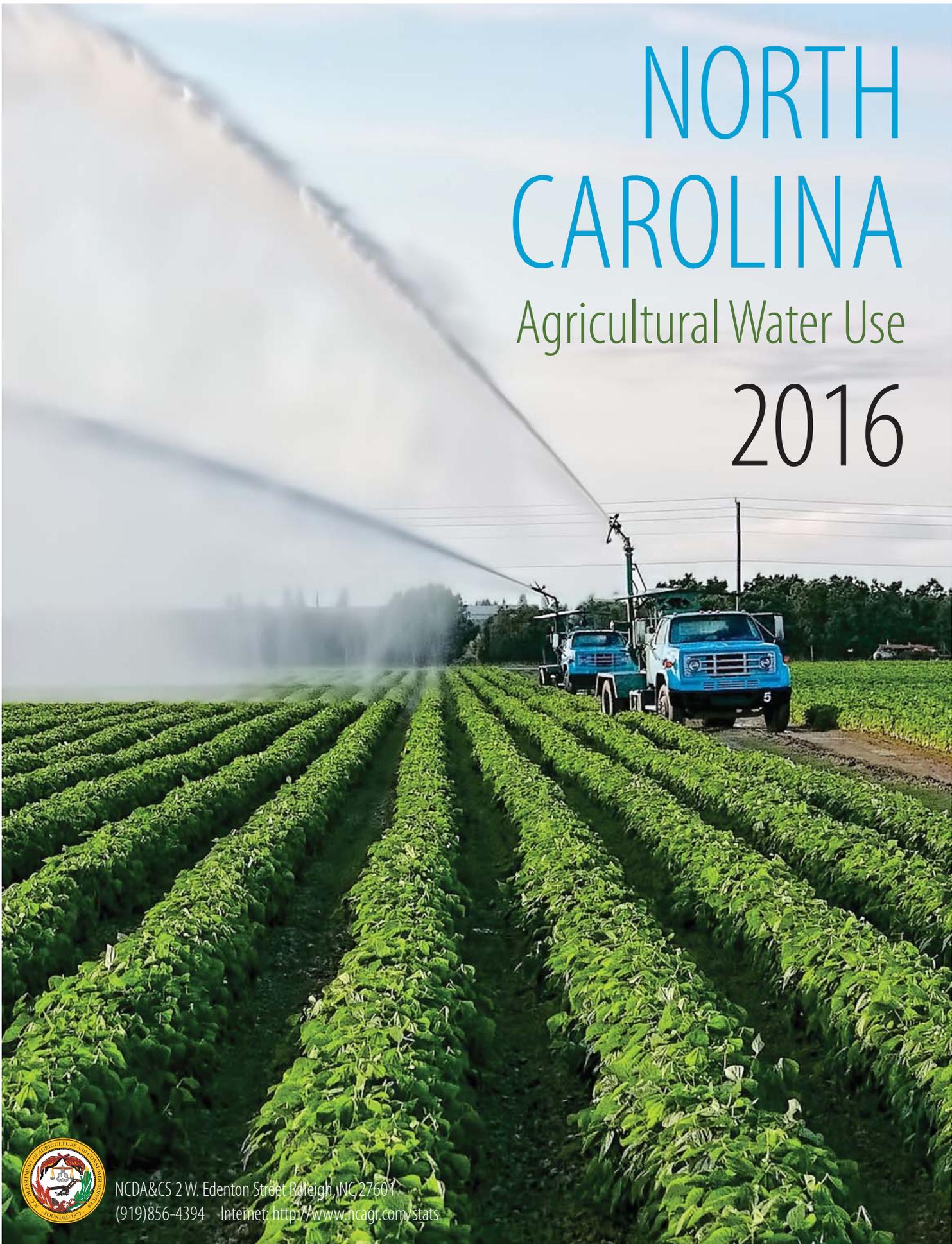


NORTH CAROLINA

Agricultural Water Use

2016



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NORTH CAROLINA

2016 Agricultural Water Use Survey

The seventh statewide survey was conducted to document water use for the agricultural sector during 2016. As directed in legislation enacted in 2008 (SL2008-0143), the North Carolina Department of Agriculture and Consumer Services, Agricultural Statistics Division, is required to collect annual information from farmers who withdraw 10,000 gallons or more in any one day. Individual responses remain confidential and are only used in combination with other reports to produce totals.

Farmers who use over 1,000,000 gallons in any one day are required to report their water usage directly to the Department of Environmental Quality (DEQ). DEQ's report can be found on http://www.ncwater.org/Permits_and_Registration/Water-Withdrawal_and_Transfer_Registration/report.

When looking at agricultural water use from a total volume withdrawn perspective, table 1 on page 4 is most representative of total water use. Because farms that withdraw the largest amounts of water do not make those withdrawals every day, the average daily use across all days of the year is most representative of relative volumes used. On average, farm operations that use irrigation will withdraw water about 18 days each month. Field crop operations use water even less often, primarily to supplement rainfall. While there are other agricultural users of water, including livestock and poultry producers, aquaculture farms, and others, the largest volume of water use is from irrigators. The average North Carolina farm that uses water does so infrequently and in relatively small amounts. Table 2 on page 7 displays "demand" use, which is calculated by dividing the total water withdrawn for the month by the days applied.

The results of this survey reflect water withdrawals from ground and surface sources. Many comparisons across sectors will incorporate an estimate of consumptive use of withdrawals. The definition of a consumptive use varies depending on the source. Most experts in agricultural sciences consider consumptive use to be the amount of water that is either taken up by plants, or evaporated. According to an Economic Research Service (USDA) report https://www.ers.usda.gov/webdocs/publications/41964/30286_wateruse.pdf?v=41143, irrigation consumptive use on farms is about 61 percent of total withdrawals nationally. This can vary greatly between regions depending on the type of system used and efficiency of the irrigation equipment.

Of the farms surveyed in the state, 945 withdrew over 10,000 gallons of water in any one day. The majority of the state experienced normal soil moisture conditions until March when much of the state experienced abnormally dry conditions in April. The situation improved significantly in May with the exception of the far western counties which fell into moderate drought conditions. The majority of the state experienced normal conditions through August. Abnormally dry conditions spread from the far western counties into the western piedmont in September and across the piedmont in December. Counties which went into moderate drought in June fell into extreme and exceptional drought by November. July was the largest water use month in 2016, averaging 95.7 million gallons daily, with a maximum daily withdrawal of 242 million gallons. The annual average daily water use for 2016 was 39.4 million gallons. The daily withdrawal capacity for the 945 operations totaled 928.1 million gallons in 2016.

A questionnaire was mailed to operations which had potential for large water usage. Operations that did not respond were contacted by telephone follow-up. In addition, livestock and poultry contractors in the state were contacted by email, phone, or mail.

The unique number of operations, the annual average daily ground and surface usage, as well as the capacity is published by county and by hydrologic unit codes (HUC). The capacity is the potential amount of ground and/or surface water that could be withdrawn in a 24-hour period. The published capacity represents the sum of capacities for all reporting operations in that county or HUC. In nearly all cases, this capacity was never met. Data was not disclosed if there were less than three operations in any category or if one report comprised 60 percent or more of the total.

One survey instrument was used to gather data for the whole state as well as for the Central Coastal Plain Capacity Use Area (CCPCUA). Results for the CCPCUA are summarized and published in a separate table.

**Table 1: Total & Average Daily Water Withdrawn ¹
2016 North Carolina Water Use by Month**

Month	Operations	Monthly Total Ground	Monthly Total Surface	Average Across All Days-Ground	Average Across All Days-Surface
	<i>Number</i>	<i>Gallons</i>	<i>Gallons</i>	<i>Gallons</i>	<i>Gallons</i>
January	657	282,653,194	174,131,399	9,117,845	5,617,142
February	673	263,616,036	171,334,417	9,090,208	5,908,083
March	703	338,797,172	295,967,719	10,928,941	9,547,346
April	767	510,174,646	506,036,217	17,005,822	16,867,874
May	791	548,976,765	634,517,446	17,708,928	20,468,305
June	848	1,086,397,882	1,341,111,526	36,213,263	44,703,718
July	876	1,194,104,566	1,771,106,975	38,519,502	57,132,483
August	840	1,002,189,347	1,532,968,550	32,328,689	49,450,598
September	756	554,706,269	603,694,491	18,490,209	20,123,150
October	696	373,569,478	367,899,789	12,050,628	11,867,735
November	670	300,190,939	164,956,737	10,006,365	5,498,558
December	642	295,667,577	142,529,890	9,537,664	4,597,738
Annual Average				18,416,505	20,981,894

Operations :

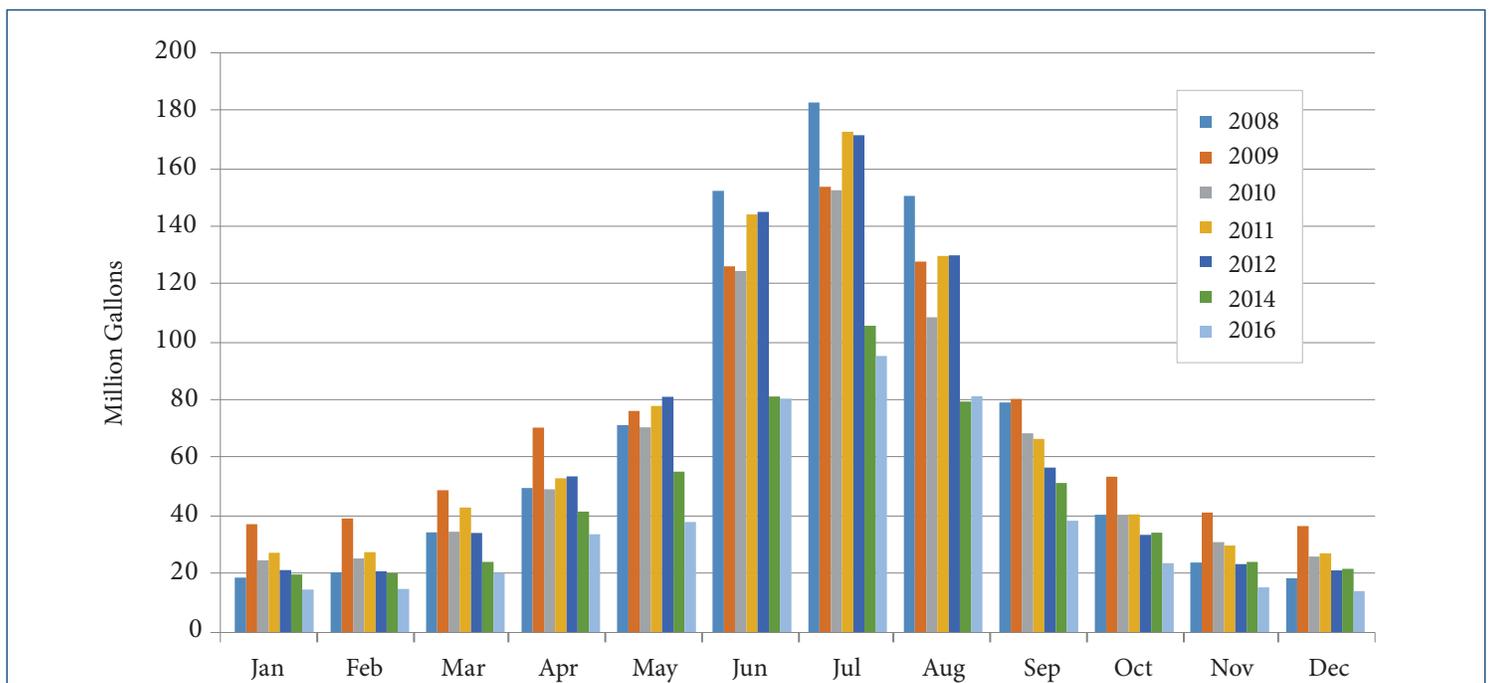
945 Total Operations

Daily Withdrawal Capacity (incl. ground & surface):

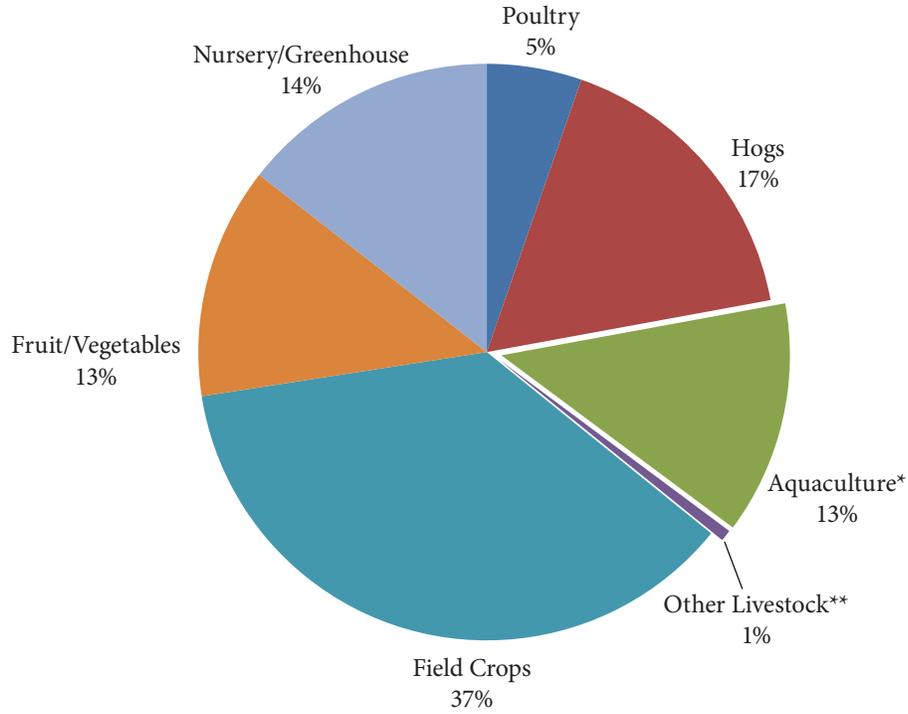
928,052,014 Gallons

¹ Users of 10,000 gallons or more per day. Averages reported in this table reflect the average water withdrawn across all days of the month. Farms that reported their withdrawals directly to DEQ by May 19, 2017 have been excluded. The monthly number of operations will not add to the total. Some operations reported both surface and ground water withdrawals, which are counted twice in the monthly number of operations. However, the total number of operations represents operations that withdrew water at any time during the year, regardless if withdrawn from multiple sources.

**Average Across All Days
Ground & Surface Water Withdrawals
2008–2016**



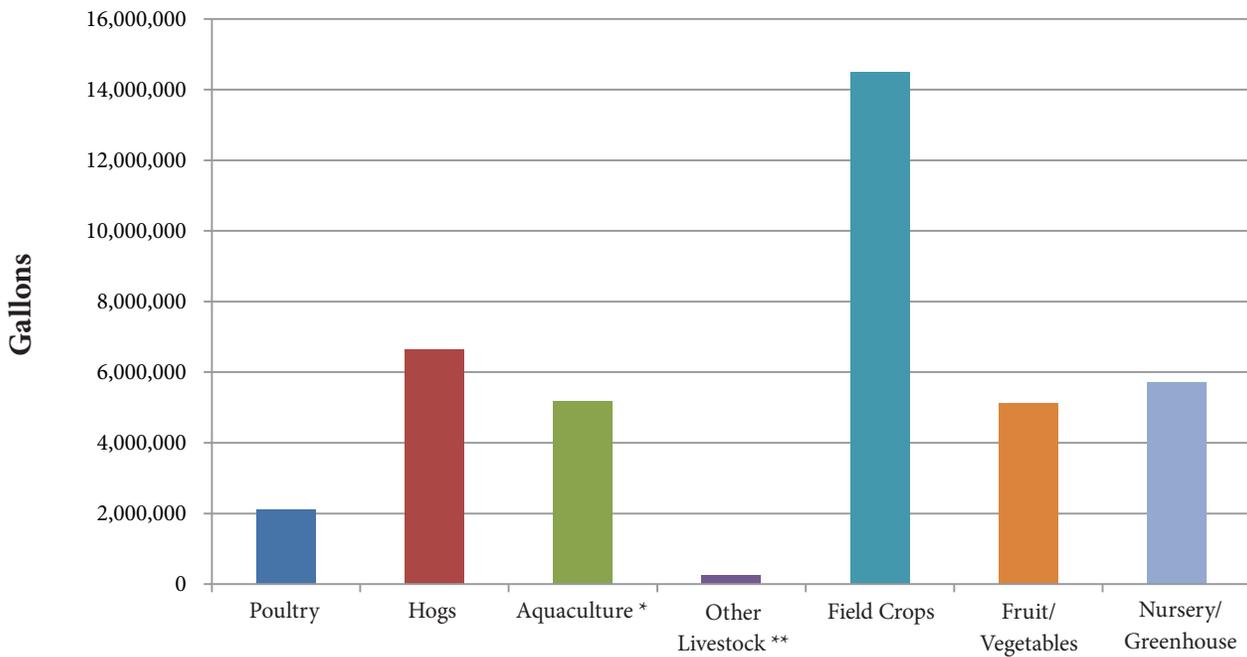
2016 Annual Water Withdrawals by Percent



* 78% of aquaculture water withdrawals occur in western counties from rivers and streams and are typically flow through/non-consumptive.

** Other Livestock includes cattle, horses, goats, sheep, etc.

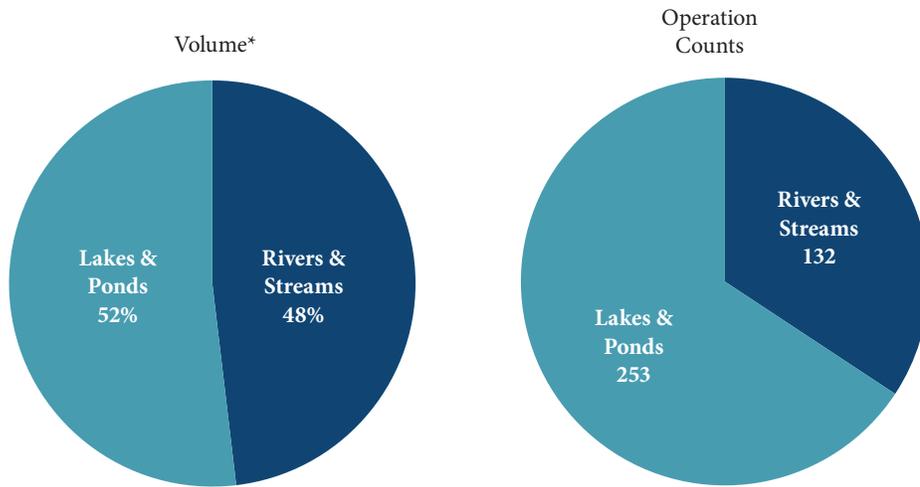
2016 Average Daily Water Withdrawals



* 78% of aquaculture water withdrawals occur in western counties from rivers and streams and are typically flow through/non-consumptive.

** Other Livestock includes cattle, horses, goats, sheep, etc.

2016 Annual Surface Water Withdrawals



* 32% of River & Stream Withdrawals are made by aquaculture operations from the western portion of the state and are typically flow through/ non-consumptive.



Table 2: Demand Use for Days Applied ¹
2016 North Carolina Water Use by Month

Month	Average Days Applied Ground	Average Days Applied Surface	Total Average Daily-Ground	Total Average Daily-Surface	Total Max Daily-Ground	Total Max Daily-Surface
	<i>Days</i>	<i>Days</i>	<i>Gallons</i>	<i>Gallons</i>	<i>Gallons</i>	<i>Gallons</i>
January	28	14	10,742,818	8,849,160	11,840,500	9,052,527
February	26	13	10,732,934	9,100,885	12,079,747	9,158,515
March	28	14	15,084,033	37,076,311	17,455,108	37,785,945
April	27	15	30,765,220	63,106,410	35,551,281	68,321,736
May	28	18	39,427,597	42,218,924	43,530,867	49,127,097
June	27	17	71,148,004	99,804,322	79,024,803	117,462,669
July	27	17	76,973,738	126,229,501	84,798,198	157,187,547
August	27	17	59,641,287	106,244,328	66,663,092	131,907,020
September	27	18	27,258,590	42,938,760	32,624,371	52,447,935
October	28	17	16,223,414	37,735,191	19,238,663	40,621,676
November	27	15	12,681,671	9,368,855	14,653,500	10,102,615
December	27	15	12,447,159	7,500,601	14,159,220	8,104,467
Annual Average			31,927,205	49,181,104		

¹ Users of 10,000 gallons or more per day. Averages reported in this table reflect the average water withdrawn during the days of application. Farms that reported their withdrawals directly to DEQ by May 19, 2017 have been excluded.



2016 North Carolina Water Use County Summary

County	Unique Operations ¹	Annual Average Daily ² Ground	Annual Average Daily ² Surface	Daily Withdrawal Capacity ³
	<i>Number</i>	<i>Gallons</i>	<i>Gallons</i>	<i>Gallons</i>
Alexander	4	33,317	*	454,800
Anson	10	130,901	*	1,916,271
Bertie	15	313,941	900,606	23,739,400
Bladen	63	915,426	266,473	69,570,111
Brunswick	4	45,723	*	1,435,200
Chatham	7	44,093	*	965,400
Cleveland	7	115,603	*	918,472
Columbus	9	188,099	*	2,016,469
Duplin	92	1,579,630	*	46,562,405
Edgecombe	10	67,294	728,354	21,101,873
Franklin	7	17,703	*	7,496,000
Granville	8	*	76,348	14,689,400
Guilford	9	*	320,465	9,046,400
Halifax	7	46,221	*	7,487,700
Harnett	14	74,294	*	10,552,805
Hertford	12	148,487	784,897	18,547,551
Johnston	25	397,719	971,190	19,694,382
Jones	12	224,536	*	2,642,206
Lee	11	28,437	142,005	7,500,713
Montgomery	10	43,583	*	3,428,200
Moore	15	51,372	161,737	8,502,960
Nash	18	*	783,263	23,995,200
New Hanover	6	165,387	*	4,269,800
Northampton	17	209,061	*	7,904,574
Onslow	7	71,883	*	1,024,240
Orange	6	39,634	9,737	748,040
Pender	19	548,703	*	88,344,461
Pitt	12	*	116,837	17,777,171
Randolph	17	72,202	*	9,995,960
Robeson	46	2,316,236	*	39,019,967
Rockingham	20	*	487,095	22,600,400

County	Unique Operations ¹	Annual Average Daily ² Ground	Annual Average Daily ² Surface	Daily Withdrawal Capacity ³
	<i>Number</i>	<i>Gallons</i>	<i>Gallons</i>	<i>Gallons</i>
Sampson	94	2,051,120	*	43,445,150
Scotland	20	1,706,081	*	14,983,764
Surry	15	89,235	*	10,310,720
Transylvania	5	*	1,762,892	4,177,200
Union	24	286,629	*	7,695,180
Vance	4	*	66,208	5,499,600
Wake	14	*	517,170	8,967,520
Wayne	28	563,875	*	9,807,771
Wilkes	15	93,206	*	2,392,165
Yadkin	6	52,506	*	974,200
Other Counties ⁴	201	5,684,366	12,886,618	325,850,213
State	945	18,416,505	20,981,894	928,052,014

* Disclosure - one operation is greater than 60% of total or less than 3 operations reported. ¹ Represents the unique # of operations which withdrew surface and or ground water ² Represents the average across all days of the year ³ Includes ground and surface
⁴ Includes nondisclosed data from the table above and all data for Alamance, Alleghany, Ashe, Avery, Beaufort, Buncombe, Burke, Cabarrus, Caldwell, Camden, Carteret, Caswell, Catawba, Cherokee, Chowan, Clay, Craven, Cumberland, Currituck, Dare, Davidson, Davie, Durham, Forsyth, Gaston, Gates, Graham, Greene, Haywood, Henderson, Hoke, Hyde, Iredell, Jackson, Lenoir, Lincoln, McDowell, Macon, Madison, Martin, Mecklenburg, Mitchell, Pamlico, Pasquotank, Perquimans, Person, Polk, Richmond, Rowan, Rutherford, Stanly, Stokes, Swain, Tyrrell, Warren, Washington, Watauga, Wilson, Yancey, as well as non-disclosed data from the published counties.

2016 North Carolina Water Use - Hydrologic Unit Code Summary

Hydrologic Unit Code	Unique Operations ¹	Annual Average Daily ² Ground	Annual Average Daily ² Surface	Daily Withdrawal Capacity ³
	<i>Number</i>	<i>Gallons</i>	<i>Gallons</i>	<i>Gallons</i>
3010107	26	407,679	722,908	29,870,674
3010203	27	261,532	2,311,421	41,954,835
3010204	6	58,960	*	*
3010205	8	*	234,327	10,786,600
3020101	34	*	1,599,595	54,397,200
3020102	9	*	138,340	6,651,840
3020103	15	386,422	*	23,906,233
3020201	42	414,144	1,012,605	24,650,340
3020202	25	397,381	4,621	10,434,617
3020203	46	1,141,038	788,969	56,042,639
3020204	11	111,531	*	2,184,869
3030002	29	*	595,190	40,252,327
3030003	42	198,289	383,382	22,502,080
3030004	33	462,012	714,655	20,663,546
3030005	15	312,893	*	5,237,096
3030006	132	2,339,783	1,237,866	127,355,555
3030007	133	2,680,812	1,659,784	110,366,151
3040101	41	237,720	*	17,832,985
3040102	9	51,899	*	4,559,400
3040103	6	43,093	*	*
3040104	14	85,154	23,808	2,617,911
3040105	36	3,091,548	263,911	30,813,660
3040201	4	36,943	*	403,717
3040203	47	1,233,314	157,965	39,129,671
3040204	43	1,587,534	*	17,582,920
3040206	16	345,950	*	4,796,677
3040208	3	39,032	*	*
3050101	14	73,650	*	*
3050102	8	61,853	1,150,100	15,554,720
3050105	9	147,831	*	1,897,672
6010105	12	*	1,903,675	17,995,200
Other HUC⁴	50	2,208,508	6,078,772	187,610,880
STATE	945	18,416,505	20,981,894	928,052,014

* Disclosure - one operation is greater than 60% of total or less than 3 operations reported. ¹ Represents the unique # of operations which withdrew surface and or ground water ² Represents the average across all days of the year ³ Includes ground and surface
⁴ Includes nondisclosed data from the table above and all data for 03010102, 03010103, 03010104, 03010106, 03020104, 03020301, 03020302, 03050103, 06010106, 06010108, 06010202, 06010203, 6020002

2016 Central Coastal Plain Total Water Use by Month ¹

Month	Operations	Average Across All Days-Ground	Average Across All Days-Surface	Total Max Daily-Ground	Total Max Daily-Surface
	<i>Number</i>	<i>Gallons</i>	<i>Gallons</i>	<i>Gallons</i>	<i>Gallons</i>
January	172	2,757,165	15,194	3,026,132	248,871
February	176	2,729,170	156,084	3,118,139	504,821
March	182	3,340,304	909,116	5,340,688	8,473,873
April	193	5,201,360	1,336,514	13,902,787	13,192,551
May	199	5,665,086	1,914,820	14,749,686	7,295,817
June	210	7,541,215	6,906,553	17,405,257	22,013,900
July	207	7,632,899	6,788,469	16,505,883	23,924,847
August	202	6,172,606	4,230,472	16,486,355	20,125,295
September	191	4,768,367	1,818,895	8,911,720	10,116,202
October	179	3,683,502	359,525	6,528,721	1,032,909
November	173	3,159,897	23,070	4,574,676	92,623
December	172	2,924,717	25,671	3,279,066	160,509
Annual Average		4,631,357	2,040,365		

Operations:

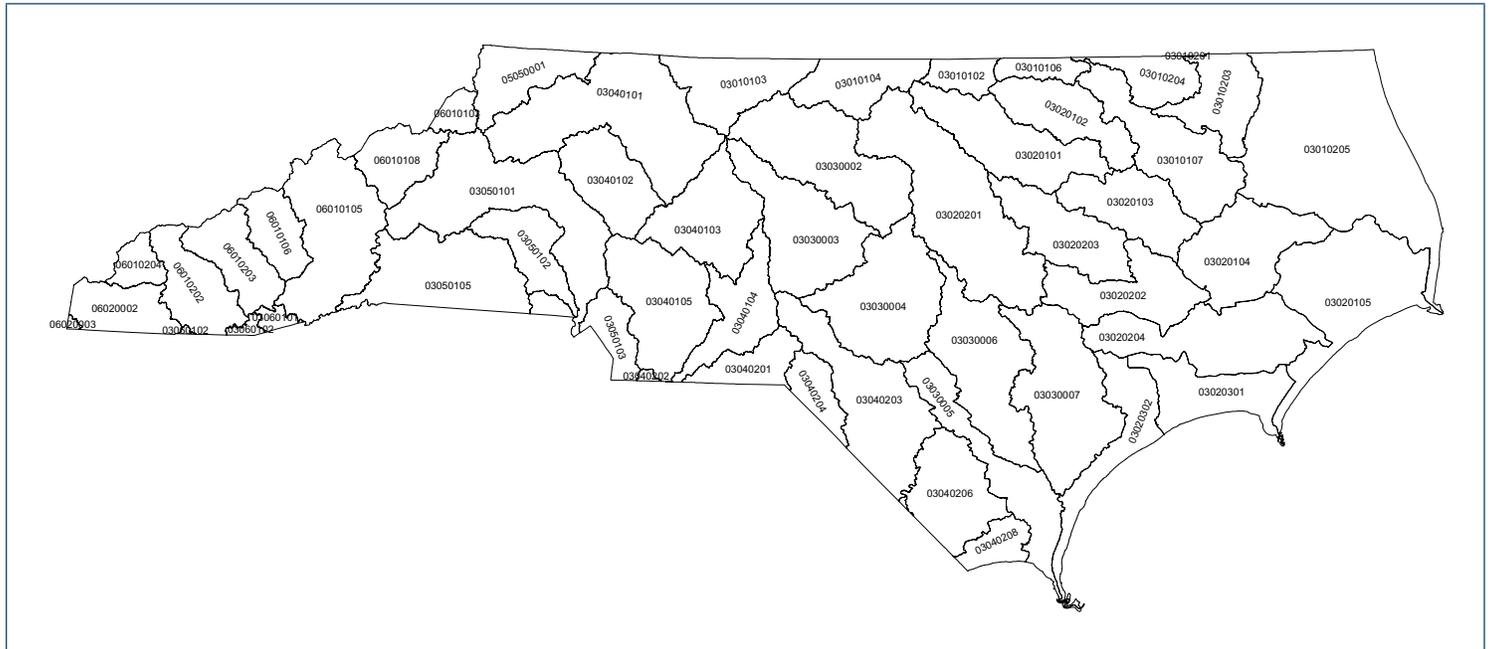
221 Total Operations

Daily Withdrawal Capacity (incl. ground & surface):

159,291,603 Gallons

¹ Users of 10,000 gallons or more per day. Averages reported in this table reflect the average water withdrawn across all days of the month. Farms that reported their withdrawals directly to DEQ by May 19, 2017 have been excluded. The total number of operations represents operations that withdrew water at any time during the year. Central Coastal Plain Counties include Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne, and Wilson.

Hydrologic Unit Codes (HUC)



Statistical Defensibility

The North Carolina Department of Agriculture and Consumer Services' Agricultural Statistics Division conducted a census of all known farm operations in North Carolina which had farming types that could potentially use more than 10,000 gallons of water in one day. More than 2,700 such operations were contacted and included farms with a history of withdrawing more than 10,000 gallons on any one day. Also included were operations with large numbers of poultry, hogs, cattle, aquaculture, fruits, vegetables, nursery/ greenhouse crops, tobacco, or other field crops which are often irrigated. A 89% response rate was attained via mail, phone, or electronically via the web or email. Historical data for all respondents was reviewed to insure comparability with previous surveys. Operations were offered work sheets which assisted them, if necessary, in reporting their withdrawals.

The Census of Agriculture List, the most comprehensive source of farms, was used as the basis for this survey. Although no under-coverage estimator has been applied, the list of NC farmers is expanded on a daily basis as new operations are discovered through routine list building activities. Since agricultural operations that withdraw at least 10,000 gallons of water per day tend to be larger, more intensive farms, under-coverage for this survey is minimal based on historic surveys with similar operations.

Taking the above steps, including conducting a census of all known farm operations that use 10,000 gallons of water on any one day, results in zero sampling error around the estimates and minimal non-sampling and coverage error. Prior to the 2008 NC Agricultural Water Use Survey, there was no official statistically defensible data set to represent agricultural water use in North Carolina.

