0.76	2.28	3.04	0.52	1.47	0.81	0.22	0.59	0.81	5%
Domestic use from wells	1.20	0.00	1.20	0.71	0.00	0.71	1.72	0.00	1.72	1.94	0.00	1.94	1.42	0.00	1.42	9%
Livestock Use	0.35	0.06	0.41	0.36	0.06	0.42	0.35	0.13	0.48	0.24	0.06	0.30	0.16	0.05	0.21	1%
Other*	0.15	0.24	0.39	0.12	0.30	0.42	0.03	0.00	0.03	0.30	0.88	1.18	0.20	0.67	0.87	6%
Total Use	**1.71**	**8.62**	**10.3**	**1.27**	**10.6**	**11.9**	**3.11**	**12.9**	**16**	**3.52**	**14.9**	**17.2**	**2.32**	**12.8**	**15.1**	**100%**

G—Groundwater S—Surface Water ST—Sub Total mgd– Millions Gallons per Day

* Other consists of water used for mining, commercial, golf course irrigation and aquaculture purposes.

Table 17: Percent Change in Water Usage (g/d/p), 1985-2005

	1985	1990	1995	2000[10, 11]	2005	% Change 1985-1990	% Change 1990-1995	% Change 1995-2000	% Change 2000-2005	% Change 1985-2005
Usage, mgd	10.3	11.9	16.0	17.2	15.1	14.8%	35.1%	7.3%	-12.0%	47.0%
Population	83,581	93,851	107,352	115,531	118,386	12.3%	14.4%	10.1%	2.5%	41.6%
g/d/p	124	127	149	149	128	2.2%	18.1%	-2.6%	-14.3%	2.9%

g/d/p— gallons per day per person

[10] The decrease in usage compared to 2000 is mainly attributed to the closing of Flynt Fabrics in 2000, which used 1 mgd. If Flynt Fabrics had remained open and continued to use the same amount of water as previously, the g/d/p would be 150 and the overall upward trend would have continued.

[11] Orange County's 2000 population figure was amended by the U.S. Census.

Source: Tables 16 and 17 — United States Geological Survey

WATER RESOURCES

Public Water System Safe Yields

Why the indicator was selected

The U.S. Environmental Protection Agency (EPA) defines a safe yield as "the annual amount of water that can be taken from a source of supply over a period of years without depleting the source beyond its abilities to be replenished naturally in 'wet' years." This statistic is a useful gauge for determining the resource storage capacity that is available within a water system.

How the indicator was measured

This indicator includes only the three largest water suppliers in Orange County (Orange Water and Sewer Authority (OWASA), Orange-Alamance Water System (OAWS) and the Town of Hillsborough because smaller community-based water providers are not required to identify or report their safe yields. The Division of Water Resources (DWR) and the Triangle J Council of Governments (TJCOG) compiled these data from Local Water Supply Plans which were submitted to DWR by the providers for 1992 and 1997. TJCOG and the largest water providers also contributed data for 2001 and 2003. The remaining data was provided by local water providers, as shown in Table 18. One-half of OAWS' customers are within Orange County, an increase since the one-third reported in the *2004 State of the Environment* report. Thus the numbers reported for the OAWS system were adjusted by 50% to estimate the demand trends within Orange County. It should be noted that the Town of Hillsborough and OAWS bought finished water from Durham and Graham-Mebane respectively during extended periods over the past several years. These supplemental supply sources are not factored into the safe yield calculations because the purchase arrangements are not permanent in nature and may be discontinued. Table 19 reveals the average and maximum daily demands on each water system for the years listed.

The trend in Orange County

STEADY

Since 1992, the safe yield for OAWS has remained fixed. Their demand typically exceeds their safe yield, as shown in Tables 18 and 19. This system remains dependent on purchasing water during drought conditions or to meet increased demand. Hillsborough increased their safe yield by developing the West Fork Eno River Reservoir. OWASA has a significantly larger water supply than Hillsborough or OAWS and additional storage is anticipated by using an operating stone quarry that will become available to OWASA in approximately 20 years. OWASA's safe yield was adjusted downward in 2003 using more conservative modeling than was previously used. OWASA is also developing a water reuse system in which reclaimed water will be used in selected chiller plants at UNC-CH. This system is expected to decrease the demand for OWASA potable water by more than six percent.

Recommendations

To support a sustainable future, Orange County should:

- Support wastewater reclamation/reuse projects such as the one involving OWASA and UNC-Chapel Hill. A similar reuse system is being studied for the planned Carolina North project in Chapel Hill.
- Continue to educate citizens about the benefits and need for water conservation and pursue conservation at County facilities.

Table 18: Public Water Supply Safe Yields, 1992-2008

Water Provider	1992	1997	2001	2003	2008
Orange Water and Sewer Authority	13.50	13.50	15.10	12.50 [12]	12.50
Hillsborough	0.76	0.76	2.56	2.56 [13]	2.56
Orange-Alamance Water System (Orange County portion)	0.12	0.12	0.12	0.12	0.12

All figures in mgd - million gallons per day.

[12] Decrease due to change in OWASA's modeling using a more conservative estimate of 30-year drought condition safe yield.
[13] Equals 1.8 mgd for West Fork Eno River Reservoir plus 0.68 mgd for Lake Ben Johnson plus 0.08 mgd for Lake Orange.

Table 19: Average and Maximum Daily Demand Per Year, 1992-2008

	Orange Water and Sewer Authority		Hillsborough		Orange-Alamance Water System [14]	
Year	Average Daily Demand	Maximum Daily Demand	Average Daily Demand	Maximum Daily Demand	Average Daily Demand	Maximum Daily Demand
1992	7.14	12.00	1.46	2.04	0.24	0.34
1996	7.91	11.25	1.47	2.29	-	-
1997	8.38	12.29	1.80	2.65	0.36	0.44
1998	8.45	13.45	1.72	2.37	-	-
1999	8.56	14.11	1.52	2.53	-	-
2000	9.17	12.93	1.38	2.58	-	-
2001	9.46	12.76	1.23	1.87 [15]	0.29	0.39
2002	9.01	14.07	1.05	1.78	-	-
2003	8.06	12.45	1.14	2.00	0.30	0.40
2004	8.47	11.87	1.27	1.89	0.39	0.42
2005	8.58	11.99	1.20	2.29	0.36	0.39
2006	8.55	11.54	1.21	1.77	0.33	0.39
2007	8.57	13.35	1.22	1.75	0.31	0.37
2008	7.67	10.82	1.14	1.86	0.32	0.38

All figures in mgd– millions gallons per day.

[14] Portion of total demanded estimated for service area within Orange County.
[15] The large decrease in the Hillsborough demanded in 2001 was due to the closing of the Flynt Fabrics Facility.

Sources: Tables 18 and 19—Individual Water Providers

WATER RESOURCES

Groundwater Quantity

Why the indicator was selected

Groundwater is a very important source of domestic, agricultural and industrial water within Orange County. Many new wells are installed in the county each year. Usage of groundwater is largely unrecorded and thus total demand is unknown. Two recent relatively long-term droughts raised concerns for many about the supply of groundwater. While it is likely that the long-term supply of groundwater was only minimally impacted by recent drought events, accurate local information concerning the availability of groundwater is needed to safely utilize this resource. Observation wells monitor the impact of variations in climatic conditions and bedrock lithology (physical characteristics of a rock) on groundwater levels. Regolith observation wells monitor the quantity of groundwater contained in the unconsolidated material (regolith) present above bedrock, while bedrock observation wells monitor groundwater levels within bedrock. Groundwater present in the regolith represents the water stored for eventual use via supply wells which access water present in fractured bedrock.

How the indicator was measured

Currently, there are only two observation wells in Orange County. The Caldwell bedrock well is operated by the DWR and is located in the northeastern corner of the county. A second well, NC-126, is a shallow regolith well on the campus of UNC-Chapel Hill (operated by the USGS). Both wells have groundwater level records which began in 1969 and 1943 respectively, although both records contain data gaps.

The trend in Orange County

STEADY

Large fluctuations in the groundwater table have occurred since 2002 due to the impact of drought. Water levels in the Caldwell bedrock well have been measured since 1969 except for a gap from late 1991 to the middle of 2006. Since 2007, the groundwater level in this well has been significantly lower than its historical trend and in late 2007, after the water level fell consistently during the second half of 2007, was near the lowest level ever measured in the well. Additional water level data would be necessary to draw conclusions regarding groundwater levels in the county.

Recommendations

To support a sustainable future, Orange County should:

- Implement a groundwater observation well network to facilitate monitoring of this important source of water. This network should utilize regolith wells and bedrock wells to permit measurement of groundwater levels in the regolith and bedrock lithologies found in the county;
- Publish information obtained from the observation well network to increase awareness of the trend of groundwater quantity in the county; and
- Use the observation well network to monitor groundwater base flow to streams, especially streams which feed surface water reservoirs.

Figure 21: NC-126 Regolith Observation Well Groundwater Level, 1943-2008

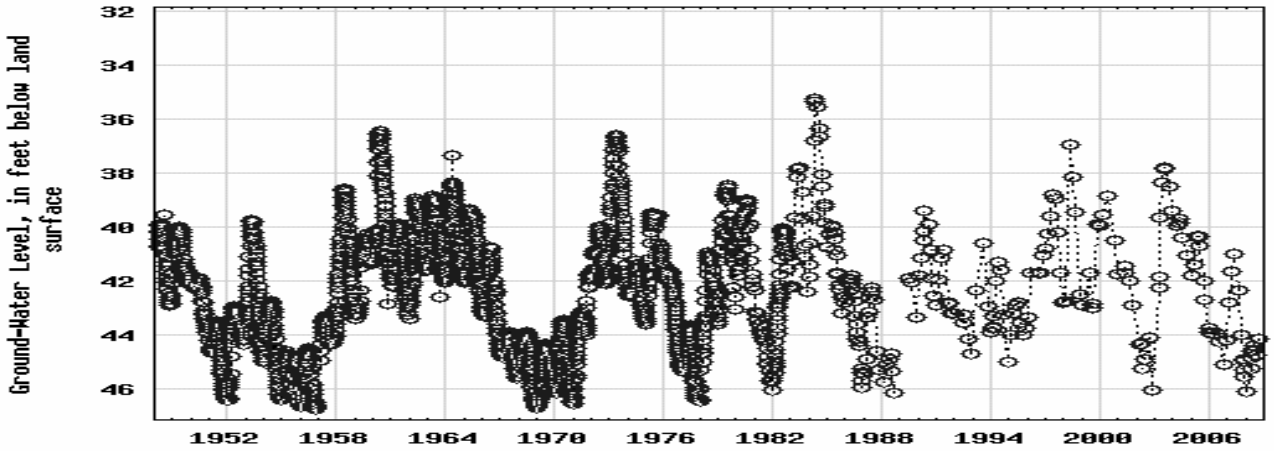


Figure 22: Caldwell Bedrock Observation Well Groundwater Level, 1970-2008

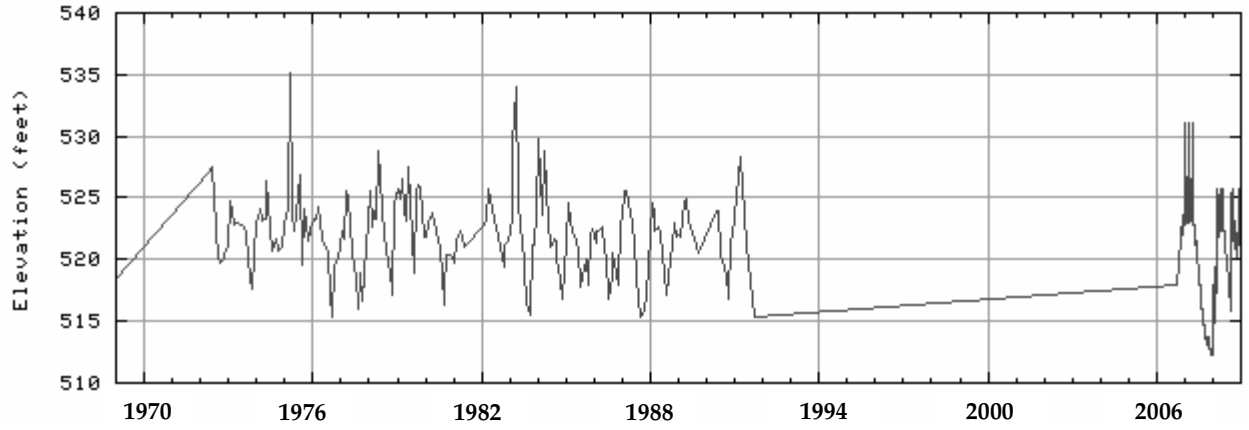


Figure 23: Groundwater Level in Caldwell Well During 2006-2008 Drought

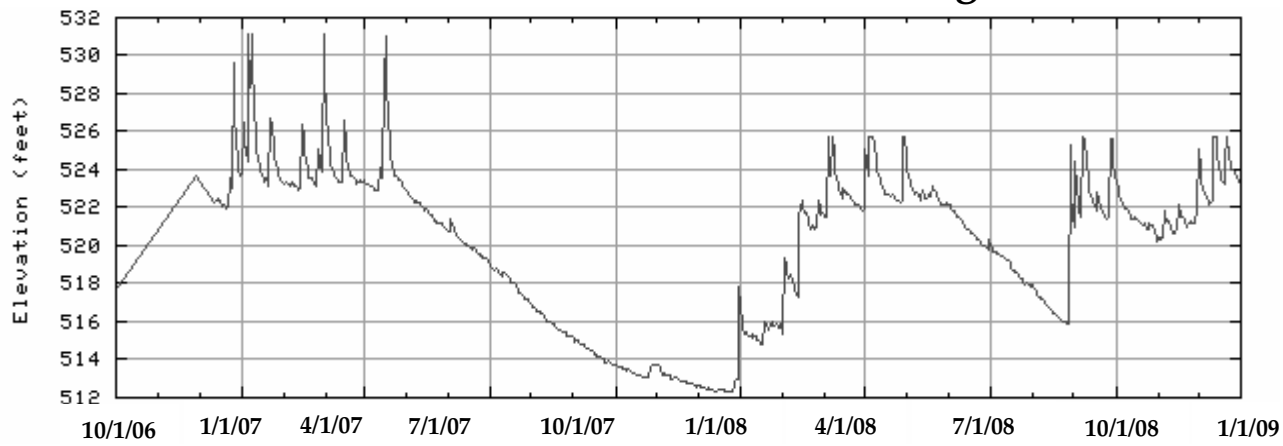


Table 20: Groundwater Wells Installed, 1991-2007

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Drinking Water Wells	305	535	426	413	400	497	481	490	514	376	398	372	257	308	294	301	277
Non-Drinking Water Wells	-	-	-	-	-	-	-	-	-	-	-	5	15	7	10	12	31
Community Supply Wells	-	-	-	-	-	-	-	-	-	-	-	2	1	2	1	1	0

Sources: Figure 21 —USGS web site. (USGS information may be approved or provisional data.) Figures 22 and 23—DWR web site. Table 20 —Orange County Environmental Health Dept.

WATER RESOURCES

Groundwater Quality

Why the indicator was selected

Current information regarding groundwater quality in the County is limited. Cunningham and Daniel (2001) documented the quality of groundwater by sampling 51 wells across the county. In general, "few drinking water concerns" were identified through their research. However, uncontrolled releases of numerous commonly available materials such as petroleum products, chemicals, waste materials, fertilizers and pesticides can result in groundwater and soil contamination. The number of groundwater contamination incidents is an indicator that demonstrates how our daily activities may impact the natural environment. In order to protect groundwater quality, it is necessary to minimize activities that are capable of negatively impacting groundwater resources.

How the indicator was measured

The Division of Waste Management (DWM) and Division of Water Quality (DWQ) within NCDENR manage release incidents that pose a risk to groundwater quality in the State. Such incidents include releases from underground storage tanks (USTs) and aboveground tanks (ASTs), surficial spills of hazardous materials, releases at dry cleaning sites, Superfund and Resource Conservation and Recovery Act (RCRA) sites and other sites which have potentially hazardous materials present on them. DWM and DWQ manage databases which detail the sites which represent a potential threat to groundwater in Orange County.

The trend in Orange County

INDETERMINATE

As Figure 24 indicates, the number of UST incidents in Orange County has increased steadily over the past twenty two years, reaching a total of nearly 450 incidents in 2008. While the number of reported incidents that have been investigated and "closed out" has grown each year, the increase does not appear to have kept pace with the number of incidents reported. Currently, 71% of UST incidents have been "closed out", meaning that these sites have been determined to no longer be a threat. Table 21 summarizes 20 categories describing nearly 850 sites (including UST sites) that pose a potential threat to groundwater. It should be noted that not all of these sites have released hazardous materials into the environment but they may merely represent a potential threat to do so.

Recommendations

To support a sustainable future, Orange County should:

- Alert residents to be vigilant of potential contamination of groundwater, as a result of their own activities and the activities of others;
- Compile information regarding groundwater contamination incidents in the county and make this information available to the public;
- Encourage the use of alternatives to hazardous materials where possible;
- When appropriate, pursue cleanup of incidents where action has stalled;
- Encourage residents to properly abandon out-of-service wells as required by NCDENR and Orange County regulations; and
- Continue to educate citizens regarding the appropriate disposal of potentially hazardous materials at Orange County Solid Waste facilities.

Figure 24: Underground Storage Tank Incidents, 1986-2008

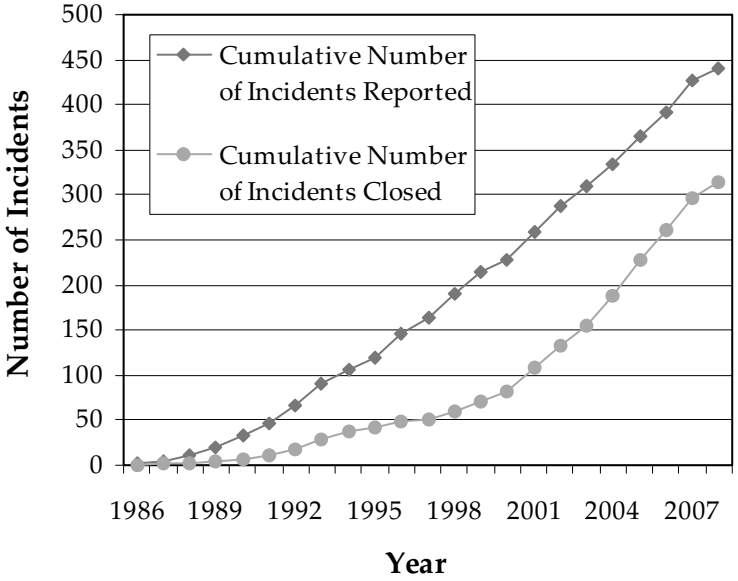


Table 21: Potential Threats to Groundwater Quality

Type of Site	Number Present in Orange County
Reported UST and AST Sites or Surface Spills of Misc. Hazardous Materials	439 [17]
UST Permits (Registered USTs, Typically Present at Gas Stations)	76[16]
Animal Operation Sites (with Certified Animal Waste Management Plans)	21[16]
NC State Superfund Program sites	14 [19]
NPL (National Priority List) Sites ("Superfund" Sites)	0[16]
Non-Discharge Permits (Ind./Municipal Facilities that Treat Various Wastes)	42[16]
National Pollutant Discharge Elimination System (NPDES) Permits	96[16]/153 [18]
Old Landfill Sites (Non-Permitted Municipal Landfills or Dump Sites)	4 [19]
Polychlorinated Biphenyl (PCB) Sites	1[16]
RCRA Hazardous Waste Large/Small Quantity Generators/Transporters	1/19 [18]
RCRA Hazardous Waste Transport, Storage, Disposal (TSD) Sites	4/19 [18]
Septage Disposal Sites (Permitted Sites for Land Application of Septage)	0[16]
Permitted Biosolids Application Sites (3,112 acres active/1,403 acres inactive)	4,515 acres[16]
Soil Remediation Sites (Bioremediation of Petroleum Contaminated Soil)	0[16]
Solid Waste Facilities (Includes Garbage, Construction Debris, Sludge, etc.)	2[16]
Dry-Cleaning Solvent Clean-up Act (DSCA) Program Sites	6 [20]
Tier II Facilities (Storing Hazardous Materials under SARA[21])	34[16]
Brownfields Sites	4 [22]
Underground Injection Control (UIC) Sites (Wells Not For Waste Injection)	11[16]
Pesticide Release Sites	0 [23]

[16] NCDENR– DEH Source Water Assessment Program Sept. 2006 [17] Summer 2008 UST Section Database [18] August 4, 2008 EPA EnviroFacts Warehouse Web Site [19] Corroborated by July 11, 2008 NCDENR database [20] July 24, 2008 DSCA Web Site [21] Superfund Amendments and Reauthorization Act [22] September 30, 2007 NC Brownfields Web Site [23] NCDACS Pesticides Division

Sources: Figure 24 and Table 21 —NCDENR—Division of Waste Management and Division of Water Quality databases.

WATER RESOURCES

Wastewater Treatment and Disposal

Why the indicator was selected

Centralized wastewater treatment is an essential service for urban centers and cities. The quality of that service can be evaluated in part by tracking the number and volume of wastewater spills, which can contribute nutrients and pollutants to surface waters. Spills occur as a result of blockages in pipes, commonly caused by the buildup of fats, greases and other materials inappropriately added to the waste disposal system.

Septic systems also represent a significant method of wastewater treatment and disposal in the county. Approximately 9,000 septic systems have been installed in the county since 1985. Maintenance of septic systems is necessary to ensure proper operation. Improperly functioning or failing septic systems can contaminate surface water and groundwater resources and could result in health hazards. According to *The North Carolina Septage Study* by Grayson, Olive and Steinbeck (1982), 10.9 percent of the 1,333 septic systems in Orange County that were checked in their study had experienced malfunctions or failures during the previous year.

How the indicator was measured

The OWASA and Hillsborough wastewater treatment plants, the DWQ and the Environmental Health Division of the Orange County Health Department provided the data for this indicator. Figure 25 and Table 22 report the total amount of wastewater released annually, the volume of wastewater that reached surface waters each year and the total amount of monetary penalties levied for these violations. Figure 26 shows the number of septic systems that have been installed and repaired in the county since 1991.

The trend in Orange County

IMPROVING

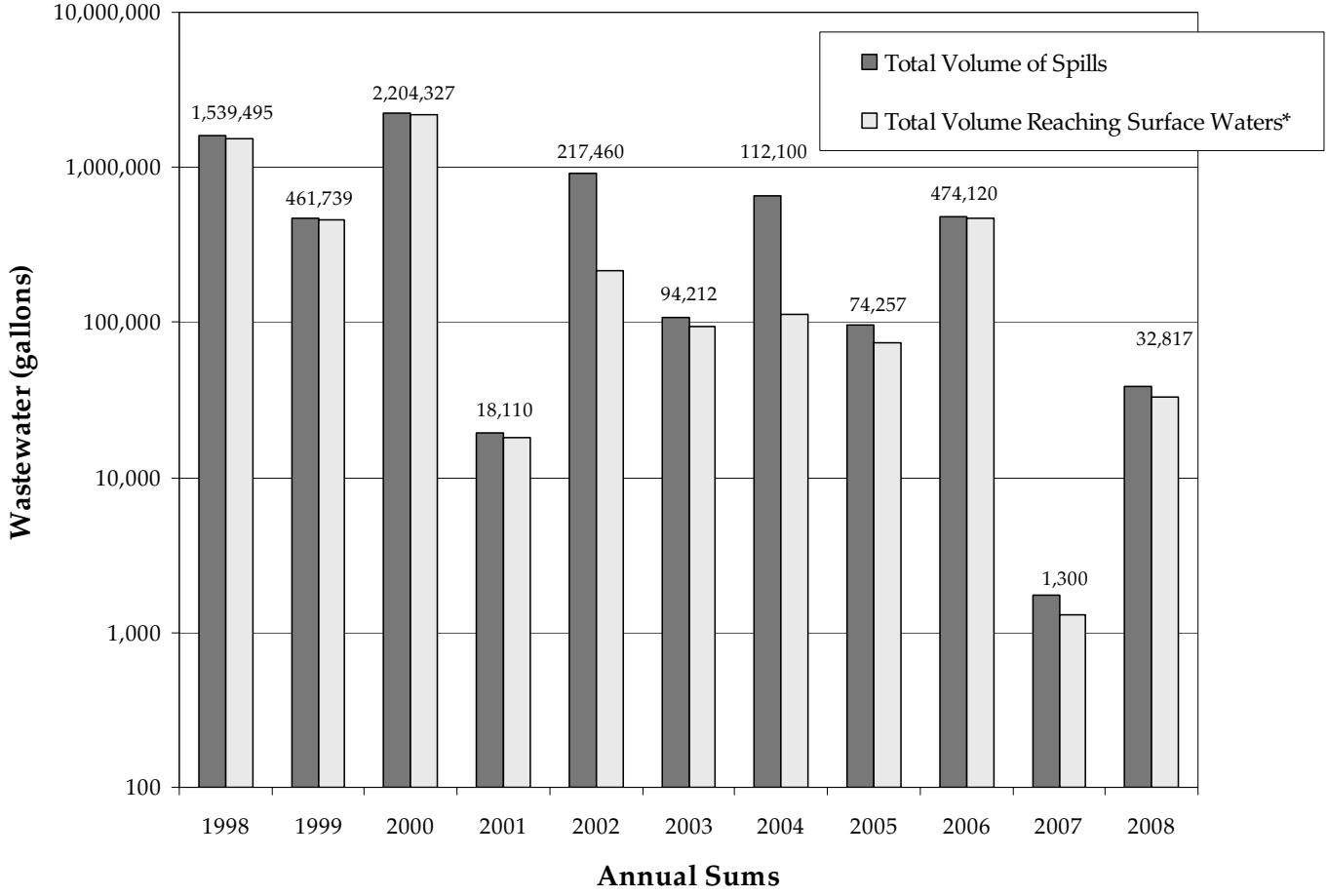
As shown in Table 22, the number of wastewater releases that occur varies from year to year but since 1998 a total of 284 spills of wastewater have occurred, with more than 5 million gallons reaching surface waters. Table 22 also indicates that the annual number of wastewater spills decreased in the past few years. Figure 25 illustrates that the volume of wastewater reaching surface waters also fell in the last two years. Figure 26 demonstrates that nearly 7,000 septic systems have been installed since 1991 and more than 1,200 failing systems have been repaired since then.

Recommendations

Since the County does not operate a wastewater treatment plant, to support a sustainable future, Orange County should:

- Continue to track the number and volume of wastewater spills;
- Educate citizens regarding appropriate septic system maintenance and upkeep, as well as what materials to avoid disposing of in septic systems; and
- Support citizen education regarding the appropriate disposal of waste materials including using household hazardous materials disposal facilities operated by the Orange County Solid Waste Management Department.

Figure 25: Total Volume of Wastewater Spills, 1998-2008

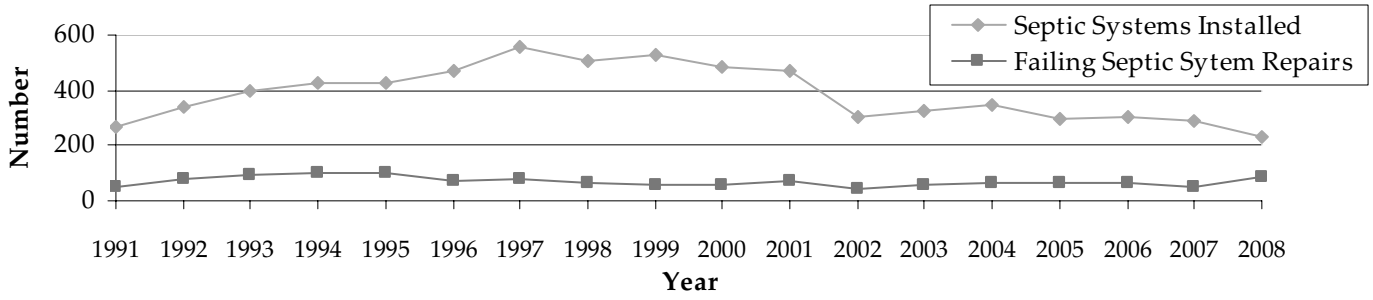


* Numbers shown represent the total volume of wastewater reaching surface waters for each year.

Table 22: Wastewater Spills and Associated Permit Violations, 1998-2008

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Number of Spills	62	55	26	10	31	33	16	19	14	4	14	284
Total Monetary Penalties Assessed, in Dollars	$5,425	$10,425	$24,836	$3,500	$0	$0	$0	$0	$0	$0	$0	$44,186

Figure 26: Septic System Installations and Repairs to Failing Systems



Sources: Figure 25 and Table 22 — NCDENR - Division of Water Quality, OWASA, Town of Hillsborough
Figure 26 —Environmental Health Division of the Orange County Health Department

WATER RESOURCES

Surface Water Quality

Why the indicator was selected

Dissolved oxygen (DO) and total nitrogen (TN) content were selected as indicators because taken together they provide a fairly good measure of surface water quality. DO content of a stream can be considered the single most important indicator of habitat quality. If the concentration of DO in a stream is less than 5 mg/L, fish and other organisms can become stressed. The TN content is the sum of nitrate, nitrite, organic nitrogen and ammonia concentrations present in a water sample. These compounds are potentially present in surface water as a result of the over-application of fertilizer, from wastewater treatment plant effluent, in groundwater impacted by septic systems and as a result of stormwater runoff from agricultural fields, animal lots and urban areas.

How the indicator was measured

Online DO and TN data was obtained from the United States Geological Survey. Sampling locations within Orange County (and one in Durham County) were utilized which had analytical results available over at least the period from 1988 to 2008. Single locations on the Eno River, Morgan Creek and Cane Creek were used to determine trends in water quality over the twenty year time interval. A single location on the Little River within Durham County was also used to track the water quality trend for the Little River, as no information was available for the stretch of this stream in Orange County.

The trend in Orange County

MIXED

The trends of the data for the sampling locations listed indicates that dissolved oxygen levels have decreased in all four streams over the last twenty years (Figure 27). This trend is of concern as it appears to be consistent at all of the stream sampling locations included herein. Total nitrogen concentrations decreased over the same interval for three of the streams, increasing over time at only the Little River sampling location in Durham County (Figure 28). The decrease in the total nitrogen trends over time is encouraging.

Recommendations

To support a sustainable future, Orange County should:

- Continue to work with other local governments and organizations to improve water quality and stream integrity. The Jordan Lake and Falls Lake Nutrient Management Strategies that are being developed have brought together many different parties to work on improving water quality in the Jordan Lake and Falls Lake watersheds;
- Investigate options available for reducing non-point sources of nutrients and other pollutants that make their way into the county's water bodies;
- Enforce and update regulations to protect surface water quality;
- Continue to educate citizens regarding threats to surface water quality; and
- Support existing efforts to improve surface water quality.

Figure 27: Dissolved Oxygen Level Trends, 1988-2008

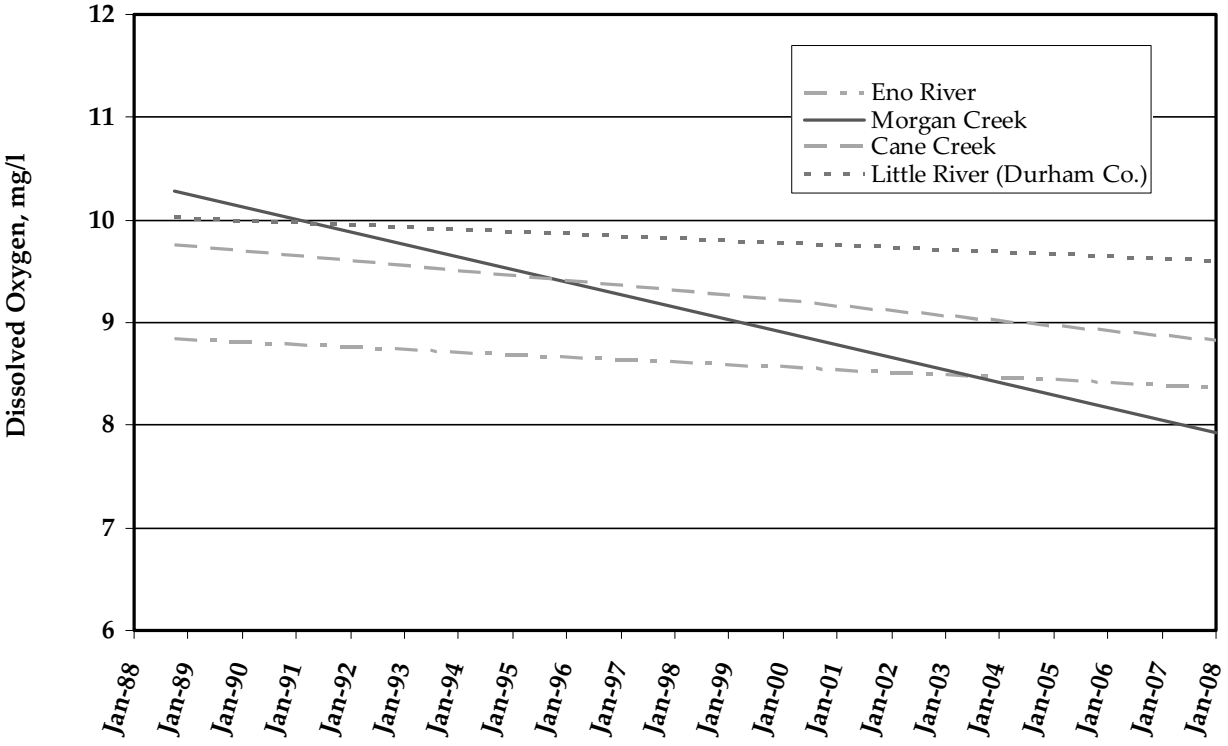
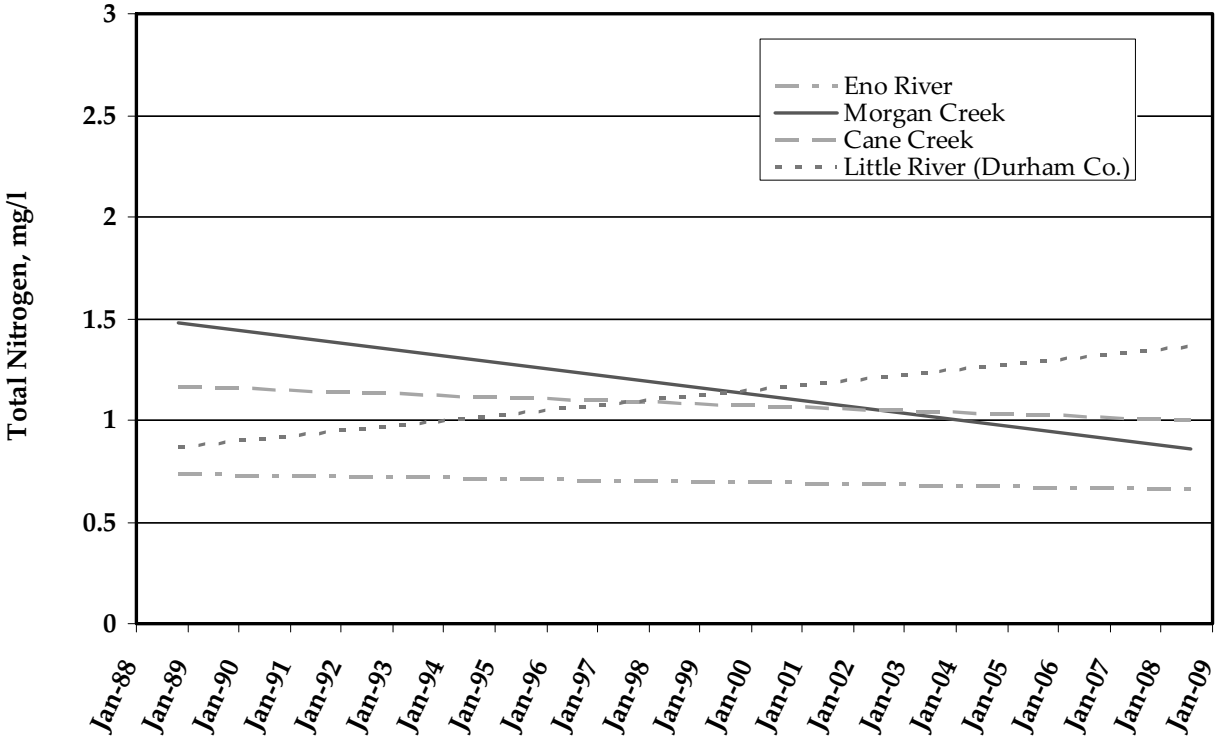


Figure 28: Total Nitrogen Level Trends, 1988-2008



Source: Figure 27 and 28 —USGS NWISWeb database, includes final and provisional data that may not have received Director's approval and may be subject to revision.

WATER RESOURCES

Stream Ratings

Why the indicator was selected

The Division of Water Quality classifies waters in North Carolina according to their best intended uses and periodically evaluates how capable water bodies are at supporting their designated use. DWQ assesses streams using different types of biological data including benthic macroinvertebrate bioclassification, fish community structure (NCIBI), phytoplankton and algal bloom measurements and physical and chemical parameter measurements. Streams that are determined to be either **Partially Supporting** or **Not Supporting** their designated use are considered **Impaired**. Streams that are found to be meeting their intended use are termed **Fully Supporting**. The use of macroinvertebrate and fish population data has proven to be a reliable water quality monitoring tool, as benthic macroinvertebrate and fish communities can be sensitive to subtle changes in water quality.

How the indicator was measured

Fish population and benthos evaluations are used to monitor river and stream water quality. Benthic macroinvertebrates, or benthos, are organisms that live on the bottom of rivers and streams. In freshwater, many of these organisms consist of aquatic insect larvae. DWQ assigns each benthic sample a bio-classification ranging from Poor to Excellent which reflects water quality at that location. The table below illustrates how the results of the NCIBI fish population surveys and bioclassification analyses correlate with stream ratings:

Stream Rating	Bioclassification	NCIBI
Fully Supporting **(FS)**	Excellent	Excellent
Fully Supporting **(FS)**	Good	Good
Fully Supporting **(FS)**	Good-Fair	Good-Fair
Partially Supporting **(PS)**	Fair	Fair
Not Supporting **(NS)**	Poor	Poor

The trend in Orange County

STEADY

In general, Orange County appears to be maintaining the quality of streams in rural areas (Table 23). Among the streams that have been checked by DWQ since 1996, all streams outside of Chapel Hill and Carrboro, except Collins Creek (Figure 29), were found to be **Fully Supporting** of their intended use during their most recent analysis. **Partially Supporting** or **Not-Supporting** streams appear to be limited to the urban areas of the county, indicating that runoff from development and sewage treatment plant effluent are likely impacting water quality. It is not certain why Collins Creek is not meeting its' intended use, although agricultural fields, biosolids application sites, private wastewater treatment plants with permitted discharges and areas undergoing development are present in the Collins Creek watershed.

Recommendations

To support a sustainable future, Orange County should:

- Continue acquiring property and conservation easements to protect streams;
- Enforce and maintain streamside buffers to protect water quality; and
- Support efforts to improve and restore water quality, especially those measures that concern streams in urban areas of the County.

Table 23: Water Quality Summary, 1984-2005

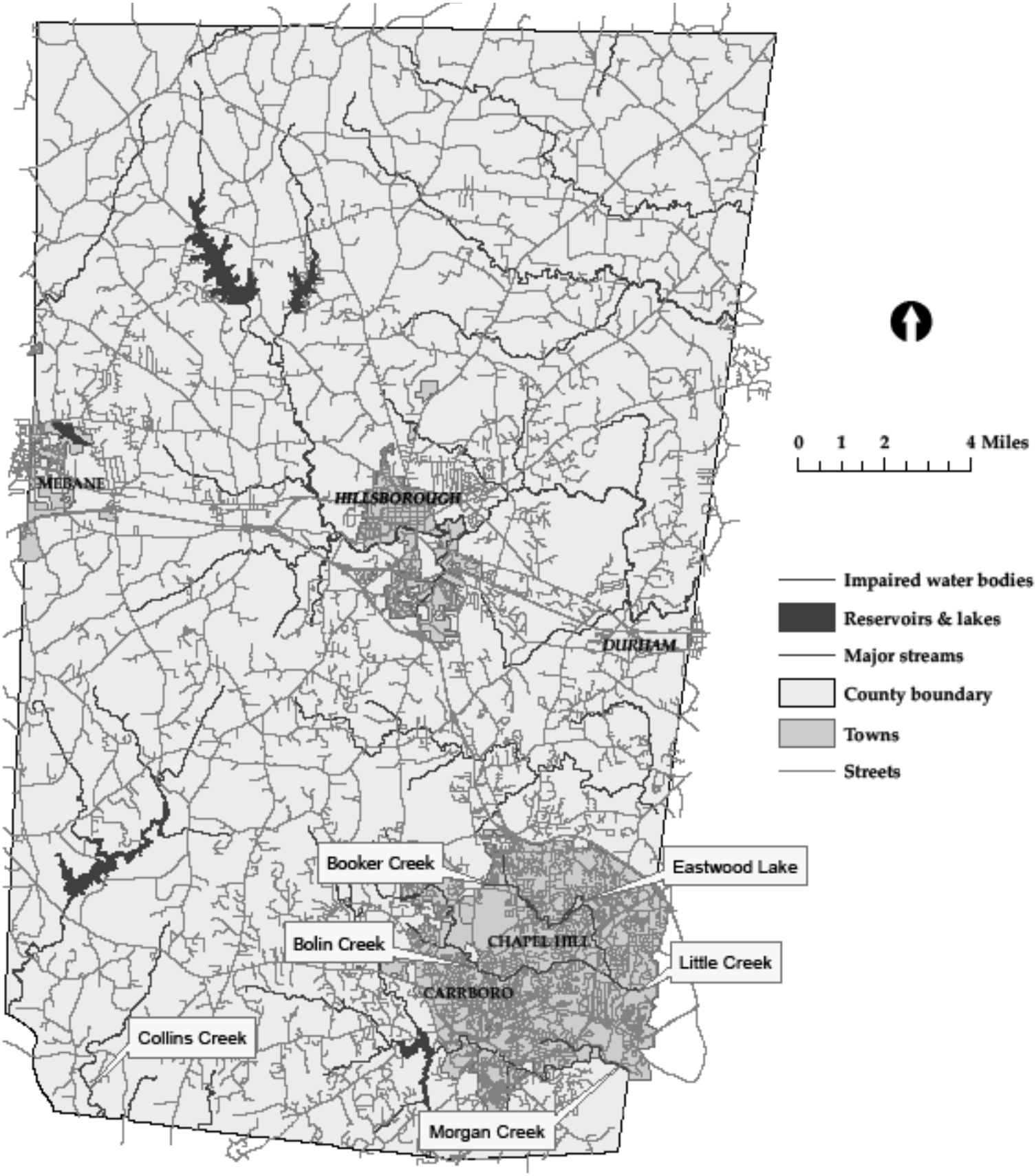
Cape Fear River Basin								
Water Body and Sample Location	Year							
	1984	1985	1987	1990	1993	1996	1998	2003
Cane Creek SR 1114					FS (w) FS (s)		FS (w) FS (s)	FS (s)
New Hope Creek SR 1734					FS			
Morgan Creek NC 54		FS			FS (w) FS (s)		FS (w)	FS
Morgan Creek SR 1726	PS (s)	NS	PS (s)	PS (s)	PS (s)		PS (s)	
Morgan Creek SR 1900						PS	NS	PS
Bolin Creek Off SR 1750						PS	NS	

Neuse River Basin								
Water Body and Sample Location	Year							
	1988-1989	1991	1994	1995	1996	1998	2000	2005
Seven Mile Creek SR 1120		FS		FS			FS	FS
Eno River SR 1336		FS		FS			FS	FS
Eno River SR 1336							FS	FS
Eno River NC 70 BYP.	FS							
Eno River 2nd NC 70 BYP.	FS							
Eno River NC86, above WWTP			FS					
Eno River NC86, below WWTP			PS					
Eno River SR 1569	FS	FS		FS	FS	FS	FS	FS
S. Fork Little River SR 1538				FS			FS	FS
N. Fork Little River SR 1519				PS			FS	
N. Fork Little River SR 1538				FS			FS	FS

WWTP - wastewater treatment plant w– Winter sampling s– Summer sampling FS– Fully Supporting PS– Partially Supporting NS– Non-Supporting. All Cape Fear basin samples were benthic macroinvertebrate samples except Morgan Creek-SR 1900 and Bolin Creek samples which were fish community (NCIBI) samples. The 2003 Morgan Creek-SR 1900 sample was also a benthic macroinvertebrate sample. All Neuse River basin samples were benthic macroinvertebrate samples except the Eno River-1336 samples which were NCIBI samples. The 1998 Eno River-SR 1569 sample was also a NCIBI sample.

Source: Table 23 —NC Division of Water Quality—Biological Assessment Unit

Figure 29: Impaired Water Bodies as of 2008



Source: Figure 29— Orange County ERCD, prepared April 17, 2009

WATER RESOURCES

Ongoing Concern: Radon and Arsenic in Groundwater

Between 1993 and 2001 the U.S. Geological Survey (USGS), in collaboration with Orange County, completed three investigations of the groundwater in Orange County. These projects were referenced in the *Water Resources Initiative (2005)*[24], an initiative to document critical needs for advancing the characterization and protection of groundwater resources in the county. The USGS report by Cunningham and Daniel (2001) stated that "the groundwater [in the county] was found to be of good quality," identifying only three naturally occurring elements present in groundwater in excess of State drinking water standards - iron, manganese and zinc[25]. These are essential elements to plants and animals but according to the 2001 USGS report, ingestion of large amounts of iron can cause staining and affect taste.

Of perhaps greater import is the finding, as described in both the 2001 USGS report, as well as in recent work conducted by the N.C. Geological Survey, that radon and arsenic are additional naturally occurring elements that could be of concern to groundwater users in the county.

Radon is a gas formed during the decay of uranium 238 and is mainly found in association with granitic rocks. In Orange County, radon has been detected in the groundwater, particularly in the southern portion of the county where a large body of granitic rock is present in the subsurface. Radon is primarily a concern because the inhalation of radon gas particles has been linked to an increased potential for the development of lung cancer. Sixty-seven percent of the groundwater samples collected in Orange County during the 2001 USGS study contained radon in concentrations in excess of the proposed EPA's Maximum Contaminant Level (MCL) of 300 pCi/L (picocuries per liter[26]) and one sample exceeded the proposed Alternative MCL (AMCL) of 4,000 pCi/L. It should be noted, however, that debate still exists concerning the risk posed by elevated radon concentrations, and the proposed MCL for radon has not been finalized. Orange County's *Water Resources Initiative* (2005) stated "Additional research and follow-up on these [radon] findings are of immediate and critical importance to citizens who live in the parts of the county most affected and this action should not be delayed any longer."

Arsenic is another naturally occurring element that can be present in the groundwater of Orange County. The N.C. Division of Water Quality has studied arsenic in groundwater and concluded "the volcanic and volcaniclastic rocks of the Carolina Slate Belt (which underlies most of Orange County and is now known as the Virgilina sequence of the Carolina terrane) are the most probable host materials for arsenic bearing groundwater." The N.C. Geological Survey analyzed N.C. Department of Health and Human Services data from nearly 500 wells in Orange County. This work found that, in general, groundwater from wells located in areas where the bedrock is made up of "welded tuffs proximal to a pluton[27]" appear to contain the highest concentrations of arsenic in the county. The allowable concentration of arsenic in groundwater is 50 ug/L, whereas the N.C. drinking water standard for arsenic is 10 ug/L. The N.C. Department of Public Health recommendation for arsenic in drinking water is even lower, 0.02 ug/L.

To address this concern, Orange County should:

- Support groundwater sampling for radon and arsenic and other potential contaminants (naturally occurring and artificially generated) as needed;
- Investigate further study of radon in groundwater in areas of the county underlain by granitic rock, perhaps in conjunction with the USGS and adjoining counties;
- Proceed with plans to establish the Orange County Observation Well Network to research groundwater quantity and quality concerns across the county; and
- As described in the *Water Resources Initiative*, the County "should develop an inventory of ground-water contamination incidents based on county/state/federal reports…" This inventory should be made available to the public in an easily understandable format.

[24] The Water Resources Initiative was prepared by the CFE and approved by the Board of County Commissioners in 2005.

[25] Zinc may be present as a result of the use of galvanized well construction materials.

[26] A curie is a unit of radioactivity, defined is 0.037 decays/second, which is roughly the radioactivity of one gram of radium; a picocurie is 10^{-12} curies, and measures the amount of radioactivity in a liter of liquid substance.

[27] A pluton is an intrusive igneous rock and tuff is a rock formed from the consolidation of volcanic ash ejected from a volcano.

ORANGE COUNTY'S LANDS LEGACY PROGRAM

In April 2000, the Orange County Board of Commissioners adopted the Lands Legacy Program to protect the county's most important natural and cultural areas through voluntary means, including purchasing land or working with private landowners to convey conservation easements.

Golden-banded Skipper (locally extinct)

The Lands Legacy Program was the first comprehensive county land acquisition program in North Carolina. The program has received national recognition, winning the Excellence in County Planning Award from the American Planning Association in 2007. It was also a finalist for the Leadership in Conservation Award from the Trust for Public Land and the National Association of Counties.

As of **December 2008**, Orange County has:

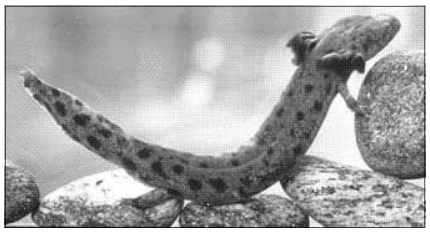
- Acquired **977** acres of land for county parkland and nature preserves
- Protected **1,550** acres of privately-owned natural areas and farmland with conservation easements

Sharp-shinned Hawk (locally extinct)

Purple Fringeless Orchid

Four-toed Salamander (locally extinct)

Southern Anemone



Neuse River Waterdog

Currently, the Lands Legacy Program has protected a total of **2,527** acres.

Table 24: Lands Legacy Acquisitions, 2000-2008

Land Purchases		
Site Name	**Acres**	**Year**
McGowan Creek Preserve	63	2000
Little River Regional Park & Natural Area*	136	2000
Twin Creeks Park/School sites	193	2001
Seven Mile Creek Preserve	134	2001
Blackwood Farm (future park)	152	2001
Cedar Grove Park addition	12	2004
Millhouse Road Park (future park)	79	2004 & 2007
New Hope Preserve (4 properties)	57	2005-07
Lewis' Heartleaf Preserve (donation)	10	2005
Northeast District Park (future park)	143	2007
Total	**977**	

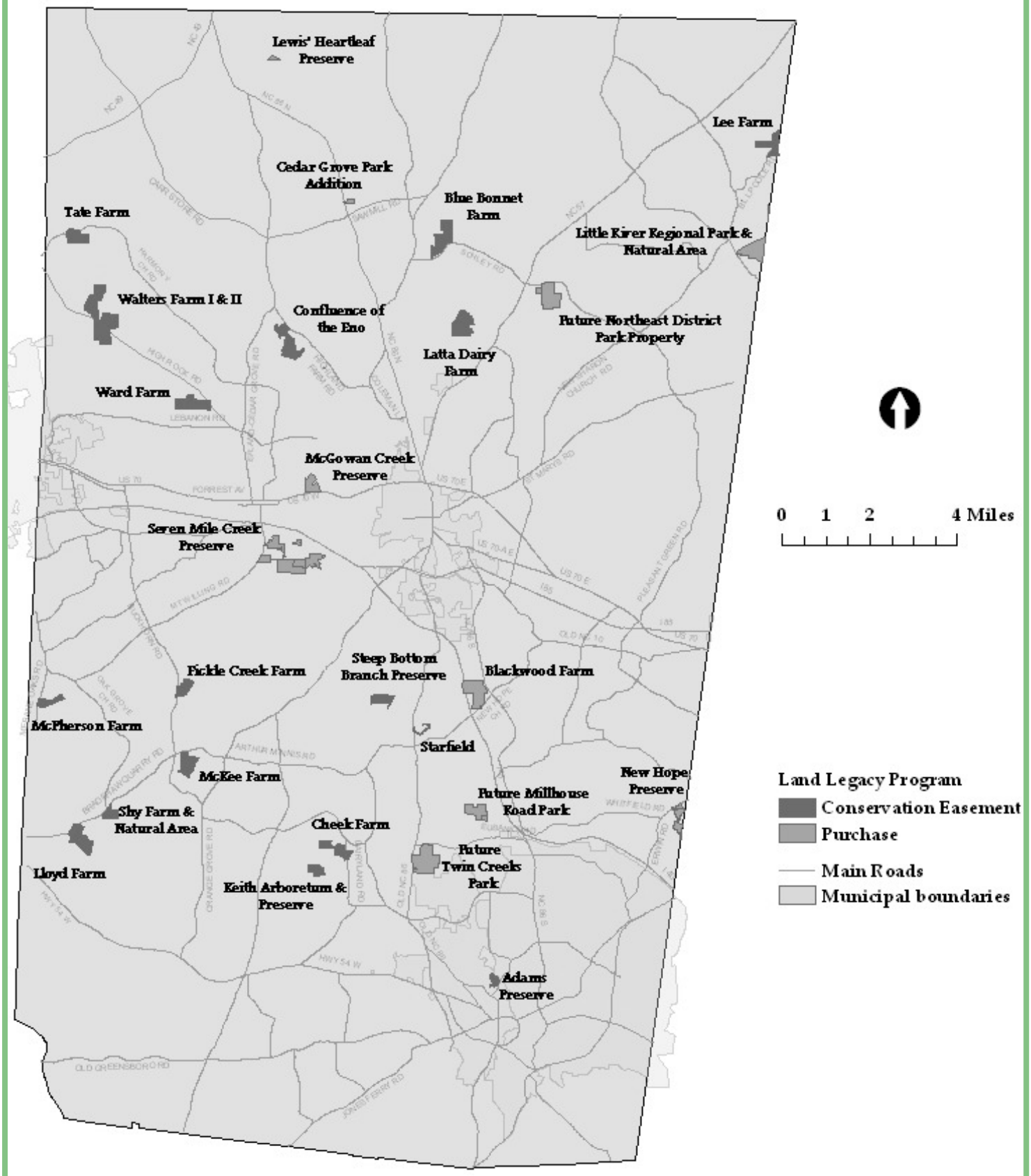
* Little River Park includes another 255 acres acquired by/in Durham County

Note: Orange County also contributed funds to purchase 808 acres for Eno River State Park in 2003.

Conservation Easements		
Project Name	**Acres**	**Year**
Walters Farm	71	2001
Shy Conservation Area	45	2002
Hollow Rock Trail	1	2003
Walters Farm	223	2003
Volpe Conservation Area	24	2004
Starfield Subdivision	3	2004
Cheek Farm	78	2004
Adams Tract	27	2004
Steep Bottom Branch Conservation Area	65	2004
Ward Farm	112	2004
Lloyd Farm	125	2005
McPherson Farm	47	2005
Keith Arboretum and Preserve	45	2006
Fickle Creek Farm	61	2007
Latta Dairy Farm	138	2007
McKee Farm	92	2007
Tate Farm	80	2007
Lee Farm	62	2007
Blue Bonnet Farm	141	2008
Eno Confluence	110	2008
Total	**1,550**	

Source: Table 24—Orange County ERCD

Figure 30: Lands Legacy Projects, 2000-2008



Source: Figure 30—Orange County ERCD, prepared August 6, 2009

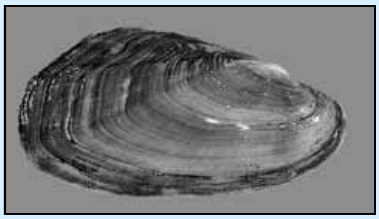
What Can You Do to Improve the *State of Your Environment*?

1. Share this report with others through the following link:
http://www.co.orange.nc.us/ercd/2009_SOE_index.asp

Warbling Vireo

2. Use Public Transportation.
   A. Bus - http://gotriangle.org/index.php
      - Orange Public Transit - http://www.co.orange.nc.us/transportation/RidetheBus.asp
      - Triangle Transit - http://www.triangletransit.org/
      - Chapel Hill Transit - http://www.ci.chapel-hill.nc.us/index.aspx?NID=397
      - Regional Transit Providers - http://www.co.orange.nc.us/transportation RelatedLinks.asp

   B. Bike, Walk, Telecommute, Carpool, Vanpool - http://www.co.orange.nc.us/transportation/BusAlternatives.asp


Dwarf Wedgemussel

3. Plant a garden. http://www.eartheasy.com/grow_backyard_vegetable_garden.html

4. Shop at your local farmer's market:
   - Carrboro Farmers Market - http://www.carrborofarmersmarket.com/
   - Eno River Farmers' Market - http://www.enoriverfarmersmarket.com/
   - South Estes Farmers' Market - http://southestesfarmersmarket.com/
   - Hillsborough Farmers Market - http://hillsboroughfarmersmarket.org/default.aspx

5. Install a programmable thermostat or adjust your thermostat when leaving home for the day.

6. Consider enrolling your land in Orange County's Present Use Value Program or Voluntary Agricultural District Program.
   - Contact the Orange County Tax Assessor's Office about the Present Use Value Program (919) 245-2100
   - Voluntary Agricultural District Program—http://www.co.orange.nc.us/ercd/apb_voluntary_agriculture_districts.asp

Northern Oak Hairstreak

7. Maintain your septic system and test your well water:
http://www.co.orange.nc.us/envhlth/inspections/SepticSystemAdditionalResources.asp
http://www.co.orange.nc.us/envhlth/inspections/WaterTesting.asp

8. Weatherize your home to make it more energy efficient:
http://pueblo.gsa.gov/cic_text/housing/weather/weather.htm

9. Support local businesses to keep your money within the community:
http://www.webuylocal.org/about

10. Follow best management practices for maintaining your yard, farm and forest land:
   - http://www.dfr.state.nc.us/water_quality/water_quality.htm
   - http://www.co.orange.nc.us/soilwater/index.asp
   - http://www.epa.gov/watertrain/agmodule/

Smooth Coneflower (locally extinct)

11. Visit your local parks and nature preserves:
   - http://www.co.orange.nc.us/RecParks/parks.asp
   - http://www.co.orange.nc.us/ercd/future_parks_and_preserves.asp
   - http://townhall.townofchapelhill.org/parks_&_rec/facilities_greenways_&_parks/
   - http://www.ci.carrboro.nc.us/RP/parks.htm

12. Change your light bulbs to compact fluorescents:
   - http://www.energystar.gov/index.cfm?c=cfls.pr_cfls
   - http://www.nytimes.com/2009/03/28/business/energy-environment/28bulbside.html

Eastern Shooting Star (locally extinct)

13. Run multiple errands at one time. http://www.drivelesssavemore.com/driving/trip_chaining/

14. Properly abandon your out of use well: http://www.co.orange.nc.us/envhlth/inspections/documents/WellAbandonmentPacket.pdf

15. Do not dispose of grease, oil or unused medications down the drain or the toilet:
- http://www.owasa.org/Documents/DocView.aspx?IDX=1124
- http://www.p2pays.org/ref/20/19024/19024ac.pdf

16. Consider a conservation easement for your property:
- Contact the ERCD at (919) 245-2590, http://www.co.orange.nc.us/ercd/lands_legacy.asp or Triangle Land Conservancy, http://www.triangleland.org.

17. Recycle glass, plastic, mixed paper, cardboard, oil, batteries, aluminum, newspaper, magazines at your nearest convenience center or at the curb: http://www.co.orange.nc.us/recycling/community.asp

18. Dispose of hazardous waste, electronics, metal, wood and appliances properly by taking them to the Orange County Landfill and Convenience Center on Eubanks Road: http://www.co.orange.nc.us/recycling/hhw.asp

19. Conserve water:
- http://www.h2orange.org/linkwaterconservation.asp
- http://www.bae.ncsu.edu/programs/extension/publicat/wqwm/ag508_3/
- http://www.bae.ncsu.edu/programs/extension/publicat/wqwm/ag508_6.html
- http://www.bae.ncsu.edu/programs/extension/publicat/wqwm/ag508_1.html

20. Get a soil test done through Orange County Cooperative Extension prior to fertilizing your yard. http://www.agr.state.nc.us/agronomi/sthome.htm

21. Make your voice heard; get involved in the political process. http://www.co.orange.nc.us/boards/listing.asp

ORANGE COUNTY CONTACTS

Environment & Resource Conservation Department (ERCD): http://www.co.orange.nc.us/ercd/index.asp

Commission for the Environment: http://www.co.orange.nc.us/ercd/commission_for_environment.asp

Health Department—Environmental Health Services: http://www.co.orange.nc.us/envhlth/index.asp

Board of County Commissioners: http://www.co.orange.nc.us/OCCLERKS/bocc.asp

Cooperative Extension: http://orange.ces.ncsu.edu/

Indian Physic
(locally extinct)

Large Witch-alder

Crested Coralroot

Bradley's Spleenwort