WATER SUPPLY ALTERNATIVES IN THE NORTH CAROLINA CENTRAL COASTAL PLAIN CAPACITY USE AREA

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Abstract. Groundwater is the primary water source in the central coastal plain of North Carolina, comprising 67% (64 mgd) of the total publicly supplied water (95 mgd) in 1997. In order to reverse declining water levels and salt water intrusion in the important Cretaceous aquifers, the Environmental Management Commission passed rules for ground water use in the fifteen county Central Coastal Plain Capacity Use Area (CCPCUA). A critical provision of the CCPCUA rules is reduction of Cretaceous aquifer withdrawals by up to 75% by 2018. Of 122 public water supply systems in the CCPCUA, 36 systems may have to reduce Cretaceous aquifer withdrawals by a total of 25 mgd by 2018. The most promising water supply alternatives are aggressive water conservation, development of underutilized or alternate aquifers, rivers, and regionalized water supply systems. The cost to replace Cretaceous aquifer reductions and meet future demands of the 36 public water systems is roughly estimated to be $180 to $250 million. The water supply situation in the CCPCUA is comparable to that of coastal Georgia, and it should be closely monitored to provide insight into effective water supply management in Georgia's coastal counties.

INTRODUCTION

Groundwater is the main source for public water supply systems in the central coastal plain of North Carolina, comprising 67% (64 mgd) of the total public water supply (95 mgd) in 1997 (NCDENR, 1997 and USGS, 1995). Outside of public water service areas, approximately 68 mgd of self-supplied groundwater is used by residences, commercial and industrial establishments, as well as by farms for irrigation, livestock, and aquaculture. In addition, mining companies in the region withdraw as much as 60 to 80 mgd for pit dewatering and depressurization. The principal water supply aquifers in North Carolina's central coastal plain are the Cretaceous Black Creek and Upper Cape Fear aquifers.

Studies by the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Resources (DWR) have demonstrated that withdrawals from the Cretaceous aquifers are occurring faster than the water is being recharged (NCDENR, 2000). Concern over declining water levels, decreasing well yield, and salt water intrusion into these aquifers prompted the Environmental Management Commission to designate the Central Coastal Plain Capacity Use Area (CCPCUA). The CCPCUA is a primarily rural area that includes 15 counties: Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne, and Wilson Counties; divided into three zones: the declining water level zone, aquifer dewatering zone, and salt water encroachment zone (Figure 1).

The DWR has developed rules for the CCPCUA to protect the long term productivity of aquifers and to allow the use of groundwater at rates that do not exceed the recharge rate of the aquifer. The CCPCUA rules require permitting of water withdrawals >100,000 gpd, implementation of conservation measures, repositioning

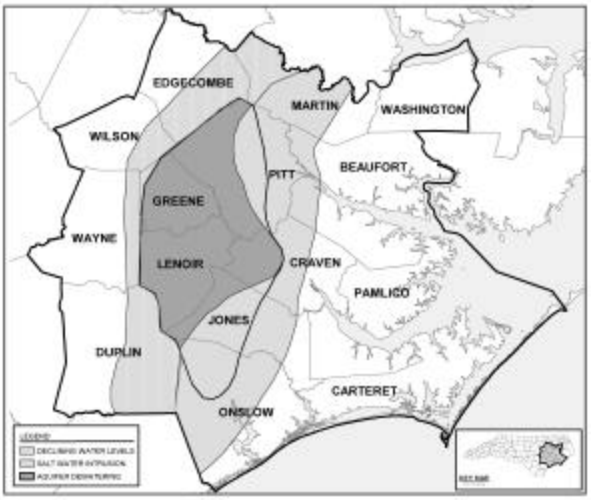

Figure 1. Central Coastal Plain Capacity Use Area.

of pump intakes above the top of any confined aquifer, and reduction of Cretaceous aquifer withdrawals by up to 75% by 2018.

Over 70% of the population within the CCPCUA is served by approximately 122 public water systems. The largest systems include Greenville (11.9 mgd), Wilson (8.0 mgd), Marine Base Camp Lejeune (6.5 mgd), Goldsboro (6.2 mgd), Onslow County (6.1 mgd), Kinston (5.4 mgd), New Bern (4.2 mgd), and Jacksonville (4.0 mgd), Marine Corps Air Station Cherry Point (3.2 mgd), Wayne County (3.1 mgd), and Craven County (1.9 mgd). Most of the public waer supply systems in the CCPCUA are small, supplying less than 1 mgd to customers. Therefore, the North Carolina Rural Economic Development Center undertook a study to identify public water supply systems affected by the CCPCUA rules, assess current and future water supply alternatives, and estimate the costs of compliance with the CCPCUA rules.

EFFECT OF CCPCUA RULES ON PUBLIC WATER SUPPLY SYSTEMS

Water supply plans and technical literature were reviewed (NCDENR, 1997), system operators were interviewed, and CCPCUA residents were consulted to develop an understanding of current and future public water supply in the CCPCUA. Approximately 100 of the 122 public water systems in the CCPCUA use groundwater. The CCPCUA rules will have a substantial effect on these public water supply systems:

- Virtually all systems using groundwater will have to raise pump intakes above the top of the uppermost confined aquifer screened by the well to prevent aquifer dewatering. This could substantially reduce the capacity of groundwater wells.
- 76 systems using groundwater withdraw more than 0.100 mgd and will need to apply for a water use permit. These systems will have to implement specific water conservation measures (water conservation-based rate structures, water loss reduction program, water conservation ordinance for irrigation, public education, etc.).
- 36 systems will have to reduce withdrawals from Cretaceous aquifers by a total of 25 mgd by 2018 (Table 1). Almost all of the aggregate reduction is in Lenoir, Onslow, Craven, Pitt, Wayne, Martin, and Greene Counties. Water systems in Beaufort, Carteret, Pamlico, Washington, and Wilson Counties do not face any reductions, because they are outside of the three water management zones or because systems do not utilize the Cretaceous aquifers.
- Water system deficit projections for the 36 water systems facing withdrawal restrictions are estimated to be 16.8 mgd by 2020, if the CCPCUA rule is fully implemented. The difference between the withdrawal reductions and predicted deficits indicates that some of these systems have already begun water resource planning efforts, including development and implementation of alternative water supply sources.

WATER SUPPLY ALTERNATIVES

The most promising alternatives to continued depletion of the Cretaceous aquifers include:

- aggressive water conservation, including control of water loss and unmetered use;
- water reclamation and re-use, including industrial water re-use;
- alternate aquifers (in particular the Castle Hayne, but also the Peedee, Beaufort, Yorktown), most likely requiring treatment plant new construction or upgrades;
- surface water (Neuse River, Tar River, Contentnea Creek, Northeast Cape Fear River), including upgrades to surface water intakes and treatment plants and new reservoir construction;
- regionalization and water purchasing agreements, including regional water and sewer authorities (the Neuse Regional Water and Sewer Authority has already been formed by five systems in Lenoir County) and transmission network expansion in order to share resources; and
- other strategies, including use of abandoned mines for supply and/or storage, use of up to 60 mgd pumped from the PCS phosphate mine in Beaufort County, desalination, and aquifer storage and recovery.

These alternatives were considered for each of the 36 public water supply systems facing mandatory withdrawal reductions under the CCPCUA rules. Alternatives for each system were ranked according to

source location, yield, feasibility, environmental impacts, regulatory concerns, and ability to meet all or most of the projected 2020 average daily demand. Cost estimates were prepared that represent the probable costs to develop, treat and distribute new water supplies. The analysis was intended to highlight promising water supply alternatives and to provide information for general planning purposes. Additional engineering studies will be required to fully and properly evaluate the feasibility of developing any system-specific water supply alternative.

Table 1. Public Water Systems Facing Withdrawal Reductions from Cretaceous Aquifers in the CCPCUA (all values in mgd)

County	Water System	1997 Water System Capacity/Base Rate (all sources)	Estimated Withdrawal Reduction 2018	2020 Water System Capacity	2020 Demand	2020 Water Supply Reserve / (Deficit)
Craven	Craven Cty	1.924	1.443	0.481	2.695	(2.214)
Craven	New Bern	4.228	3.171	5.057	5.720	(0.663)
Duplin	Beulaville	0.136	0.036	0.100	0.161	(0.061)
Duplin	Chinquapin WA	0.431	0.048	0.383	0.433	(0.050)
Duplin	Duplin County WD A	0.140	0.009	0.130	0.175	(0.045)
Duplin	Duplin County WD B	0.270	0.081	0.189	0.327	(0.138)
Duplin	Duplin County WD F	0.100	0.000	0.100	0.401	(0.301)
Duplin	Greenevers	0.100	0.000	0.100	0.098	0.002
Edgecombe	Conetoe	No Information				
Edgecombe	Pinetops	0.350	0.105	0.245	0.351	(0.106)
Greene	Greene County	1.080	0.810	0.270	1.088	(0.818)
Greene	Snow Hill	0.640	0.480	0.160	0.442	(0.282)
Jones	Jones County	0.560	0.420	0.500	0.547	(0.047)
Lenoir	Deep Run WC	1.020	0.765	1.418	1.550	(0.132)
Lenoir	Kinston	5.379	4.034	13.322	15.960	(2.638)
Lenoir	La Grange	0.388	0.291	0.432	0.446	(0.014)
Lenoir	N Lenoir WC	1.582	1.187	1.843	1.929	(0.086)
Lenoir	Pink Hill	0.100	0.000	0.177	0.103	0.074
Martin	Robersonville	1.184	0.888	0.296	1.321	(1.025)
Martin	Williamston	0.922	0.692	0.231	3.070	(2.840)
Onslow	Jacksonville	4.076	2.976	1.100	5.141	(4.041)
Onslow	Onslow County	7.345	2.669	12.093	11.803	0.290
Onslow	Richlands	0.175	0.075	0.100	0.239	(0.139)
Pitt	Ayden	0.549	0.412	0.137	0.708	(0.571)
Pitt	Bell Arthur WC	No Information				
Pitt	Bethel	0.160	0.060	0.100	0.254	(0.154)
Pitt	Eastern Pines WC	No Information				
Pitt	Farmville	1.572	1.179	0.393	1.830	(1.437)
Pitt	Greenville	15.765	0.574	22.691	18.570	4.121
Pitt	Grifton	0.232	0.132	0.100	0.338	(0.238)
Pitt	Stokes RW Corp	0.144	0.000	0.144	0.558	(0.414)
Pitt	Winterville	0.432	0.324	0.108	0.603	(0.495)
Wayne	Fork Township	0.808	0.517	0.292	1.182	(0.890)
Wayne	Walnut Creek	0.145	0.044	0.102	0.282	(0.181)
Wayne	Wayne WD	3.186	1.561	3.205	4.504	(1.299)
Wilson	Stantonsburg	0.100	0.000	0.100	0.101	(0.001)
	TOTALS	55.223	24.982	66.098	82.930	(16.832)

The total cost to develop sufficient water supplies to meet Cretaceous aquifer withdrawal reductions and future 2020 water demand for directly affected public water systems is estimated to be $180 to $250 million. Individual system improvements are estimated to cost from <$1 million to >$50 million (typically at least $3.00 per gallon to $4.50 per gallon). In addition to the costs incurred by the 36 public water supply systems facing mandated reduction of Cretaceous aquifer withdrawals, virtually all of the 100 systems that use ground water will incur a potentially substantial financial burden due to new requirements for pump repositioning, permitting, and conservation planning.

CONCLUSIONS

The CCPCUA rules are a drastic measure proposed to address a significant concern. Several factors will strongly influence successful implementation of the rules and improvement in aquifer conditions: the large number of affected public water supply systems, the contrast between a few large systems and many very small systems, the wide distribution of systems throughout a largely rural area, and the short time in which Cretaceous aquifer reductions must be implemented. Regional cooperation will be extremely important, allowing an economy of scale in addressing aggregate demand, cost sharing, uniform rates, and bond-issuing authority. Therefore, the state should consider funding key initiatives, such as system improvements for systems with a small customer base, development of regional water and sewer authorities, construction of key regional transmission lines, and enhanced monitoring to determine the effectiveness of the rules in improving aquifer conditions. Finally, all public water supply systems, including those not required to reduce Cretaceous aquifer withdrawals, should initiate planning to meet future demands for 2020 and beyond. The water supply situation in the CCPCUA is comparable to that of coastal Georgia, and it should be closely monitored to provide insight into effective water supply management in Georgia's coastal counties.

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