TAR RIVER BASIN HYDROLOGIC MODEL DATA COLLECTION

DRAFT REPORT

Prepared for Hydrologics Inc.

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Introduction

On behalf of North Carolina Division of Water Resources (NCDWR), Hydrologics, Inc. is developing a basin-wide water use model, using OASIS, for the Tar River Basin upstream of Washington, North Carolina (Figure 1). Table 1 summarizes the portion of area contained within the limits of the model domain by county.

In support of the model development, Moffatt & Nichol (M&N) was tasked with gathering and processing water use and discharge data by agriculture, industrial, and municipal sources. The objective of the data collection effort was to develop a time series for water withdrawal and discharge for the past 79 years (1930-2009). Data was gathered from private industry as well as the following governmental agencies:

- NC Division of Water Resources (DWR)
- NC Division of Water Quality (DWQ)
- National Climactic Data Center (NCDC)
- National Agricultural Statistics Service (NASS)
- United States Department of Agriculture (USDA)
- North Carolina Department of Agriculture (NCDA)
- North Carolina Cooperative Extension Service (NCCES)
- United States Geological Survey (USGS)
- Municipal and Local Government Bodies

Methods used and sources of data acquired to develop the water use time series in support of model development are discussed below.

1. Agriculture

1.1. Data Sources

1.1.1. National Agricultural Statistics Service

Approximately every five years, the NASS requests agriculture data from farmers and land owners. Responses to the survey yield extensive data regarding land acreage, crop type grown, livestock counts, and other information. M&N contacted the NASS to obtain all records for counties within the Tar River basin back to 1930. Data included irrigated and non-irrigated acreage on tobacco, cotton, soybeans, corn, peanuts, tree farms, and head counts for livestock. Agriculture Census data was obtained for the following years: 1930, 1935, 1940, 1945, 1950, 1954, 1959, 1964, 1969, 1974, 1978, 1982, 1987, 1992, 1997, 2002, and 2007.

1.1.2. North Carolina Agriculture Statistics

Incomplete statistics data was collected from the NC Department of Agriculture back to 1930. The NCDA began collecting information for some crops prior to 1930, and others around 1975. Prior to 1975, only crop acreage for corn, cotton, tobacco and peanuts was available. After 1975, wheat, corn, oats, barley, sorghum, cotton, tobacco, peanuts, potatoes, and hay acreage was available. Also beginning in 1975, information regarding cattle, hogs and pigs, chickens, and turkeys is available.

The NCDA Plant Division maintains a database with up-to-date information regarding container and field nurseries in the State. Included in the database is nursery type and acreage. All nurseries less than 2 acres were considered to be container nurseries.

1.1.3. Consultation with Agriculture Extension Agents

After compiling all data, during October 2010, M&N contacted agriculture extension agents of counties within the Tar Basin with a questionnaire requesting verification of the most up-to-date agricultural production statistics for their county. Input from the extension agents was also used to generate estimates of the geographic distribution of the various crops and irrigation patterns within the county as a whole, as well as within each modeling subbasins located in each county.

Based on the input from the county extension agents, the livestock and agricultural products were appropriately distributed throughout the county. Extension agents were also requested to estimate the percentage of livestock and crops that are irrigated/watered with surface water. Where no data was available, the distribution of agriculture was considered to be uniform across the county. Halifax and Pitt counties were the only areas where such data was unavailable.

Numerous agricultural surface water withdrawals have been documented by aerial reconnaissance efforts undertaken in recent years by the City of Rocky Mount (Wayne Hollowell, Personal Communication, December 2010); few of these withdrawals were found to be registered with the Division of Water Resources. In light of the paucity of hard data on these withdrawals and the fact that Nash County has the second highest level of agricultural production of any county in the Tar basin, a personal meeting was held with Charlie Tyson, Director of Cooperative Extension for Nash County (Charlie Tyson, Personal Communication, December 2010). Much of the geographic distribution of agricultural production and the distinction between surface water and ground water sources used in the development of agricultural water use time series for Nash County was derived from that meeting.

1.1.4. Consultation with Dr. Ronald Sneed

Dr. Ronald Sneed, retired professor from North Carolina State University and former State extension irrigation specialist, was consulted to review the compiled agricultural data. Dr. Sneed provided insight on typical irrigation practices in use in the areas as well as to further delineate the distribution of the agriculture within each county. (Dr. Ronald Sneed, Personal Communication, November 2010)

1.1.5. Golf Course Irrigation

The extent of golf courses was determined based on a combination of available geographic information, aerial photography, and knowledge from the county extension agents.

1.2. Methods

1.2.1. Determining Crop Acreage and Livestock Head

Raw data was obtained from the sources listed above. Data gaps were filled using the following methods.

1.2.1.1. Tobacco

No significant irrigation of tobacco existed prior to 1950 and was therefore assumed to be 0. A ratio between irrigated and total acres of tobacco was computed for years where both values were known. A linear interpolation between the closest years with values using the percent irrigated was done for all data gaps.

1.2.1.2. Turf

No significant irrigated turf producers existed prior to 1970. 1969 irrigated turf acreage was assumed to be 0. Linear interpolation was done for all missing turf acreage between 1970 and 2007.

1.2.1.3. Golf Courses

An estimate of water use for golf courses was made based on the total acreage of each course. The total rate of water irrigation was assumed to be on average 1.5 in/week during (1 Apr-31 Oct); it is assumed that rate is applied over tees, greens and fairways which comprise 40% of the total golf course area; i.e. the estimate irrigation is 0.57 in/week x (total acreage). For the remainder of the year (Nov 1 – Mar 31) is assumed that only tees and greens are irrigated; tees and greens are assumed to comprise 2.9% of total acres at 1.5in/week. Data from 2006 and 2007 provided by City of Raleigh and Johnston County was used to validate the assumptions on golf course irrigation use.

Golf course acreage in 1969 was assumed to be 35% of the total acreage in 1998. In 1930, the total acreage was assumed to be 10% of the total acreage of 2008. Linear interpolation was performed for all years in between. The water demand curve for golf courses was also adjusted for the years 1930 up to 1968.

1.2.1.4. Nurseries

Both field and container nursery acreage in 1969 was assumed to be 30% of the total acreage of 2002 when no historical data was available. Field nursery acreage was assumed to be 0 in 1930. Linear interpolation was done for years in between. Container nurseries began in 1960. Therefore, container nursery acreage was assumed to be 0 in 1959. NCDA database values were used for the years 2006-2008. Linear interpolation was done for all unknown values.

1.2.1.5. Secondary Crops (Soybeans, Cotton, Corn, Peanuts, Irrigated Pasture and Hay)

Irrigation for secondary crops was assumed to be 0 before 1976 unless otherwise noted in the Agriculture Census. Linear interpolation was performed for any unknown values. Soy acreage was split evenly into early and late soy.

1.2.1.6. Vegetables

Irrigated acreage in 1975 was assumed to be 20% of the total acreage of 2002. It was assumed to be 0 in 1950. Linear interpolation was performed for irrigated vegetable acreage in all other years where data was not available. Unirrigated vegetable acreages were linearly interpolated where data was unavailable.

1.2.1.7. Blueberries and Strawberries.

Irrigated blueberry and strawberry acreage was assumed to be constant between 1975 and 2001 and from 2002 to 2008. Prior to 1975, it was assumed there was no irrigation on either crop. Large blueberry and strawberry farms are rare in this portion of the State.

1.2.1.8. Other Fruits - Orchards

Irrigated fruit acreage was assumed to be 50% of the total acreage in 2002. It was assumed to be 0 in 1950. Linear interpolation was performed for years in between.

1.2.1.9. Livestock

Linear interpolations were performed for years where no Census or Agricultural Statistics data exists.

1.2.2. Determining Agricultural Water Use

The methodology for determining water use by agriculture in the basin mirrored that of the Cape Fear and Neuse River Basin Models. Evapotranspiration (ET) demand for tobacco, soybeans, peanuts, cotton, and corn was estimated based on the moisture curves provided by Dr. Sneed. The plant dates (start dates) were staggered based on geographical location of the county in which they are planted. The corresponding counties fell into the following classifications: upper – Person, Granville, Vance, Warren, Franklin, Halifax; middle – Nash, Edgecombe; and lower – Pitt and Martin. Crop requirements for turfgrass, golf courses, nursery crops, vegetables, blueberries, strawberries, and other fruit were estimated seasonally. The general breakdown for these crops incorporated a warm and cool season with special consideration for frost/freeze protection where applicable. USGS water use daily requirements from the 1995 Water Use Report were used for livestock water use requirements, per the Cape Fear Model Report (Moffatt & Nichol, 1999).

To summarize,

Table 1-1. Crop Water Requirements

Crop	Start Date			Evapotranspiration
	High	Mid	Low	
Tobacco	20 May	10 May	30 April	By Curve
Early Soybeans	20 May	28 May	1 May	By Curve
Late Soybeans	20 June	20 June	20 June	By Curve
Peanuts	N/A	7 May	7 May	By Curve
Cotton	N/A	7 May	7 May	By Curve
Corn	23 April	14 April	7 April	By Curve

Pasture and Hay: 1 May – 30 September, 1”/week; Rest of year = none

Turfgrass: 15 April – 15 October, 1.25”/ week; Rest of year = none

Golf Courses: 1 April – 31 October, 0.57”/week; Rest of year = Tees and greens 2.9% of total acres, 2”/week

Nursery (container): 1 June – 31 August, 0.75”/day; 1 April -31 May and 1 September – 31 October, 0.5”/day; Rest of year = 0.2”/day

Nursery (field): 1 May – 31 October, 1.25”/week; Rest of year = none

Vegetables: 1 April – 15 August, 1.25”/week; 16 August – 31 October, 1”/week; Rest of year = none

Blueberries: 15 April -15 June, 1.25”/week (production); 16 June – 30 September, 1.25”/week (protection); 28 February – 14 April, 1”/day for frost/freeze protection, highly variable

Strawberries: 1 April – 1 June, 1.25”/week (production); 15 September – 31 October, 1.25”/week (establishment); 1 October – 15 November, 1”/day (establishment); 28 February – 1 April, 1”/day for frost/freeze protection, highly variable

Other fruit: (Peaches, pecans, Apples, etc.): 15 April – 31 August, 1.25”/week (production); 1 March – 14 April, 0.16”/hr = 3.84”/day for frost/freeze protection

Table 1-2: Livestock Water Requirements

Livestock	Water Requirement	Duration
Beef Cattle	12 gal/day/head	All Year
Dairy Cattle	40 gal/day/head	All Year
Horses	12 gal/day/head	All Year
Pigs	4 gal/day/head	All Year
Chickens	9 gal/day/100 head	All Year
Turkeys	9 gal/day/100 head	All Year
Other animals (mainly goats, sheep)	2 gal/day/head	All Year

With the data above, a total agricultural water use demand curve consisting of daily values was computed for the time period between 1930 and 2009. For tobacco, soybeans, peanuts, cotton, and corn, irrigation is directly related to crop stress and rainfall. Therefore, each crops' weekly ET demand was compared to weekly rainfall totals. Where shortfalls of rainfall occurred, irrigation was assumed to make up the balance of the demand. The shortfall amount was then evenly distributed over the next week. All other crops and livestock had fairly constant irrigation and water usage and were therefore not related to rainfall. Completing these calculations for the each year gives a daily total agricultural water use for the model.

When reviewing this information, it is important to be aware of the overall history of irrigation in North Carolina. Prior to the 1950's, little irrigation was done in North Carolina. Up until that time, only steel pipe was used for irrigation, and the war effort was consuming most available steel supplies. However, during the 1950's, three catalysts spurred the initial growth of irrigation in NC: the ending of WWII, the advent of aluminum pipe, and the drought of the 1950's. Aluminum pipe was especially important because its weight allowed fixed systems to be moved with relative ease. The next important advance in irrigation came in the late 1960's and early 1970's with the birth of automated irrigation and hard hose reel systems. These systems allowed irrigation of secondary crops like corn and soybeans to become economically feasible. Of course, other factors such as changes in leisure time and affluence have also had effects on irrigation since commercial turf and golf courses rely heavily on irrigation.

The system used for determining total water use used for irrigation and watering of livestock is described in Section 2.2.1.

1.2.3. Rainfall

Rainfall data was used in determining frequency of irrigation. As described above, a weekly irrigation amount was assigned to each crop. If the rainfall total in that week did not reach the minimum value, irrigation was used to supplement. Rainfall for 1930-2009 was gathered from the National Climactic Data Center. The location of gages is illustrated in Figure 2 and summarized in Table 2.

1.2.4. Groundwater and Surface Water Uses

Due to the low gradients in the topography of the Tar River basin, and the increasingly porous soils as one moves east in basin, there is a strong potential for a highly interactive relationship between ground water and surface water hydrology. As a result, large groundwater withdrawals located in the immediate vicinity of surface waters within the basin have the potential to affect stream flows nearly as much as direct surface water withdrawals.

Anecdotal accounts from agricultural resources professionals (Charlie Tyson, Personal Communication, December 2010) indicate that some irrigation systems in the basin are fed by ponds that are recharged with groundwater wells in the immediate vicinity of large perennial streams and/or the Tar River. While such ponds may not be directly connected to flowing streams, there is connectivity to the surrounding groundwater table. During high use periods withdrawal from these ponds will influence the surface water flow.

For purpose of this study "surface" water withdrawals are defined to include all direct withdrawals from the mainstem of the Tar River or major tributaries. Additionally, surface water ponds and groundwater withdrawals that are expected to have a major influence on the Tar River flow during drought conditions are included.

Unfortunately, there is no available geographic distribution data of individual agricultural users within the basin. Moffatt & Nichol had to rely on review of aerial photos and communication with local agricultural resources professionals to generally characterize the portion of agricultural withdrawal that is surface water. Those operations within approximately 500 feet of the Tar River or a major tributary were accounted for in the model as surface water withdrawals.

1.3. Data Distribution

The distribution of agricultural water use was developed based input from NC Agriculture Extension Agents from each county. The agents were asked to verify the values and note the distribution of those crops within the county based on the model nodes. Figure 3 summarizes the distribution of agriculture with respect to the location of the calibration gages used in the model.

The verified distributions were then applied to the water use for each county by assigning an estimated portion of the crop/livestock to the drainage area of the node. These values were then used to formulate an overall time series for historical water use.

2. Municipal and Industrial Withdrawals

2.1. Data Sources

Initial requests withdrawal data were made to NCDWR, respectively, and these bulk data on withdrawal volumes (from Local Water Supply Plans) were supplemented with data and information from individual private and municipal entities throughout the basin. A significant collection effort was undertaken by Moffatt & Nichol. Only entities withdrawing more than 100,000 gallons per day were considered. Table 3 summarizes the withdrawal data compiled and the record of data available. Figure 4 illustrates the distribution of water withdrawals.

Each water user was requested to provide water withdrawal data for as far back as possible, with a preference for daily data where it was available. Anecdotal information on events such as facility start-up and shut-down dates and expansions was also gathered and taken into account.

Data was provided in several formats and time periods. The majority of the water withdrawal information was provided up through December 2009.

2.2. Methodology

The water withdrawal data was organized into a monthly time series for input into the model. The start dates provided by the withdrawal entities were used, if available. For the public water users, back calculations were done based on the city or county population data to determine the historical water withdrawals. The time series were extrapolated back as far back as 1930, if documentation and accounts indicated that the withdrawal

existed to that year. Otherwise, if no withdrawal at that location prior to a certain year, the time series was only extended back to the corresponding start month. No direct industrial withdrawals (current or historical) greater than 100,000 gallons per day were identified in the Tar River Basin.

3. Municipal and Industrial Discharges

3.1. Data Sources

The primary source for the total municipal and industrial discharges into the basin is from the NPDES permitting and monitoring program at NCDWQ. All permitted discharges were compiled as identified in Table 4 and the location is illustrated in Figure 5. A file for each discharger in the basin was created. The NCDWQ discharge records typically dated back to 1994. In addition each discharger was requested to provide water withdrawal data for as far back as possible, with a preference for daily data where it was available. Anecdotal information on events such as facility start-up and shut-down dates and expansions was also gathered from individual facilities and taken into account.

Time series were developed for facilities that are currently in use, as well as historic (now closed) facilities.

3.2. Methods

Records directly from individual facilities were given preference where available. In order to generate historical time series prior to reported discharge data, linear interpolations of per capita discharge volumes were developed on the basis of city and county population data. To fill in any data gaps for industrial discharges, the earliest recorded discharges were assumed to be constant back until the facility opened.

All entities that discharge greater than 100,000 gallons per day were considered. The time series were extrapolated back as far back as 1930, if documentation and accounts indicated that the discharge existed that long ago. Otherwise, if no discharge existed at that location prior to a certain year, the time series was only extended back to the corresponding start month.

Extensive interpolation was performed to fill in any data gaps prior to 1994. Although there was little data to be had, the discharge data set represents a detailed and extensive assessment of available information and historic accounts.

4. References

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Referenced Tables

Table 1. Summary of Tar River Basin - Distribution by County

County	Total County Area (acreage)	Area within the Tar River Basin (acreage)	Percentage of the County within the Tar River Basin
Edgecombe	324,297	322,889	100%
Franklin	316,682	283,770	90%
Granville	343,233	147,514	43%
Halifax	468,000	282,591	60%
Martin	295,963	7,866	3%
Nash	347,331	277,560	80%
Person	258,581	20,181	8%
Pitt	419,058	77,030	18%
Vance	172,724	82,711	48%
Warren	283,766	174,686	62%
Wilson	239,485	44,522	19%

Table 2. Basis of County Rainfall Statistics

County Name	Rain Gages Used
Edgecombe	Wilson gage 1936-2009; Filled gaps with Louisburg gage 1930-1936.
Franklin	Louisburg gage 1930-2009.
Granville	Durham gage 1930-2009.
Halifax	Enfield gage 1930-2009. Gaps filled with Warrenton and Rocky Mount gages.
Martin	Pitt/Greenville airport gage 1930-2009
Nash	Louisburg gage1930-1973; Rocky Mount Airport 1973-2009.
Person	Louisburg gage 1930-2004; Person county/Roxboro Airport 2004-2009
Pitt	Pitt/Greenville airport gage 1930-2009
Vance	Louisburg 1930-1948; Warrenton 1948; Henderson 2004-2009. Gaps filled with Louisburg gage
Warren	Warrenton gage; gaps filled with Louisburg gage. Wilson 3 SW 1936-2008; gaps filled with Greenville data
Wilson	Wilson 3 SW 1936-2009; filled gaps with Rocky Mount/Wilson gage.

Table 3. Summary Water Withdrawal Data

Background Data: Tar River Basin Water Withdrawal >100,000 gal/day						
PWSS		**Plants**	**SW Sources**	**Historical Assumptions**	**Data Available**	**Projected Withdrawal Period**
1	Rocky Mount	Tar River WTP Sunset Ave WTP	Tar River/Tar River Reservoir	Both facilities withdraw from Tar River upstream form same model node. Finished water production flipped back and forth between two plants. Single time series developed. City of Rocky Mount poulation data used.	1997/2002/2007-2009 NCDWR monthly data, daily raw water intake data from 2006-2010	1930-2009
2	Greenville	Greenville WTP	Tar River	Single facility continuously operated since 1905. City of Greenville poulation data used.	1997/2002/2007-2009 NCDWR monthly data, daily raw water intake data from 1999-2010	1930-2009
3	Tarboro	Tarboro WTP	Tar River	Single facility continuously operated since 1934. City of Tarboro poulation data used.	1997/2002/2007-2009 NCDWR monthly data	1934-2009
4	Louisburg	Louisburg WTP	Tar River	Single facility continuously operated since 1932. City of Louisburg poulation data used.	1997/2002/2007-2009 monthly data, monthly raw water intake data from 1986-2010	1932-2009
5	Franklinton	Franklinton WTP	New City Pond/Old City Pond	Single facility continuously operated. Start date unknown. Town of Franklinton poulation data used.	1997/2002/2007-2009 NCDWR monthly data	1930-2009
6	Enfield	Enfield WTP	Fishing Creek	Current facility start date estimated at 1960. Replaced older plant on adjacent site. Municipal records indicate bond floated for water system in 1920. Town of Enfield poulation data used.	1997/2002/2007-2009 NCDWR monthly data	1930-2009
7	Henderson	Henderson WTP	Fox's Pond	Facility abandoned when Henderson connected to Kerr Lake Regional Water Supply in 1975. Capacity estimated by City Staff to be 2.5-3.0 MGD. Monthly time series generated for 1975 and City of Hendeson population data used to extrapolate back.	No intake data available	1930-1975
8	Oxford	Oxford WTP	Tar River	Facility abandoned when Oxford connected to Kerr Lake RWS in 1975. Capacity and withdrawals unknown. Ratio of monthly water purchases from Kerr Lake RWS to recent reported wastewater discharges calculated and used to extrapolate withdawals based on historical discharge volumes.	No intake data available	1930-1975

Table 4. Summary of Wastewater Discharges

Permit	Owner	Facility	County	Type	Class	Permitted Flow (MGD)	Subbasin	Receiving Stream	Longitude	Latitude	Projected Discharge Period	Historical Assumptions
NC0001058	DSM Pharmaceuticals, Inc.	DSM Pharmaceuticals	Pitt	Industrial Process & Commercial	Minor	not limited	03-03-05	Parker Creek	-77.356670	35.656670	1970-2009	Plant began operation in 1970.
NC0001589	Hospira, Inc.	Hospira, Inc. -RM1	Nash	Industrial Process & Commercial	Minor	not limited	03-03-02	Beech Branch	-77.760280	36.036670	1963-2009	Plant began operation in early 1960s . Exact year unknown. Assume 1963.
NC0020061	Town of Spring Hope	Spring Hope WWTP	Nash	Municipal, < 1MGD	Minor	0.400	03-03-02	TAR RIVER	-78.112780	35.905280	1947-2009	1947 best Town Officials could estimate.
NC0020231	Town of Louisburg	Louisburg WWTP	Franklin	Municipal, Large	MAJOR	1.37	03-03-01	TAR RIVER	-78.292220	36.086670	1952-2009	1952 best Town Officials could estimate.
NC0020435	Town of Pinetops	Pinetops WWTP	Edgecombe	Municipal, < 1MGD	Minor	0.300	03-03-03	Town Creek	-77.617780	35.806670	1967-2009	Current plant started in 1967. No record of prior facilities.
NC0020605	Town of Tarboro	Tarboro WWTP	Edgecombe	Municipal, Large	MAJOR	5.00	03-03-03	TAR RIVER	-77.538610	35.883060	1959-2009	Current plant started in 1959. No record of prior facilities.
NC0020834	Town of Warrenton	Warrenton WWTP	Warren	Municipal, Large	MAJOR	2.00	03-03-04	Fishing Creek	-78.168610	36.379720	1962-2009	Trickling filter plant existed at site as early as 1962. No record of prior facilities.
NC0023337	Town of Scotland Neck	Scotland Neck WWTP	Halifax	Municipal, < 1MGD	Minor	0.675	03-03-04	Canal Creek	-77.433890	36.119440	1963-2009	Original plant built at site in 1963. No record of prior facilities.
NC0023931	Greenville Utilities Comm.	GUC WWTP	Pitt	Municipal, Large	MAJOR	1.75	03-03-05	TAR RIVER	-77.301670	35.598890	1930-2009	Plant operating at site since 1907
NC0025054	City of Oxford	Oxford WWTP	Granville	Municipal, Large	MAJOR	3.50	03-03-01	Fishing Creek	-78.591110	36.277220	1930-2009	*See note below
NC0025402	Town of Enfield	Enfield WWTP	Halifax	Municipal, Large	MAJOR	1.00	03-03-04	Fishing Creek	-77.693060	36.151110	1935-2009	1935 best Town Officials could estimate.
NC0025691	Town of Littleton	Littleton WWTP	Halifax	Municipal, < 1MGD	Minor	0.280	03-03-04	Butterwood Creek	-77.906110	36.415000	1973-2009	Current plant started in 1973. No record of prior facilities.
NC0026042	Town of Robersonville	Robersonville WWTP	Martin	Municipal, Large	MAJOR	1.80	03-03-06	Flat Swamp	-77.258330	35.811110	1940-2009	1940 best Town Officials could estimate.
NC0030317	City of Rocky Mount	Tar River Regional WWTP	Edgecombe	Municipal, Large	MAJOR	21.0	03-03-02	TAR RIVER	-77.724170	35.976940	1930-2009	City has operated a WWTP at or near the site since 1911.
NC0042269	Town of Bunn	Bunn WWTP	Franklin	Municipal, < 1MGD	Minor	0.150	03-03-01	Crooked Creek	-78.261390	35.944720	1977-2009	Current plant started in 1977. No record of prior facilities.
NC0050661	Town of Macclesfield	Macclesfield WWTP	Edgecombe	Municipal, < 1MGD	Minor	0.175	03-03-03	Bynums Mill Creek	-77.666390	35.745000	1985-2009	Current plant started in 1985. No record of prior facilities.
NC0069311	Franklin County	Franklin County WWTP	Franklin	Municipal, Large	MAJOR	3.00	03-03-01	Cedar Creek	-78.416940	36.070000	1989-2009	Current plant started in 1989. No prior facility operated by Franklin County.
NC0072125	City of Rocky Mount	Tar River WTP	Nash	Water Treatment Plant	Minor	not limited	03-03-02	TAR RIVER	-77.883330	35.900560	1971-2009	Facility completed in 1971
NC0072133	City of Rocky Mount	Sunset Avenue WTP	Nash	Water Treatment Plant	Minor	not limited	03-03-02	TAR RIVER	-77.818890	35.952780	1935-2009	Plant operating at site since 1935
NC0077437	Edgecombe Genco LLC	Battleboro plant	Edgecombe	Industrial Process & Commercial	Minor	0.904	03-03-02	TAR RIVER	-77.758060	35.977780	1970-2009	Cogeneration plant began operation in 1970
NC0082139	Greenville Utilities Comm.	Greenville WTP	Pitt	Water Treatment Plant	Minor	1.20	03-03-05	TAR RIVER	-77.398610	35.634440	01/1994-05/2010	WTP operating at site since 1905

*Note on Oxford: The current wastewater treatment plant at Oxford was purchased from Burlington industries, rehabilitated, and upgraded for municipal use beginning in 1969. It replaced two prior and aging wastewater treatment plants located north and south of town, the Northside WWTP and Southside WWTP, respectively. City staff were unable to locate and records discharge volumes from these facilities or even the proportion of the City's sewer flow that went to each of them, but they were both completely phased out and all flows were routed to the current plant by 1987. Both of these facilities discharged to tributaries that ultimately fed to the Tar River upstream of the gage at Louisburg, so all of Oxford's facilities over the years have flowed to the same node in the Tar River basin model. Further, no information was available to document when the old plants originally started up. In light of these facts, a single time series of wastewater discharges from the City of Oxford, was generated and extrapolated based on population and the reported flows from the existing plant, all the way back to 1930.

Referenced Figures

Figure 1. Tar River Basin

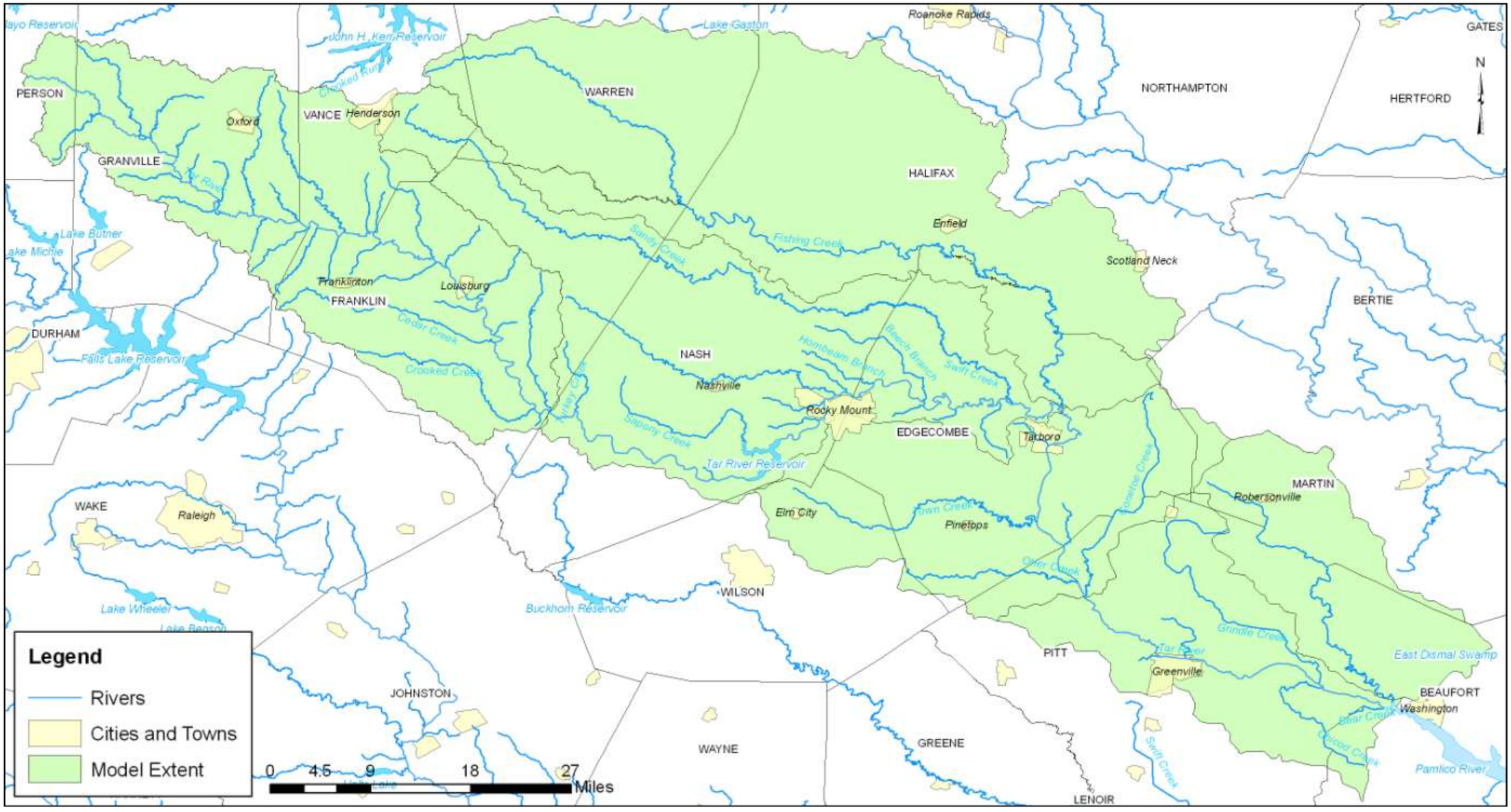

Figure 2. Rain Gages

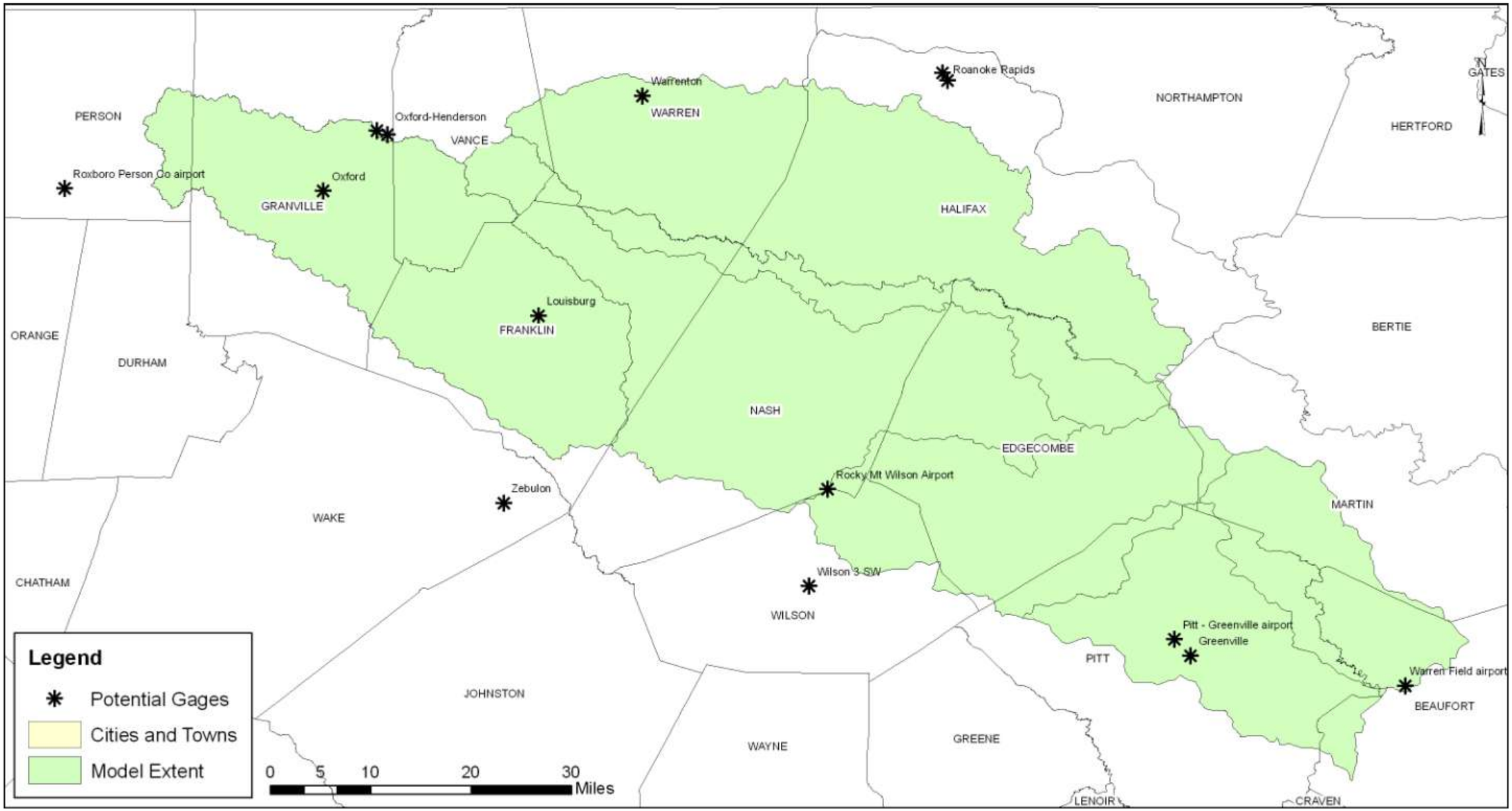

Figure 3. Agricultural Subbasin Distribution by County and Node

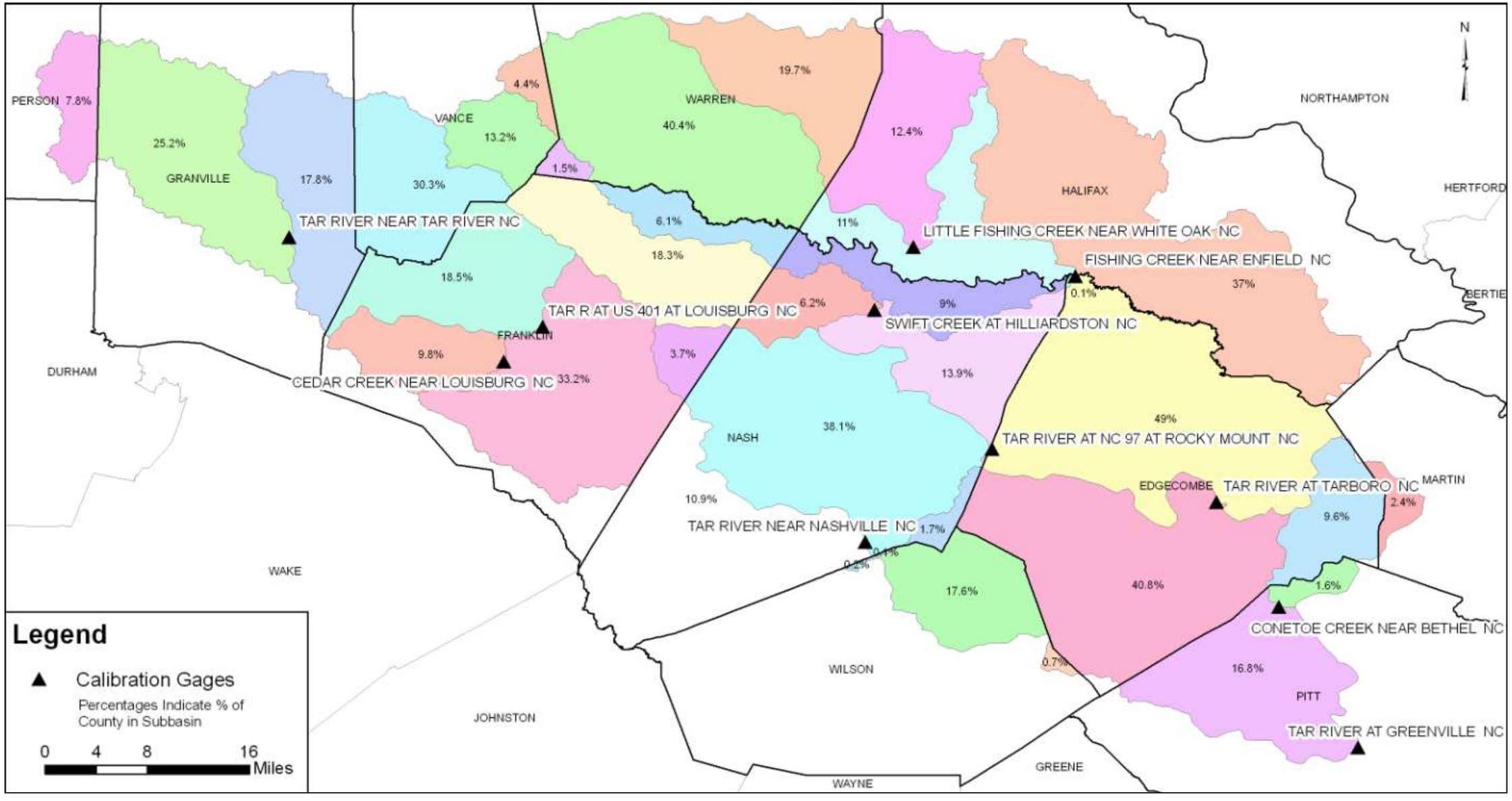

Figure 4. Water Withdrawal Locations

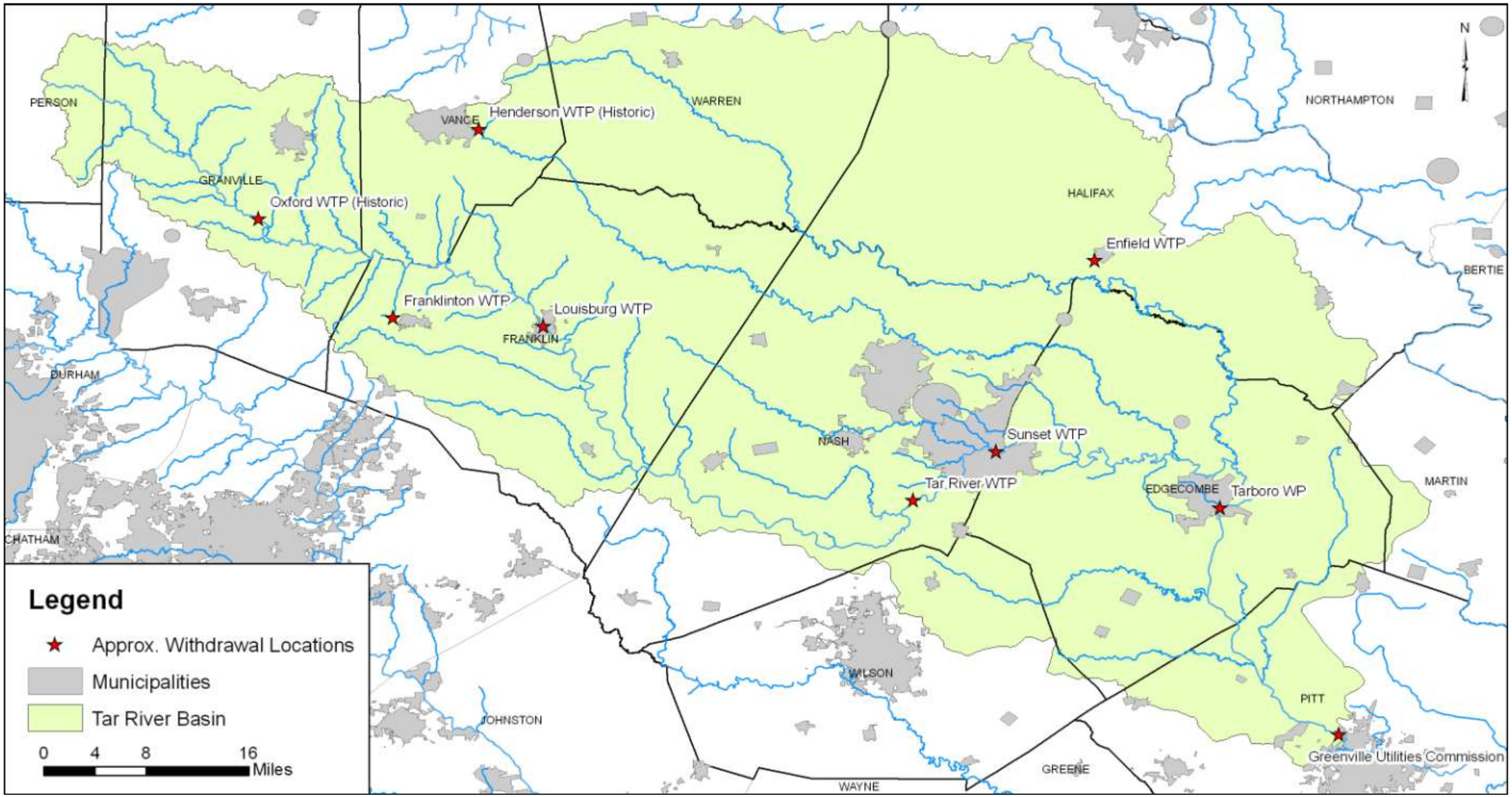

Figure 5. Wastewater Discharge Locations