PENDER COUNTY

WATER MASTER PLAN

Prepared For

Pender County
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Executive Summary

Purpose

McKim & Creed, P.A. was authorized by Pender County to prepare a Water Master plan for the period from 2005 to 2030 to aid in planning and implementation of County-wide public water facilities. Over the past decade, the County has experienced tremendous growth, which has placed a strain on existing water facilities in and outside of the County, and created the need for a safe and dependable public water supply system. Based on the findings of this study, growth is expected to continue into the foreseeable future, furthering the need for an expanded and dependable potable water supply.

Scope

The scope of the water master plan provides for County-wide planning for future water demands, identification of system improvements required, and recommendations for implementation. Specifically, the study includes the projection of water demands for the study period, identification of water distribution system needs, evaluation of water supply sources and water treatment alternatives, opinions of probable project cost, and schedules of implementation for the recommended alternatives.

Existing Facilities

Pender County residents are largely supplied drinking water by private wells; however, a few communities in the County are served by private water utilities. The Rocky Point Topsail Water and Sewer District (RPTWSD), established in 1996 by the County Commissioners, provides water to portions of Rocky Point and Topsail Townships and is projected for system "build out" by Mid 2007. Currently, Phase 1B and Phase 3 of the RPTWSD are operational, while Phases 4 and 5 are under construction and should be completed in mid-2007. Once completed, these phases will serve nearly 4,600 customers and entail approximately 215 miles of 2-inch through 16-inch water main, three elevated water storage tanks (1,300,000 gallon total), one 200,000 gallon ground storage tank, and four water booster pumping stations. The RPTWSD currently purchases a supply of bulk potable water from the Town of Wallace in neighboring Duplin County. Per the existing interlocal agreement, the supply of water from Wallace is limited to 800,000 gallons per day.

The Maple Hill Water District (MHWD) also has an existing water system that was constructed in 1992, and is located in the northeast portion of the County. The MHWD purchases water from the Chinquapin Water Association in Duplin County, which draws water from the Black Creek Aquifer in the Central Coastal Plain. The system is comprised of a 150,000 gallon elevated tank and associated distribution system with 2" through 6" diameter water mains. The district currently serves 334 customers with an average daily demand of approximately 4,500 gallons per day. Refer to Exhibit A, which depicts the location of the MHWD.

Projected Demands

Projected demands for potable water have been developed for each of the water and sewer districts that have been recently created by Pender County. *Table 1* below provides a summary of the projected water demands for each district in 5-year increments for the project planning period:

Table 1 – Summary of Total Water Demand by District (Million Gallons Per Day)

DISTRICT	2010	2015	2020	2025	2030
Rocky Pt/Topsail	2.09	3.19	4.59	5.61	6.38
Scott's Hill	0.11	0.16	0.24	0.28	0.30
Moore's Creek	0.22	0.44	0.83	1.33	1.72
Central	0.32	0.55	0.70	0.92	1.28
Columbia/Union	0.40	0.67	0.79	1.04	1.46
Bulk Sale Allocation	0.00	0.00	0.00	0.00	1.00
COUNTY TOTAL	**3.14**	**5.01**	**7.15**	**9.18**	**12.14**

It is noted that the projected demand for potable water is expected to exceed the County's available supply before the year 2010. Specifically, water demands in the RPTWSD alone are projected at over 2 million gallons per day by the year 2010. Given the limited 800,000 gallon per day supply available from Wallace, it is recommended that the County immediately proceed with design, permitting and construction of a water treatment facility to meet projected needs. As identified in this report, the recommended water treatment facility would be located on US 421 and be supplied bulk raw water by the Lower Cape Fear Water and Sewer Authority (Authority).

Water Source Alternatives

Three raw (untreated) water supply alternatives and three treated water supply alternatives were considered to determine the most feasible and cost-effective solution for supplying source water to meet Pender County's projected water demands. The five alternatives for treated water supply required the purchase of water from systems located outside of Pender County and subsequent infrastructure upgrades to these systems would be needed to supply the water demands projected. Water source alternatives are summarized as follows:

- *Brunswick County* – This option considered purchase of treated water from Brunswick County's Northwest Water Treatment Plant. Consultations with Brunswick County yielded that an expansion of the plant's capacity as well as significant transmission piping costs would likely be required in order to deliver the water to Pender County. This option proved cost-prohibitive and was not recommended.
- *City of Wilmington* – At the time of this report, the City's Sweeney Water Treatment Plant did not have sufficient capacity to supply the projected needs of Pender County.

Additionally, significant infrastructure costs would be incurred to convey treated water to the Pender County system. Due to prohibitive costs and the lack of available capacity, this option was not recommended

- *New Hanover County* – Similar to the City of Wilmington, New Hanover County does not have sufficient capacity or pressure to supply Pender County's long-term needs. The County is in the process developing a new ground water treatment plant in the northern portion of the County, however, a timetable for completion was unattainable and it is expected that only a minimal amount of additional capacity would be available. Therefore, this option was not recommended.

The potential alternatives for raw water supply are summarized as follows:

- *Groundwater Supply* - A detailed groundwater study was not included in the scope of this project; however, Pender County could potentially develop ground water supplies in the Castle Hayne Aquifer and construct full-scale ground water treatment facilities located near Hampstead and/or US 421. Generally, the Castle Hayne and Pee Dee Aquifers are relatively shallow and spotty in the County and experience degrading water quality over time. Poor water quality in these areas would necessitate membrane treatment or other similar processes, which are significantly more costly than traditional water treatment. Further, developing wells at Hampstead or US 421 would likely be more expensive than the recommended alternative of purchasing raw water from the Authority. Additionally, consultations with NCDENR Division of Water Resources officials indicated that it is possible that Capacity Use Regulations may be extended to Pender County in the future. In this case, the County would be required to significantly reduce their withdrawal and dependency on ground water. Salt water intrusion could also become a concern in the County in the future. For these reasons, it was determined that the County would direct efforts for future water supply sources to surface water rather than ground water.
- *Construct New Raw Water Intake on NE Cape Fear River* – This option would require construction of a new intake on the NE Cape Fear River, including raw water pumping facilities and raw water transmission main. Significant regulatory issues and costs, as well as the potential for brackish water conditions, may necessitate provisions for advanced treatment capabilities. Due to the capital costs associated with the intake structure and advanced treatment, as well as higher operation & maintenance costs, this option was not recommended.
- *Purchase Raw Water from the Lower Cape Fear Water & Sewer Authority* - The Authority operates a 45 MGD raw water pump station at Lock and Dam # 1 in Bladen County, which draws water from the Cape Fear River. Raw water is conveyed from this station to Brunswick County, the City of Wilmington, and two industrial users through 60-inch and 48-inch segments of raw water transmission main. This raw water main is routed along US 421 near the New Hanover County / Pender County Line and would provide Pender County convenient access to a supply of bulk raw water. The Cape Fear River has an identified capacity for water supply of 106 MGD at Lock & Dam No.1 and the

Authority has the ability to upgrade and/or modify their facilities in order to meet Pender County's long-term water supply needs. This option would involve construction of a raw water transmission main to connect to the Authority's raw water main and convey raw water to a surface water treatment facility recommended for implementation in the same proximate location.

Advantages

- This is the most cost-effective County-wide solution
- The Cape Fear River has an identified capacity for water supply of 106 MGD
- The Authority has the ability to upgrade their facilities as required to meet Pender County's long-term needs
- Convenient access to the Authority's existing raw water main is provided.
- Eliminates the need for the County to operate and maintain its own intake
- Reduces regulatory concerns associated with construction of a new intake

Disadvantages

- The County would be subject to an initial System Development Fee for the Authority. Currently these fees are set at $141,877 per 1 million gallons per day of capacity.
- An initial 20-inch diameter high service transmission main would be required for construction along US 421 to connect to the RPTWSD in Rocky Point.

Based on evaluation of all alternatives for water supply, it is recommended that the County pursue design and construction of a new water treatment plant on US 421 (discussed below), supplied raw water by the Authority.

Recommended Water Treatment Facility

Based on the recommended raw water supply option, it is recommended that a new water treatment facility be constructed on US 421 near the Authority's existing raw water main. In conjunction with the findings of the Pender Wastewater Master Plan Document, it is proposed that the new water plant be co-located with the recommended wastewater plant for this area. Significant savings will be realized by shared facilities on a co-located sight such as administration and bio-solids handling, etc. For phasing purposes, construction of the water treatment facility was evaluated in four phases as indicated in *Table 2*.

Table 2 – Water Treatment Facility Summary Table

Phase	Capacity	Plant Cost	High Service Transmission Main Cost	Total Cost	Remarks
IA - 2008	2 MGD	$8,000,000	$9,500,000	$17,500,000	Plant & Main Connecting to RPTWSD
I B - 2010	4 MGD	$7,900,000	$37,300,000	$45,200,000	Plant Upgrade & Parallel Main Transmission Main
II- 2020	8 MGD	$17,200,000	$11,200,000	$28,400,000	Plant Upgrade & Parallel Main Transmission Main
III - 2030	12 MGD	$23,000,000	$0	$23,000,000	Plant Upgrade

Water Transmission and Distribution Facilities

Analyses were performed for required potable water distribution and transmission systems throughout the county, based on population projections and corresponding potable water demands. The evaluations and recommendations are stratified by the proposed water & sewer districts currently under consideration by the County and include major transmission mains, distribution system piping, pumping stations, and water storage needs. Each system was hydraulically modeled for projected Year 2030 demands, with primary treated water supplied by the proposed water plant recommended for construction on US 421. The opinions of probable project costs and major system components are provided in *Table 3* below. Additionally, an opinion of probable cost has been developed for providing the Town of Topsail Beach with up to 1 million gallons per day of treated water via the RPTWSD system currently under construction. However, it should be noted that Phase II of the recommended water treatment facility (noted in Table 2), or portions thereof, would need to be constructed in order to supply this ultimate demand.

Historically, development of water systems in Pender County (specifically the RPTWSD) has been based on voluntary participation from residents, with a density of 15 customers per mile typically required to generate the revenue necessary to construct the system and service associated debt. This approach and the 15 customers per mile density have proven very successful in the development of the RPTWSD and it is recommended that the County continue this approach for implementation of additional water infrastructure throughout the various districts.

Table 3– District Water Transmission System Summary

District	Total LF Pipe	No. Tanks	No. Booster Pump Stations	Total Project Cost*
Moore's Creek	1,027,200	1	1	$45,000,000
Columbia / Union	970,000	2	2	$44,000,000
Central	600,000	2	0	$27,000,000
Scott's Hill	100,000	0	0	$3,000,000
District Total				**$119,000,000**
Provide 1MGD Water to Topsail Beach	15,000	1	1	$6,050,000

**Costs in Table 3 are provided in Year 2005 dollars.*

It is anticipated that each district would be phased and developed based on voluntary participation by residents, similar to process used by the RPTWSD. Under this process, construction of the district infrastructure would be modified and adjusted to meet demands and geographic location of actual users. Therefore, it is noted that costs indicated in Table 3 are for ultimate build-out of the districts and could potentially be less depending upon the rate of participation by residents.

Recommendations

Based on the assumptions and projections in this report, the County will soon be faced with a lack of available treated water to meet projected demands. It is recommended that the County begin immediate investigation for implementation of the Phase IA water treatment facility noted in Table 2 of this summary.

Upon creation of the proposed water and sewer districts, it is recommended that design and construction of facilities in the districts be conducted commensurate with available water supply capacities as well as the voluntary participation density requirement of 15 customers per mile.

I. Introduction

Purpose

McKim & Creed was authorized by Pender County to prepare a wastewater master plan and a water master plan for the planning period 2005 to 2030. The elements of the wastewater master plan include a projection of wastewater flows as well as recommended wastewater conveyance, treatment, and dispersal recommendations and is a companion document to the water master plan. The wastewater master plan was compiled under the premise of serving mainly future development and does not include provisions for serving established communities.

The water master plan includes water demand projections, an analysis of water supply, water treatment, and water transmission systems needs and was developed with the focus of serving both existing and future development. Opinions of probable costs and schedules of implementation for recommended alternatives have been provided.

Background

Pender County has experienced tremendous growth over the past 15 years, as noted by a 77% population increase for this period. The 2000 Census data indicate that such rapid growth will continue in the County for the foreseeable future, with a projected Year 2030 population of approximately 75,000 residents. This growth has placed a burden on existing water and wastewater facilities in the County and will continue to pose water and sewer infrastructure challenges in the future. Significant infrastructure improvements will be necessary to meet projected demands.

A few small, private water distribution and wastewater collection/treatment systems exist in the County; however these systems are dedicated for specific uses and are limited in capacity and expandability. The Rocky Point / Topsail Water and Sewer District is in the final construction of the Phase 3 water system and is expected to finalize construction of Phases 4 and 5 by Mid 2007. Completion of these phases will provide water generally to the southern tier of the county; however, the remainder of County residents will continue to obtain water from individual wells. Individual septic tank systems and sub-surface drain fields have been the typical methods of wastewater treatment and dispersal in the past; however, a combination of more stringent regulations and less than desirable soil characteristics have severely limited the functionality of such systems as a means of wastewater treatment. The lack of viable wastewater treatment and dispersal availability and lack of County-wide public water has curtailed non-residential development and economic growth throughout Pender County.

Pender County recognizes the need for providing public water and wastewater infrastructure that meets current needs, supports projected growth, and is environmentally sound. The Wastewater Master Plan will serve as a planning tool for permitting, design, and implementation of public wastewater treatment and disposal systems in the County. The Water

Master plan, provided in this document, will serve as a planning tool for the implementation of public water facilities in the County.

Flow and population projections are for a planning period of 25 years, for the period 2005 to 2030. Population estimates and water demands were developed throughout the planning period in 5-year increments and meetings with County staff were held to review and confirm the methodology used to develop future population growth and resulting demands.

II. Population

A. Section 1 – Predicting Population

1. Purpose

This Section details the methodology used to estimate the population throughout the County for the 25 year study period. The input of the Pender County staff and other project team members was crucial in the development of this document. This information serves as the basis for all proceeding work recommended for the Pender County Water Master plan.

B. Population Projections

1. Historical and Current Population

Pender County's population has grown to 2 ½ times its original size over the past 25 years and has become one of the fastest growing counties in North Carolina. Historically it has been a rural county with modest coastal area development; however, in recent years it has attracted significant development in the coastal areas and along the I-40/117 corridor. U.S. Census Bureau data shows that Pender County has grown from 18,850 in 1960 to 41,082 in 2000.

Pender County is bordered by counties exhibiting a wide range of growth profiles. To the south, New Hanover County and Brunswick County have experienced significant growth surrounding their coastal areas and the City of Wilmington, while Sampson and Duplin Counties to the north have experienced modest growth. Both Bladen and Columbus Counties to the west have exhibited low growth profiles and Onslow County to the northeast has experienced a decrease in population.

In order to estimate the growth for the last five years, interim population data were gathered and correlated to the increase in school enrollment and housing permits. It was found that growth in population from 2001 through 2005 varied between 1.5% and 3.4% per year.

2. Population Growth

North Carolina is growing at an above average rate and coastal areas of the state are attracting an increasing number of retirement communities and vacation home developments. In addition, the growth of the City of Wilmington and New Hanover County is beginning to expand into Pender County. Due to easy access to major transportation routes, coastal resources and affordable land, many new homeowners are choosing to live in Pender County and commute to work in Wilmington. It is expected that growth in these two sectors will continue at an accelerated rate.

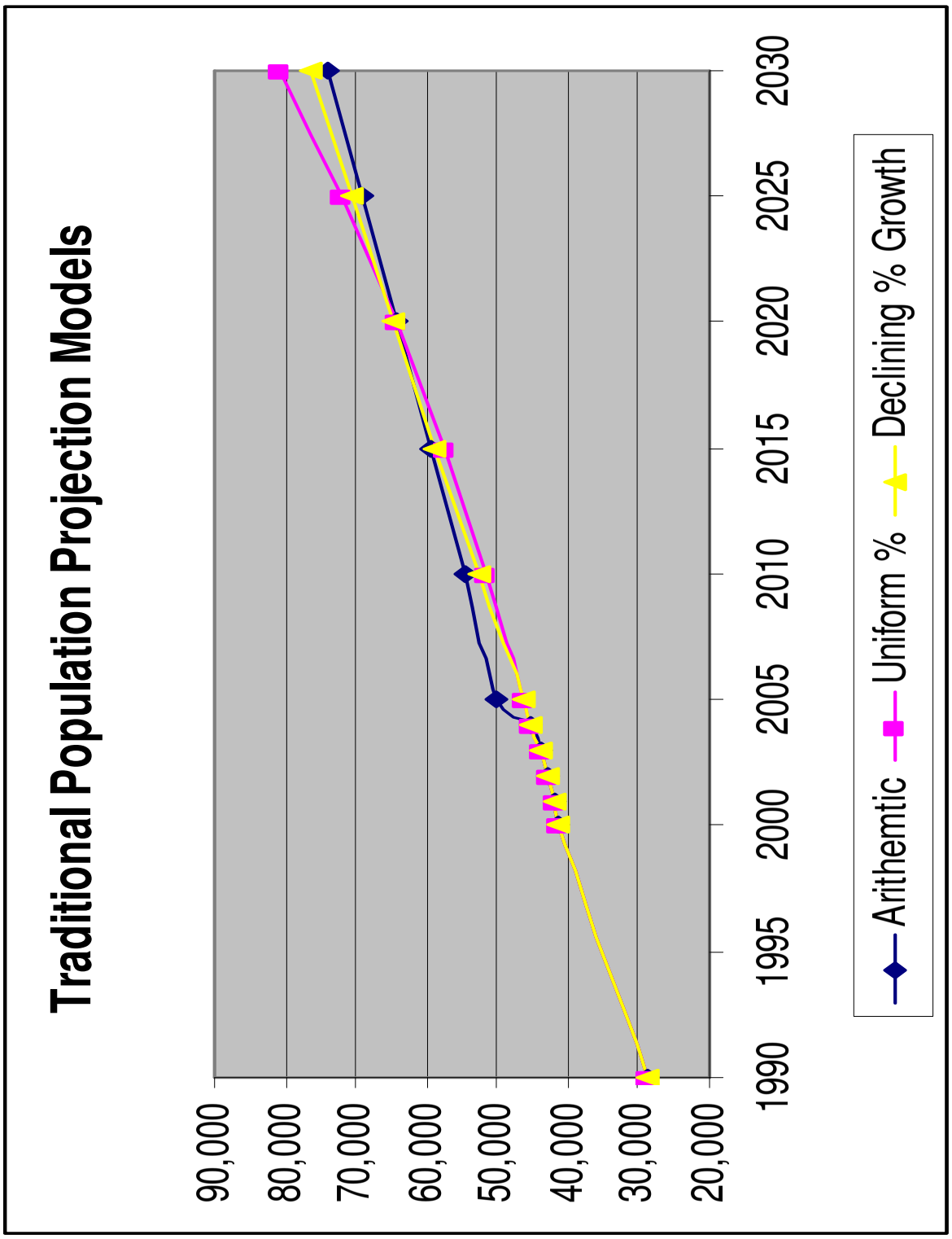
The rate of which such growth occurs and to what extent depends upon the aggressiveness of policy in Pender County. By providing infrastructure such as public water and sewer and using sound development strategies, the County is expected to experience a significant growth rate.

With public water and sewer available, industrial and commercial recruitment will increase, followed by an increased demand for housing and amenities.

In order to predict the level of growth the County can expect in an increased growth rate environment, the populations of several analogous high growth areas were examined. Each one of these counties has experienced significant growth in recent years, with each having a different set of pressures driving that growth.

As a first step in predicting future growth within the County, previous census data were applied to several traditional population growth models. These include arithmetic, uniform percentage, and declining percentage growth models. These models are based upon the assumption the historical growth trend will continue into the future. All of these methods yielded a similar result with the County's population reaching between 75,000 and 81,000 by 2030. Table 1 provides a graph of the various growth models evaluated for this master plan.

Figure No. 1 - Traditional Growth Models for Pender County



After further analysis and discussion with the County about these predictive models, an issue was raised concerning traditional modeling techniques and their inability to predict the often extraordinary population growth rate changes that occur with the available water and wastewater infrastructure. The challenge was tailoring these more traditional growth models to improve such prediction capabilities. Subsequently, the models were modified based on surrounding Counties that have experienced "infrastructure driven" growth, as well as an analysis of timing for Pender County's future infrastructure improvements.

For comparison purposes, the populations of several other high growth Counties were examined, again with each having a different set of pressures driving growth.

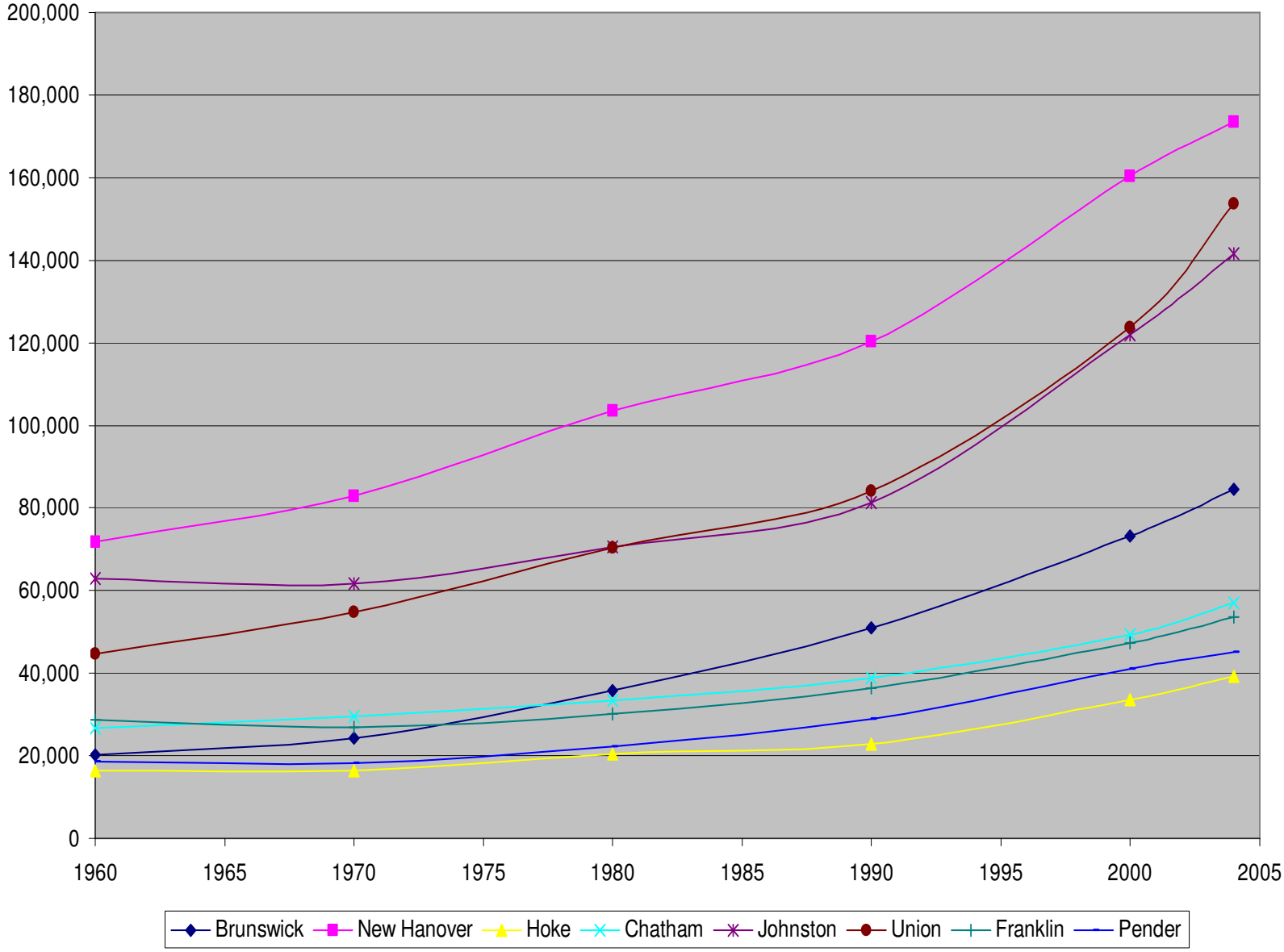
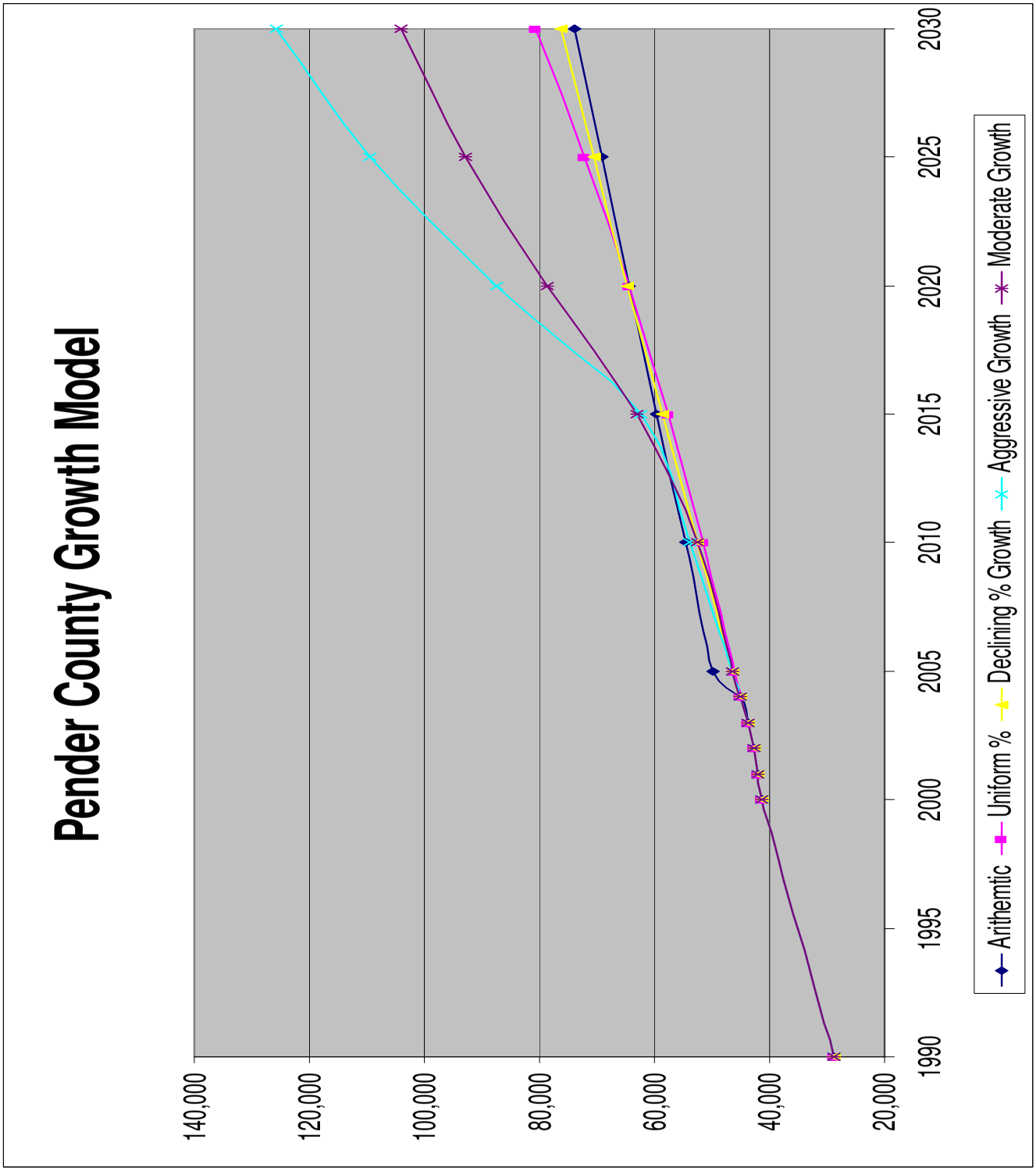


Figure No. 2 – Comparison of County Population Growth

Of the counties considered, Brunswick County has the most in common with Pender County. Like Pender County, Brunswick County is also a coastal county that is experiencing the pressure from the outward growth of New Hanover County. Brunswick County's recent growth profile was used to create an aggressive growth model for Pender County. The aggressive growth model shown in Figure No. 2 predicted an increase of Pender County's population of over 300% between 2000 and 2030. While this kind of growth profile is possible, it is expected that a more moderate growth increase is more probable.

Another model was created using a more moderate growth rate as seen in Brunswick County between 1984 and 2004. In 1984, Brunswick County's population was roughly equal to Pender County's current population. This moderate growth model predicts that Pender County's population will grow to 104,000 by 2030. After further discussion and consultation with County staff, the moderate growth model was chosen as the basis for population growth predictions noted in this study.

Figure No. 3 – Growth Models for Pender County



3. Population by Township

All areas of Pender County are not growing uniformly. The coastal areas, the I-40/117 corridor, and the area bordering New Hanover County are growing rapidly, while other areas in the County are growing at a modest pace. Therefore, each township within the County was evaluated as a separate growth area in the analysis utilizing census data that are available for each township and for incorporated areas within the County. Based upon discussions with the County, incorporated towns were excluded from the analysis as they may not be immediately served by the County's water and sewer systems; however, where feasible, the towns will be integrated into the planning of future water and sewer facilities.

In townships where water and sewer are expected to be in place, growth is anticipated to accelerate. The amount of growth in these areas is equal to the difference between the Countywide Moderate Growth curve and the Declining Percentage Growth curve (Figure 1). As previously stated, the accelerated growth is a direct result of the addition of water and wastewater infrastructure. Without this infrastructure it is assumed that the township's population would continue to grow as predicted in the declining percentage growth model. Therefore the population represented by the area between the two curves (Figure No. 4) was added to the townships' populations in accordance with the development timeline.

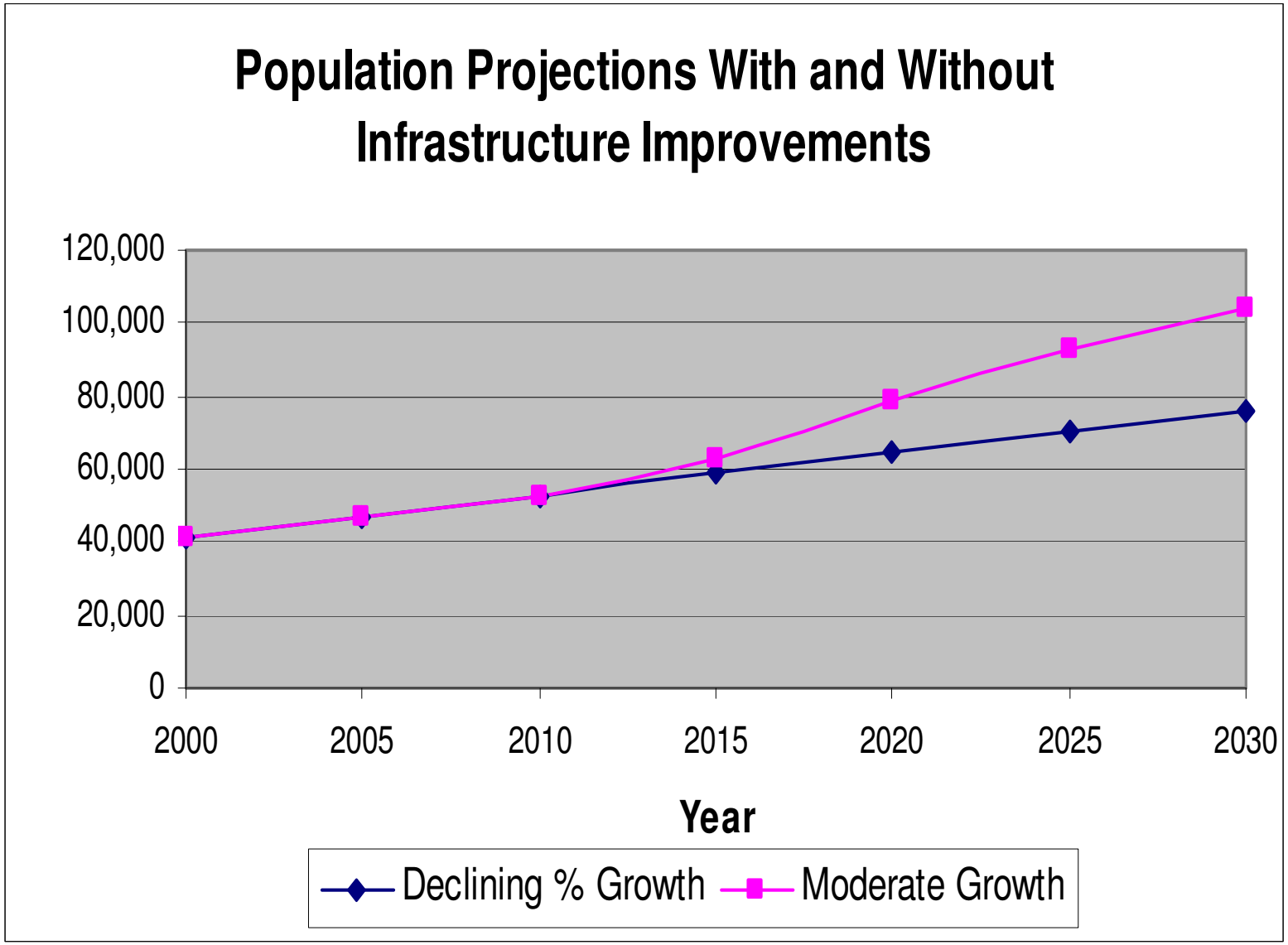

Population Projections With and Without Infrastructure Improvements
120,000
100,000
80,000
60,000
40,000
20,000
0
2000
2005
2010
2015
2020
2025
2030
Year
Declining % Growth
Moderate Growth

Figure No. 4

The number of households to be served during the study period was determined for each township. The person per household ratio (as reported in the 2000 census) was used to make the conversion from predicted population to predicted number households. For the purposes of this study, the person per household ratio for each township was held constant. A breakdown of the historical population growth and number of households, as taken from US Census Data, for each township is shown in Table 2 as follows:.

Table No. 2 - Existing Data on Population by Township

	1990 Pop	1990 Housing Units	1990 People /home	2000 Pop	2000 Housing Units	2000 People / Home	Housing Units per Sq Mile	% Change in Pop	% Change in Housing Units	Change in Pop	% Total Growth in Pop	Change in Housing Units	% Total Growth in Housing Units
Burgaw	5,515	2,036	2.71	7,474	2,876	2.60	35.5	135.52%	141.26%	1,959	16.02%	840	45.33%
Town	1,807	702	2.57	3,337	1,051	3.18	306.0	184.67%	149.72%	1,530	12.51%	349	18.83%
St. Helena Village	321	145	2.21	395	175	2.26	31.0	123.05%	120.69%	74	0.61%	30	1.62%
Remainder	3,387	1,189	2.85	3,742	1,650	2.27	23.0	110.48%	138.77%	355	2.90%	461	24.88%
Canetuck	369	148	2.49	361	210	1.72	4.7	97.83%	141.89%	-8	-0.07%	62	3.35%
Caswell	1,016	398	2.55	1,172	601	1.95	12.2	115.35%	151.01%	156	1.28%	203	10.96%
Atkinson	275	141	1.95	236	117	2.02	127.6	85.82%	82.98%	-39	-0.32%	-24	-1.30%
Remainder	741	257	2.88	936	484	1.93	10.0	126.32%	188.33%	195	1.59%	227	12.25%
Columbia	1,790	626	2.86	2,179	904	2.41	9.2	121.73%	144.41%	389	3.18%	278	15.00%
Atkinson	0	0	0.00	0	0	0.00	0.0	0.00%	0.00%	0	0.00%	0	0.00%
Remainder	1,790	626	2.86	2,179	904	2.41	9.2	121.73%	144.41%	389	3.18%	278	15.00%
Grady	1,725	599	2.88	2,192	962	2.28	18.6	127.07%	160.60%	467	3.82%	363	19.59%
Holly	2,095	743	2.82	2,263	1,137	1.99	5.5	108.02%	153.03%	168	1.37%	394	21.26%
Long Creek	1,280	494	2.59	1,854	798	2.32	19.7	144.84%	161.54%	574	4.69%	304	16.41%
Rocky Point	3,377	1,295	2.61	5,786	2,370	2.44	44.4	171.34%	183.01%	2,409	19.70%	1,075	58.01%
Topsail	8,403	3,510	2.39	13,806	9,190	1.50	58.3	164.30%	261.82%	5,403	44.19%	5,680	306.53%
Surf City	970	*660*	1.47	1,101	1,929	0.57	507.6	113.51%	292.27%	131	1.07%	1,269	68.48%
Topsail Beach	346	998	0.35	471	1,149	0.41	262.8	136.13%	115.13%	125	1.02%	151	8.15%
Remainder	7,087	1,852	3.83	12,234	6,112	2.00	40.9	172.63%	330.02%	5,147	42.10%	4,260	229.90%
Union	3,285	1,263	2.60	3,995	1,750	2.28	19.6	121.61%	138.56%	710	5.81%	487	26.28%
Wallace	*15*	*6*	2.50	18	7	2.57	25.4	120.00%	116.67%	3	0.02%	1	0.05%
Watha	99	41	2.41	151	71	2.13	77.9	152.53%	173.17%	52	0.43%	30	1.62%
Remainder	3,171	1,216		3,826	1,672	2.29	19.0			655	5.36%	456	24.61%
TOTAL	28,855	18,945	1.52	41,082	20,798	1.98	23.9	142.37%	109.78%	12,227	100.00%	1,853	100.00%

Numbers in italics were estimated based upon U.S. Census Bureau data.

By applying the previously discussed growth model to the available data on existing population, population and households were projected by township. Tables 3 and 4 provide a summation of these projections:

Table No. 3 – Projected Population by Township

		2000	2005	2010	2015	2020	2025	2030
Burgaw		7,474	8,337	9,305	10,273	11,241	13,409	15,827
	Town	3,337	4,011	4,767	5,523	6,279	7,035	7,791
	St. Helena Village	395	428	465	502	539	576	613
	Remainder	3,742	3,898	4,073	4,248	4,423	4,598	4,773
Canetuck		361	357	353	349	345	341	337
Caswell		1,172	1,241	1,318	1,395	1,472	1,549	1,626
	Atkinson	236	219	200	181	162	143	124
	Remainder	936	1,022	1,118	1,214	1,310	1,406	1,502
Columbia		2,179	2,350	2,542	2,734	2,926	3,118	3,310
	Atkinson		0	0	0	0	0	0
	Remainder	2,179	2,350	2,542	2,734	2,926	3,118	3,310
Grady		2,192	2,398	2,629	2,860	3,091	5,122	6,853
Holly		2,263	2,337	2,420	2,503	2,586	2,669	2,752
Long Creek		1,854	2,107	2,391	2,675	3,959	7,243	9,027
Rocky Point		5,786	6,848	8,038	10,028	16,018	19,008	20,498
Topsail		13,806	16,188	18,857	25,126	31,615	34,484	37,379
	Surf City	1,101	1,160	1,625	2,190	2,775	3,380	3,985
	Topsail Beach	471	526	588	800	1,012	1,224	1,436
	Remainder	12,234	14,503	17,046	19,589	22,132	24,675	27,218
Union		3,995	4,308	4,659	5,071	5,515	6,003	6,491
	Wallace	18	19	20	21	22	23	24
	Watha	151	174	200	226	252	278	304
	Remainder	3,826	4,115	4,439	4,763	5,087	5,411	5,735
TOTAL		41,082	46471	52512	63014	78768	92946	104100

Table No. 4 – Estimated Number of Housing Units by Township

		2000	2005	2010	2015	2020	2025	2030
Burgaw		2,876	3,208	3,581	3,953	4,326	5,160	6,090
	Town	1,051	1,263	1,501	1,739	1,978	2,216	2,454
	St. Helena Village	175	190	206	222	239	255	272
	Remainder	1,650	1,719	1,796	1,873	1,950	2,027	2,105
Canetuck		210	208	205	203	201	198	196
Caswell		601	636	676	715	755	794	834
	Atkinson	117	109	99	90	80	71	61
	Remainder	484	528	578	628	677	727	777
Columbia		904	975	1,055	1,134	1,214	1,294	1,373
	Atkinson	0	0	0	0	0	0	0
	Remainder	904	975	1,055	1,134	1,214	1,294	1,373
Grady		962	1,052	1,154	1,255	1,357	2,248	3,008
Holly		1,137	1,174	1,216	1,258	1,299	1,341	1,383
Long Creek		798	907	1,029	1,151	1,704	3,118	3,885
Rocky Point		2,370	2,805	3,292	4,108	6,561	7,786	8,396
Topsail		9,190	10,776	12,552	16,725	21,045	22,954	24,881
	Surf City	1,929	2,032	2,847	3,837	4,862	5,922	6,982
	Topsail Beach	1,149	1,283	1,434	1,952	2,469	2,986	3,503
	Remainder	6,112	7,246	8,516	9,786	11,057	12,327	13,598
Union		1,750	1,887	2,041	2,221	2,416	2,630	2,843
	Wallace	7	7	8	8	9	9	9
	Watha	71	82	94	106	118	131	143
	Remainder	1,672	1,798	1,940	2,081	2,223	2,365	2,506
TOTAL		20,798	23,628	26,801	32,724	40,876	47,522	52,890

4. Population by Water and Sewer District

Pender County has successfully used the "Water and Sewer District" model for expanding infrastructure in recent years and is expected to continue with this model as a basis for infrastructure development. Accordingly, the County has delineated proposed Water and Sewer Districts for this purpose (See Exhibit A).

Each Township falls partly or entirely with a District. In order to estimate the population by District the following percentages were used.

Table No. 5 – Percentage of Land Area per District

DISTRICT	Topsail	Rocky Point	Holly	Grady	Long Creek	Caswell	Canetuck	Columbia	Burgaw	Union
Rocky Pt/Topsail	94.89%	97.39%	12.28%		42.64%				15.45%	
Scott's Hill	5.11%									
Moore's Creek				100.00%	52.76%	100.00%	100.00%	5.08%	1.01%	
Central		2.61%	87.72%		4.60%				83.54%	
Columbia/Union								94.92%		100.00%

The percentages above (Table 5) were applied to the population estimated by township. For the purposes of this study all incorporated areas such as the Town of Burgaw were excluded from the calculations. The result is the following population figures (Table No 6).

Table No. 6 – Population Projections by District

DISTRICT	2000	2005	2010	2015	2020	2025	2030
Rocky Pt/Topsail	18,890	22,219	25,949	30,459	39,290	46,053	50,715
Scott's Hill	625	741	871	1,001	1,131	1,261	1,391
Moore's Creek	4,616	5,047	5,532	6,016	7,028	10,895	13,671
Central	5,347	5,582	5,845	6,129	6,564	7,012	7,352
Columbia/Union	5,894	6,346	6,852	7,358	7,864	8,371	8,877
TOTAL	**35,373**	**39,935**	**45,049**	**50,963**	**61,877**	**73,591**	**82,005**

When the same percentages are applied to the number of housing units estimated per Township, again excluding incorporated areas, the resultant estimate of housing units per District is shown in Table 7.

Table No. 7 – Housing Unit Projections by District

DISTRICT	2000	2005	2010	2015	2020	2025	2030
Rocky Pt/Topsail	8,843	10,404	12,153	14,222	18,069	21,087	23,232
Scott's Hill	312	370	435	500	565	630	695
Moore's Creek	2,140	2,334	2,552	2,770	3,215	4,904	6,121
Central	2,474	2,581	2,700	2,828	3,019	3,217	3,369
Columbia/Union	2,530	2,724	2,941	3,158	3,375	3,593	3,810
TOTAL	**16,299**	**18,412**	**20,781**	**23,478**	**28,243**	**33,431**	**37,227**

These estimates of District population and housing units are intended to be rough guidelines for planning purposes only. As each District develops and begins planning for the construction of water infrastructure, a more detailed analysis of population and housing units will be required.

III. Water Master plan

A. Section 1 – Predicting Water Demand

1. Purpose

This Section details the methodology used and results obtained from water demand prediction modeling for Pender County. The modeling effort included the collection of an extensive set of data ranging from census figures to water billing data from other comparable counties. Predicted water demands are stratified by residential, commercial, and industrial origin, as well as by Township and by District.

2. Existing Water Transmission and Distribution Facilities

Pender County currently operates two (2) public water systems, the Rocky Point/Topsail Water and Sewer District (RPTWSD) and the Maple Hill Water District (MHWD). The RPTWSD was formed in 1996 by the Pender County Board of Commissioners. Due to the magnitude of providing the entire District with a water supply and distribution system, the project was split into five phases, three phases in Rocky Point and two in the Topsail Township area. Exhibit B details the Water District Boundary.

The MHWD was constructed in 1992 and currently serves 334 customers and is located in the northeast portion of the County. The MHWD purchases water from the Chinquapin Water Association in Duplin County, which draws water from the Black Creek Aquifer in the Central Coastal Plain. The system is comprised of a 150,000 gallon elevated tank and associated distribution system with 2" through 6" diameter water mains. The district currently serves 334 customers with an average daily demand of approximately 4,500 gallons per day. Refer to Exhibit B, which depicts the boundary of the MHWD.

Potable water is supplied to the RPTWSD by the Town of Wallace in neighboring Duplin County. Wallace and the RPTWSD have an Interlocal Agreement in place that provides for up to 800,000 gallons per day of bulk water supply. While this supply has served the district well, demands are projected to quickly outpace the available supply. Subsequently, the RPTWSD and Pender County will require an alternate water source to meet future demands.

Phase 1B of the RPTWSD is currently operational and encompasses a 315 gallon per minute booster pumping station, a 300,000 gallon elevated storage tank, and approximately 70 miles of water distribution facilities.

Construction of Phase 3 of the RPTWSD is complete and is being integrated into the system. This phase included an upgrade to the existing 315 GPM booster pumping station, the addition of two additional booster pumping stations, a 500,000 gallon elevated storage tank, a 200,000 gallon ground storage tank, and approximately 80 miles of water in the Rocky Point and Hampstead areas of Pender County.

At the time of this writing, Phases 4 and 5 of the RPTWSD have begun construction. Phase 5 will provide for an additional water booster pumping station and an elevated water storage tank as well as approximately 70 miles of water distribution facilities in the Topsail area. Phase 5 is anticipated for completion in mid- 2007. Phase 4 of the RPTWSD includes approximately 20 miles of water distribution lines in the New Road and St. Helena areas of Pender County and is anticipated for completion in mid-2007.

3. Residential Water Demand Predictions

Residential water demands were predicted using the population and housing unit projections presented in Section I. – *Predicting Population*. Given the population densities that exist throughout the County, it appears feasible to serve a large percentage of residents based on the previously discussed "15 customers per mile" requirement. The percentage of residents served in each area is based upon previous experience with the Rocky Point/Topsail Water District, comparison to similar regions in the State, and input from Pender County staff.

In addition, the construction of infrastructure to serve such a large area must be undertaken in phases. With the rate of growth projections, much of the County would require access to centralized public water before 2020. Developing a centralized water service area requires a minimum housing density and significant public interest. It is expected that areas along major transportation routes and along the coastal areas will have the residential density necessary to support a public water system sooner than the more rural areas of the County. Table No. 1.1 outlines the percentages used and the predicted timeline of construction within each township.

Table No. 1.1 – Percentage of Homes Predicted to be Served

Township	Existing Residential Homes	New Residential Development	Time of Construction
Burgaw	65%	80%	2005-2010
Union	60%	75%	2005-2010
Rocky Point/Topsail	65%	90%	Completion by 2007
Long Creek/Grady	65%	80%	2005-2010
Columbia	60%	75%	2010-2015
Canetuck	60%	75%	2010-2015
Caswell	60%	75%	2010-2015
Holly	60%	75%	2015-2020

The amount of water used per residential customer was estimated using historical water use in the Rocky Point/ Topsail Water & Sewer District as well as similar rural water systems in other North Carolina Counties. In order to distinguish between areas with a more suburban makeup versus rural composition, two different user demand estimates were used in the calculations. An average daily water demand of 200 gallons per day per residential unit was used in Rocky

Point and Topsail Townships where development is more suburban in nature. In the more rural areas of the County an average daily water demand of 180 gallons per day per residential unit was used.

Using the estimated percentages of homes to be served, the number of existing and predicted homes, the proposed timeline for construction and the estimated demand per residential unit, the amount of water supply needed to serve the residential needs within each township was estimated (Table No. 1.2).

Table No. 1.2 – Predicted Residential Water Demand By Township

Township	2010	2015	2020	2025	2030
Burgaw	0.21	0.26	0.32	0.44	0.57
Union	0.21	0.23	0.25	0.27	0.29
Rocky Point	0.45	0.60	1.04	1.26	1.37
Topsail	1.17	1.40	1.63	1.86	2.09
Long Creek	0.12	0.14	0.22	0.42	0.53
Grady	0.13	0.15	0.16	0.29	0.40
Columbia	0.00	0.12	0.13	0.14	0.15
Canetuck	0.00	0.02	0.03	0.03	0.04
Caswell	0.00	0.06	0.07	0.07	0.08
Holly	0.00	0.14	0.14	0.15	0.15
TOTAL	**2.30**	**3.12**	**3.99**	**4.93**	**5.67**

4. Commercial Water Projections

a) Commercial Growth

According to Pender County staff there is a considerable demand for new commercial development. Three interchanges along the I-40 corridor within the County carry significant traffic to the coastal areas, yet minimal services or amenities exist at the interchanges. This is largely attributable to the lack of public water and wastewater facilities.

The rate of development of commercial land was determined by the predicted time table of water availability and perceived demand. Areas of high demand were assumed to be the I-40 interchange areas and the US 17 corridor in Topsail Township. Additionally, the US 117, NC 210 and US 421 corridors are expected to generate significant demands and have been incorporated as part of these projections.

Another factor considered was the prediction of availability of public wastewater facilities in these areas. Without the availability of County wastewater, larger commercial facilities may find it cost prohibitive to locate along these routes. Therefore, the demand for potable water

supply to new facilities will closely track with the demand for wastewater services for commercial use.

Determining the amount of available land was a key component in calculating commercial water demand. The County's zoning data was used to determine the acreage available within each township. Floodplains, municipal planning boundaries (ETJ's), undrained wetlands, and water features were excluded from the analysis.

Table No. 1.3 – Amount of Land Developed for Commercial Uses (Ac)

Township	Available Land Zoned B-1, B-2, B-3	2010	2015	2020	2025	2030
Burgaw	506.9	50.7	76.0	101.4	152.1	253.5
Canetuck	0.0	0.0	0.0	0.0	0.0	0.0
Caswell	0.0	0.0	0.0	0.0	0.0	0.0
Columbia	51.12	0.0	5.1	6.1	12.8	17.9
Grady	44.83	0.0	4.5	5.4	11.2	15.7
Holly	18.59	0.0	0.0	0.0	0.0	0.0
Long Creek	0.0	0.0	0.0	0.0	0.0	0.0
Rocky Point	353.63	35.4	106.1	176.8	212.2	265.2
Topsail	471.42	141.4	235.7	330.0	466.7	471.4
Union	1060.01	106.0	159.0	212.0	318.0	530.0
TOTAL	2506.5	333.5	586.4	831.7	1,172.9	1,553.7

b) Commercial Flow Predictions

Two different flow profiles were used to predict water demand in commercial areas. One for interchange areas where several fast food restaurants are grouped together and another for more varied services or retail oriented commercial development. A water demand of 3,550 gallons per acre was used for interchange areas, while a demand of 1,500 gallons per acre was used from suburban retail development. Each township was assigned a different ratio of interchange to retail development based upon perceived demand based on the percentages provided in Table No. 1.4.

Table No. 1.4 - Percentage of Commercial Development Type by Township

	Interchange (3,550 gal/ac)	Retail (1,500 gal/ac)
Burgaw	25%	75%
Columbia	15%	85%
Grady	15%	85%
Rocky Point	20%	80%
Topsail	20%	80%
Union	15%	85%

Applying these factors to the amount of anticipated land development, water demand can be predicted (see Table No. 1.5).

Table No. 1. 5 – Predicted Commercial Water Demand by Township

Township	2010	2015	2020	2025	2030
Burgaw	0.10	0.15	0.20	0.31	0.51
Canetuck	0.00	0.00	0.00	0.00	0.00
Caswell	0.00	0.00	0.00	0.00	0.00
Columbia	0.00	0.02	0.02	0.04	0.05
Grady	0.00	0.01	0.01	0.02	0.03
Holly	0.00	0.00	0.04	0.02	0.03
Long Creek	0.00	0.00	0.00	0.00	0.00
Rocky Point	0.07	0.20	0.34	0.41	0.51
Topsail	0.27	0.45	0.63	0.89	0.90
Union	0.19	0.29	0.38	0.57	0.96
TOTAL	**0.63**	**1.12**	**1.62**	**2.26**	**2.98**

5. Industrial Wastewater Projections

With the necessary water and wastewater infrastructure in place, Pender County will be poised to attract industrial development. Its proximity to Wilmington and major transportation routes make it a favorable place for industries to locate. Discussions with industrial development representatives for this area yielded that the current economic market favors light industrial applications such as distribution centers, computer processing centers, and office buildings. These representatives also indicated that Pender County will most likely see the same kind of light industry growth occurring in Wilmington.

Industrial water demand was calculated using the same methodology as was used to calculate wastewater flows (See Pender County Wastewater Master Plan Document). Water demand was determined by the amount of land currently planned for industrial uses. The amount of land was calculated by taking the acreage of land zoned for industrial use and subtracting the floodplain, undrained wetland, and municipal planning areas.

As determined in the Wastewater Master Plan Document, a water use of 1,000 gallons per day per acre of land is an appropriate estimate of water demand in industrial areas. Table No. 1.6 summarizes the amount of industrial water demand predicted for each Township.

Table No. 1.6 – Predicted Industrial Water Demand by Township

Industrial Water Demand By Land Area		Amount of Water Demand (MGD)				
Township	Total Amount of Land Zoned I-1, I-2 Available	2010	2015	2020	2025	2030
Burgaw	0.01	0.00	0.00	0.00	0.00	0.00
Canetuck	0.00	0.00	0.00	0.00	0.00	0.00
Caswell	0.00	0.00	0.00	0.00	0.00	0.00
Columbia	0.00	0.00	0.00	0.00	0.00	0.00
Grady	1143.45	0.00	0.11	0.46	0.69	0.91
Holly	485.62	0.00	0.00	0.00	0.00	0.00
Long Creek	7.58	0.00	0.00	0.01	0.01	0.01
Rocky Point	2118.39	0.21	0.64	1.06	1.27	1.59
Topsail	11.38	0.00	0.01	0.01	0.01	0.01
Union	9.11	0.00	0.01	0.01	0.01	0.01
TOTAL	**3,775.5**	**0.22**	**0.76**	**1.54**	**1.99**	**2.53**

6. Summary by Township

A summary of the County's projected water supply needs by 2030 listed by township is shown in Table No. 1.7 below.

Table No. 1.7 – Projected Total Water Demand (MGD) in 2030

	Residential	Commercial	Industrial	Bulk Sale
Burgaw	0.57	0.51	0.00	
Union	0.29	0.96	0.01	
Rocky Point	1.37	0.51	1.59	
Topsail	2.09	0.90	0.01	1.00
Long Creek	0.53	0.00	0.01	
Grady	0.40	0.03	0.91	
Columbia	0.15	0.05	0.00	
Canetuck	0.04	0.00	0.00	
Caswell	0.08	0.00	0.00	
Holly	0.15	0.03	0.00	
TOTAL	**5.67**	**2.98**	**2.53**	**1.00**

The estimated amount of water treatment capacity required in Pender County was determined for each township in 5 year increments. Within the 25 year planning period the estimated timing of the construction of this capacity is provided in Table No. 1.8:

Table No. 1.8 – Projected Total Water Demand (MGD)

	2010	2015	2020	2025	2030
Burgaw	0.31	0.42	0.52	0.74	1.08
Union	0.40	0.53	0.64	0.85	1.25
Rocky Point	0.73	1.44	2.44	2.94	3.47
Topsail	1.44	1.86	2.27	2.76	3.00
Long Creek	0.12	0.14	0.23	0.43	0.54
Grady	0.13	0.27	0.63	1.00	1.35
Columbia	0.00	0.14	0.15	0.19	0.21
Canetuck	0.00	0.02	0.03	0.03	0.04
Caswell	0.00	0.06	0.07	0.07	0.08
Holly	0.00	0.14	0.18	0.17	0.18
Bulk Sale to Town of Topsail	0.00	0.00	0.00	0.00	1.00
TOTAL	**3.14**	**5.01**	**7.15**	**9.18**	**12.19**

7. Summary by Water and Sewer District

Pender County has chosen to segment the County into regional Water & Sewer Districts (See Exhibit A). These proposed Districts will have a separate legal identity and funding capabilities but will jointly operate with the County for water supply and management. The County's existing and proposed Districts are presented in *Section I – Predicting Population*.

As planning for the construction of water infrastructure materializes, a more detailed analysis of each District should be conducted to determine actual users and demands to be served. The success of the Rocky Point/Topsail Water and Sewer District provides an excellent model for development of new districts. The 'rule of thumb' requirement of 15 customers per mile needed to generate revenues sufficient for construction, debt service, and operation/maintenance has proven successful for this District and it is recommended that the County continue this approach for the implementation of water systems into other areas or districts.

For planning purposes, water demands were divided by the proposed Districts using the percentage of each township that lies within each District. The percentages were determined by land area and are presented in Table No. 1.9.

Table No. 1.9 – Percentage of Land Area per District

DISTRICT	Topsail	Rocky Point	Holly	Grady	Long Creek	Caswell	Canetuck	Columbia	Burgaw	Union
Rocky Pt/Topsail	94.89%	97.39%	12.28%		42.64%				15.45%	
Scott's Hill	5.11%									
Moore's Creek				100.00%	52.76%	100.00%	100.00%	5.08%	1.01%	
Central		2.61%	87.72%		4.60%				83.54%	
Columbia/Union								94.92%		100.00%

The percentage noted in Table 1.9 were applied to the predicted flows of each township to calculate the water demand data presented below in Table No. 1.10.

Table No. 1.10. - Summary of Water Demand by Category in 2030 by District

DISTRICT	Residential	Commercial	Industrial	TOTAL FLOW
Rocky Pt/Topsail	3.38	1.31	1.69	6.38
Scott's Hill	0.21	0.09	0.00	0.30
Moore's Creek	0.92	0.02	0.78	1.72
Central	0.73	0.51	0.05	1.28
Columbia/Union	0.44	1.01	0.01	1.46
COUNTY TOTAL	**5.67**	**2.94**	**2.53**	**11.14**
BULK SALE ALLOCATION				**1.00**
TOTAL WATER SUPPLY NEEDED				**12.14**

When segmented into five year increments, the total water demand in each District is predicted as follows in Table No. 1.11.

Table No. 1.11 - Summary of Total Water Demand by District

DISTRICT	2010	2015	2020	2025	2030
Rocky Pt/Topsail	2.09	3.19	4.59	5.61	6.38
Scott's Hill	0.11	0.16	0.24	0.28	0.30
Moore's Creek	0.22	0.44	0.83	1.33	1.72
Central	0.32	0.55	0.70	0.92	1.28
Columbia/Union	0.40	0.67	0.79	1.04	1.46
Bulk Sale Allocation	0.00	0.00	0.00	0.00	1.00
COUNTY TOTAL	**3.14**	**5.01**	**7.15**	**9.18**	**12.14**

B. Section 2 – Raw Water Supply

1. Purpose

This section examines options for supplying raw water to Pender County's proposed water transmission and distribution system, including advantages, disadvantages, and potential regulatory issues associated with each option. Two surface water source options, including constructing an intake on the Northeast Cape Fear River and purchasing raw water from the Lower Cape Fear Water And Sewer Authority (LCFWSA), were considered to determine the best option for supplying raw water to Pender County.

2. Raw Water Supply Options

Option 1 – Construct New Intake on the Northeast Cape Fear River

Pender County could potentially construct its own intake on the Northeast Cape Fear River (NECFR) near Hampstead to develop a raw water source. This option would involve constructing an intake, a raw water pump station, and a large raw water transmission main from the intake to the proposed surface water treatment facility location. Significant regulatory issues and cost are associated with this option as well as the potential for brackish water conditions, which would necessitate higher treatment and operational costs. Consequently, this option is not recommended.

Option 2 - Purchase Raw Water from the LCFWSA – <u>RECOMMENDED</u>

The LCFWSA operates a 45 MGD raw water pump station at Lock and Dam # 1 in Bladen County, which draws water from the Cape Fear River. Raw water is conveyed from this station to Brunswick County, the City of Wilmington, and two industrial users through 60-inch and 48-inch segments of raw water transmission main. This raw water main is routed along US 421 near the New Hanover County / Pender County Line and could provide Pender County convenient access to a supply of raw water. This option would involve construction of a 48-inch water transmission main to connect to the LCFWSA's raw water main and convey raw water to a surface water treatment facility.

The LCFWSA's raw water rate at the time of this report is $.21 per 1,000 gallons. The Cape Fear River has an identified capacity for water supply of 106 MGD at Lock & Dam No.1 and the Authority has the ability to upgrade and/or modify their facilities in order to meet Pender County's long-term water supply needs.

Advantages

- Most cost-effective County-wide solution.
- The Cape Fear River has an identified capacity for water supply of 106 MGD
- The Authority has the ability to upgrade their facilities as required to meet Pender County's long-term needs
- Readily available supply.
- Convenient access to Authority's existing raw water main is provided.
- Eliminates the need for the County to operate and maintain its own raw water intake.
- Minimal regulatory concerns when compared to Option 1.
- Provides non-brackish fresh water supply.

Disadvantages

- The County would be a customer of the LCFWSA and would be subject to a system development fee of $141,877 per MGD of capacity required.
- Requires significant length of transmission main to reach existing RPTWSD system.

Option 2 was found to be the most feasible and cost effective alternative for a Raw Water Supply source. Therefore, it is recommended that the raw water supply be provided by the LCFWSA.

3. Ground Water

A detailed groundwater study was not in the scope of this project; however, Pender County could potentially develop ground water supplies in the Castle Hayne or Pee DeeAquifers and construct full-scale ground water treatment facilities located near Hampstead and/or US 421. Detailed information on water quality at these locations is unknown. Generally, the Pee Dee Aquifer is relatively shallow and spotty in the County and experiences degrading water quality over time. The Castle Hayne Aquifer is marked by high iron content and poor quality. However, yields can be high. Poor water quality in these areas would potentially necessitate membrane treatment, which is significantly more costly than traditional ground water treatment. Further, it is expected that developing wells at Hampstead or US 421 would be more expensive than the recommended alternative of utilizing raw water supplied by the LCFWSA.

Consultations with NCDENR Division of Water Resources officials indicated that it is possible that Capacity Use Regulations may be extended to Pender County in the future. In this case, the County would be required to significantly reduce their withdrawal and dependency on ground water. Salt water intrusion could also become a concern in the future. For these reasons, it is recommended that the County direct efforts for future water supply sources to surface water with careful monitoring of the ground water currently supplied by the Town of Wallace.

4. Rock Quarry

A proposed rock quarry, to be built in Holly Township, was also evaluated as a raw water source; however, quarry water might not be available until well beyond the study period. Quarry water would be similar in quality to water obtained from a shallow surficial aquifer and would require full-scale treatment. For the purposes of this report, further investigation of this source was not considered.

5. Raw Water Supply Conclusions and Recommendations

Obtaining a raw water supply from the LCFWSA is the most cost-effective solution for a raw water supply for Pender County and is the recommended option. A surface water treatment plant (discussed in Section 5) would be constructed concurrently with this option.

C. Section 3 – Purchasing a Finished Water Supply

1. Purpose

This section details Pender County's options for purchasing a supply of bulk potable water for the County's proposed water transmission and distribution system. Advantages, disadvantages, and potential regulatory issues associated with each option are discussed herein. New Hanover County, the City of Wilmington, and Brunswick County were evaluated to determine the most feasible option to provide bulk potable water to Pender County's water system.

2. Finished Water Source Options

The potential for interconnections to the New Hanover County system and the City of Wilmington system near Scott's Hill was considered. Additionally, the City of Wilmington's Sweeny Water Treatment Plant and Brunswick County's Northwest Water Treatment Plant were evaluated for potential to provide finished water along US 421 to the County's proposed water transmission system. Exhibit D illustrates each option for purchasing bulk potable water. For purposes of this report the cost-effectiveness of each solution was compared to that of building a County-owned water treatment facility in Table 3.7. Reference Section 5 for a detailed description of the proposed water treatment alternatives.

Option 1 – Purchase Finished Water from New Hanover County

Assuming adequate pressure and capacity from the New Hanover County system, this connection would provide approximately 1 to 2 MGD of finished water to Pender County's water transmission system as well as an interconnection between the existing Rocky Point/Topsail Water system and the New Hanover County system. New Hanover County is in the preliminary design stage to construct a 6 MGD groundwater treatment plant that will be located in northern New Hanover County, as well as a new elevated water storage tank that will be located in the Ogden area.

This option involves connecting to the New Hanover County water distribution system via New Hanover County's existing 16-inch water transmission main and installing approximately 23,000 linear feet of 12-inch diameter water transmission main along US 17 from Porter's Neck Road to Brown Town Road, and requires construction of a new water booster pump station. It is estimated that 1 MGD could potentially be supplied by the New Hanover County system.

To facilitate construction of this option, an encroachment agreement from NCDOT would be necessary. It is possible that the majority of this water transmission main could be laid in the existing Right-of-Way of US 17; however, considering the number of existing utility lines along the Right-of-Way of US 17, the purchase of additional utility easements would be expected. Additionally, a fee simple land acquisition would likely be required for the water booster pump station.

General environmental permits under the jurisdiction of the North Carolina Department of Environment, Health and Natural Resources (NCDENR), including storm water, erosion control, and water line extension, would be required for this option. Additionally, it is anticipated that a very limited number of wetlands pipeline crossings would be required and would be permitted under a US Army Corps of Engineers' general permit. CAMA permitting would also likely be required for the wetlands pipeline crossings. A detailed design would be necessary to determine the specific permitting issues that would need to be addressed. It is not anticipated that significant regulatory issues will be associated with this option.

A capacity fee of approximately $3,000,000 (Estimated) would be incurred and is included in the total project cost of approximately $6,500,000. In addition to the system development fee, it was estimated that New Hanover County would charge a fee of approximately $2 to $4.50 per 1,000 gallons of purchased potable water.

Table 3.1 – Purchase Water from New Hanover County - Engineer's Opinion of Probable Project Cost

Item No.	Description	Qty.	Unit	Unit Price	Extension
1.	US 17 Booster Pump Station Near Porter's Neck Road	1	LS	$ 500,000	$ 500,000
2.	12-inch Potable Water Transmission Main from Porter's Neck Road to Scott's Hill	10,000	LF	$ 75	$ 750,000
3.	12-inch Potable Water Transmission Main from Scott's Hill to Phase 3 at Brown Town Road	13,000	LF	$ 75	$ 975,000
4.	Creek Crossings Via Directional Drill	2	EA	$ 100,000	$ 200,000
				Opinion of Total Construction	**$ 2,500,000**
				Contingencies	**$ 375,000**
				Capacity and System Development Fees	**$ 3,000,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 500,000**
				Administrative and Legal Services and Land Acquisition	**$ 125,000**
				Opinion of Total Project Cost [1, 2, 3 & 4]	**$ 6,500,000**

[1] *Total project cost does not include the cost of purchasing potable water, which could range between $2 and $4.50 per 1,000 gallons. A capacity fee of $3 per gpd was used for estimating purposes in the total project cost.*

[2] *Total project cost are provided in 2005 dollars.*

[3] *Connects to New Hanover County's 16-inch line.*

[4] *Assumes adequate pressure and capacity from New Hanover County.*

Advantages:

- Provides 1-1.5 MGD capacity without significant regulatory issues.
- Interconnection with New Hanover County could be used as a backup / emergency source.

Disadvantages:

- This alternative does not provide enough capacity to be considered a County-wide water source solution and is not a cost-effective solution.
- New Hanover County utilizes ground water and is subject to limitations that would be associated as such. Additionally, water quality issues may arise due to blending water from more than one source within the transmission and distribution systems.

This option does not provide enough capacity to be considered a County-wide solution; however, an interconnection with New Hanover County would be advantageous to both counties for use in emergency situations. As discussed in Section 5 of this report, the most feasible option for providing potable water to Pender County's proposed water transmission system is to purchase bulk raw water and construct a water treatment facility on US 421. If the County chooses to build a water treatment facility to serve the majority of the County, but cannot bring the proposed water treatment facility online prior to exhausting allotted capacity from Wallace to meet the expanding demands of the RPTWSD, this option could potentially serve as a backup finished water source.

Option 2 – Purchase Finished Water from the City of Wilmington – Connect near Scott's Hill

With the availability of adequate pressure and capacity in the City's system, Pender County could potentially acquire 400,000 to 500,000 gallons per day of finished water from the City. This option involves connecting to the City's existing 8-inch potable water main, which terminates near El Ogden Drive, constructing approximately 39,000 feet of 12-inch water transmission main along US 17 from El Ogden Drive to Brown Town Road, and constructing a new water booster pump station.

As with Option 1, general environmental permits under the jurisdiction of NCDENR and US Army Corps of Engineers would be required for this option. Although a detailed design would be required to determine the specific permitting issues that would need to be addressed, it is not anticipated that significant regulatory issues would be associated with this option.

Because the proposed connection to the City's system would occur at the outer limits of the City's distribution system, pressure and capacity limitations as well as water quality concerns

would make this alternative problematic. Additional upgrades to the City's distribution system would be required, of which the County would be required to share or incur such cost of the upgrade. This alternative would provide less capacity than Option 1 (connecting to the New Hanover County system) at a higher construction cost. Additionally, this alternative would not provide sufficient capacity for a County-wide water source solution, and its viability as a long term water source is marginal. Therefore, this option is not recommended.

As part of this option, a projected system development fee of approximately $1.25 million (Estimated) would be incurred and is included in the total project cost of approximately $6.4 million. The cost of purchasing bulk potable water from the City is currently approximately $2 per 1,000 gallons.

Table 3.2 – Purchase Water from City of Wilmington - Engineer's Opinion of Probable Project Cost

Item No.	Description	Qty.	Unit	Unit Price	Extension
1.	US 17 Booster Pump Station Near El Ogden Road	1	LS	$ 500,000	$ 500,000
2.	12-inch Potable Water Transmission Main from El Ogden Road to Scott's Hill	26,000	LF	$ 75	$ 1,950,000
3.	12-inch Potable Water Transmission Main from Scott's Hill to Phase 3 at Brown Town Road	13,000	LF	$ 75	$ 975,000
4.	Creek Crossings	2	EA	$ 100,000	$ 200,000
				Opinion of Total Construction	**$ 3,700,000**
				Contingencies	**$ 600,000**
				System Development Fee	**$ 1,250,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 740,000**
				Administrative and Legal Services and Land Acquisition	**$ 115,000**
				Opinion of Total Project Cost [1, 2, 3, 4, & 5]	**$ 6,400,000**

[1] *Total project cost does not include the cost of purchasing potable water, which could be approximated at $2 per 1,000 gallons. A system development fee of $2.50 per gpd was used for estimating purposes in the total project cost.*

[2] *Total project cost are provided in 2005 dollars.*

[3] *Connects to 8-inch City of Wilmington line.*

[4] *Potential capacity and pressure limitations.*

[5] *Additional upgrades to the City's distribution system may be required. Additional upgrade costs are not included.*

Advantages:

- Interconnection with City could be used as a backup / emergency source.

Disadvantages:

- Only a small amount of capacity is available, as the connection would occur near the extreme boundary of the City's system, along small lines.
- Potential capacity and pressure limitations and water quality concerns are associated with this option. Additional upgrades to the City's system would be incurred by the County.
- Does not provide long-term viable water source.
- Not cost-effective

Option 3 – Purchase Finished Water from Brunswick County

Pender County could potentially purchase 4 MGD to 12 MGD of finished water from Brunswick County. The Northwest Regional Water Treatment Facility is located near the City of Northwest in Brunswick County and is supplied raw water from the LCFWSA. Currently, this facility has a capacity of 24 MGD with an average daily demand of approximately 15 MGD. This option involves constructing approximately 32,000 feet of 20-inch to 30-inch water transmission main from Brunswick County's Northwest Water Treatment Plant to Pender County's proposed water transmission system along US 421 at the Pender County / New Hanover County Line, including a directional drill under the Cape Fear River, and construction of a large water booster pump station.

To facilitate construction of this option, an encroachment agreement from NCDOT for installation of the water transmission main along US 421 would be necessary, although it may be possible to route a portion of this main along an easement owned by the LCFWSA. If that option is chosen, an easement would need to be obtained from the LCFWSA. In addition, privately owned easements along the pipeline route would need to be obtained. A fee simple land acquisition would likely be required for the water booster pump station.

In addition to general environmental permits under the jurisdiction of NCDENR, CAMA and US Army Corps of Engineers permits would be required for construction of this option due to the necessity of directional drilling under the Cape Fear River. A detailed design would be required to determine the specific permitting issues that would need to be addressed in construction of this option.

A system development fee of approximately $13 million to $30 million would be incurred, depending upon the amount of capacity purchased, which is included in the opinion of total

project cost for this option, and ranges from approximately $22.9 million to $42.8 million, depending upon capacity supplied. The current cost of purchasing bulk water from this facility is $2.21 per 1,000 gallons. The Northwest Plant does not currently have capacity to supply the County's entire year 2030 demand. To obtain the necessary capacity, plant upgrades would be required and the County would be required to share or incur the associated costs. Such costs can not be determined at this time and are not included in the opinion of total project cost.

Table 3.3 – Purchase 4-5 MGD Capacity from Brunswick County - Engineer's Opinion of Probable Project Cost

Item No.	Description	Qty.	Unit	Unit Price	Extension
1.	Booster Pump Station	1	LS	$ 750,000	$ 750,000
2.	20-inch Water Main from Northwest Plant to US 421	32,000	LF	$ 125	$ 4,000,000
3.	US and NC Road Crossings	1	EA	$ 200,000	$ 200,000
4.	Creek Crossings	1	EA	$ 100,000	$ 100,000
5.	Directional Drill Under Cape Fear River	1	LS	$ 2,000,000	$ 2,000,000
				Opinion of Total Construction	**$ 7,100,000**
				Contingencies	**$ 1,000,000**
				New Plant Capacity / System Development Fee	**$ 13,000,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 1,500,000**
				Administrative and Legal Services and Land Acquisition	**$ 250,000**
				Opinion of Total Project Cost [1, 2 & 3]	**$ 22,900,000**

[1] *Total project cost does not include the cost of purchasing potable water, which is currently $2.21 per 1,000 gallons. A system development fee of $2.50 per gpd was used for estimating purposes in the total project cost.*

[2] *Total project cost are provided in 2005 dollars.*

[3] *Does not include plant upgrade - capacity concerns.*

Table 3.4 – Purchase 6-8 MGD Capacity from Brunswick County - Engineer's Opinion of Probable Project Cost

Item No.	Description	Qty.	Unit	Unit Price	Extension
1.	Booster Pump Station	1	LS	$ 750,000	$ 750,000
2.	24-inch Water Main from Northwest Plant to US 421	32,000	LF	$ 150	$ 4,800,000
3.	US and NC Road Crossings	1	EA	$ 200,000	$ 200,000
4.	Creek Crossings	1	EA	$ 100,000	$ 100,000
5.	Directional Drill Under Cape Fear River	1	LS	$ 2,000,000	$ 2,000,000
				Opinion of Total Construction	**$ 8,800,000**
				Contingencies	**$ 1,300,000**
				New Plant Capacity / System Development Fee	**$ 20,000,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 1,800,000**
				Administrative and Legal Services and Land Acquisition	**$ 250,000**
				Opinion of Total Project Cost [1, 2 & 3]	**$ 32,200,000**

[1] *Total project cost does not include the cost of purchasing potable water, which is currently $2.21 per 1,000 gallons. A system development fee of $2.50 per gpd was used in estimating purposes in the total project cost.*

[2] *Total project cost are provided in 2005 dollars.*

[3] *Does not include plant upgrade - capacity concerns.*

Table 3.5 – Purchase 9-12 MGD Capacity from Brunswick County - Engineer's Opinion of Probable Project Cost

Item No.	Description	Qty.	Unit	Unit Price	Extension
1.	Booster Pump Station	1	LS	$ 1,500,000	$ 1,500,000
2.	30-inch Water Main from Northwest Plant to US 421	32,000	LF	$ 180	$ 5,760,000
3.	US and NC Road Crossings	1	EA	$ 200,000	$ 200,000
4.	Creek Crossings	1	EA	$ 100,000	$ 100,000
5.	Directional Drill Under Cape Fear River	1	LS	$ 1,500,000	$ 1,500,000
				Opinion of Total Construction	**$ 9,100,000**
				Contingencies	**$ 1,400,000**
				New Plant Capacity / System Development Fee	**$ 30,000,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 2,000,000**
				Administrative and Legal Services and Land Acquisition	**$ 250,000**
				Opinion of Total Project Cost [1, 2 & 3]	**$ 42,800,000**

[1] *Total project cost does not include the cost of purchasing potable water, which is currently $2.21 per 1,000 gallons. A system development fee of $2.50 per gpd was used for estimating purposes in the total project cost.*

[2] *Total project cost are provided in 2005 dollars.*

[3] *Does not include plant upgrade - capacity concerns.*

Advantages:

- Provides capacity comparable to that of constructing a County-owned water treatment plant.
- Dependent upon capacities chosen, piping infrastructure would be limited and future upgrades would be required for expansion of capacity if needed.

Disadvantages:

- Purchasing finished water from the Northwest Plant would be less cost-effective than purchasing raw water from the LCFWSA and constructing a County-owned water treatment facility.
- Potential capacity and pressure limitations are associated with this alternative. Additional upgrades to the Northwest Plant would be required at a cost to the County.
- Not cost-effective.

Although this option provides capacity similar to that of constructing a water treatment plant and would provide a supply of finished water to the County's water transmission system it is not the recommended water source solution. Comparisons of project costs indicate this option to be less cost-effective than purchasing raw water and constructing a County owned water treatment facility. (Reference Section 5).

Option 4 – Purchase Finished Water from the City of Wilmington's Sweeney Water Treatment Plant Via US 421

With the availability of adequate capacity and pressure from the City, Pender County could potentially be provided 4 MGD to 5 MGD of potable water from the City of Wilmington's Sweeney Water Treatment Plant. It is noted that the City is currently evaluating the need for a capacity upgrade to the Sweeney Facility and available capacity beyond City needs are unknown at this time. This option involves constructing approximately 41,000 feet of 20-inch water transmission main from the City of Wilmington's Sweeney Water Treatment Plant to US 421 at the Pender County / New Hanover County Line, and includes a directional drill under the Cape Fear River and construction of a water booster pump station. A system development fee of approximately $15 million (estimated) would be incurred and is included in the opinion of total project cost of approximately $26.4 million.

To facilitate construction of this option, an encroachment agreement from NCDOT for installation of the water transmission main along US 421 would be necessary. In addition, privately owned easements along the pipeline route would need to be obtained. A fee simple land acquisition would likely be required for the water booster pump station.

As discussed in Option 3, in addition to general environmental permits under the jurisdiction of NCDENR, CAMA minor and US Army Corps of Engineers permits would be required for this option due to the necessity of directional drilling under the Cape Fear River. A detailed design would be required to determine the specific permitting issues that would need to be addressed for construction of this option.

The cost of purchasing bulk potable water from the City could range from $2 to $4.50 per 1,000 gallons. Long-term capacity is a primary concern with this option, as the City has limited space to expand its facility. Available capacity from the City is unknown at this time; however an estimated system development fee has been included for potential costs associated with a plant upgrade.

Table 3.6 – Purchase 4-5 MGD Capacity from City's Sweeney Water Treatment Facility - Engineer's Opinion of Probable Project Cost

Item No.	Description	Qty.	Unit	Unit Price	Extension
1.	Booster Pump Station	1	LS	$ 750,000	$ 750,000
2.	20-inch Water Main from Northwest Plant to US 421	41,000	LF	$ 125	$ 5,125,000
3.	US and NC Road Crossings	1	EA	$ 200,000	$ 200,000
4.	Creek Crossings	1	EA	$ 100,000	$ 100,000
5.	Directional Drill Under Cape Fear River	1	LS	$ 2,000,000	$ 2,000,000
				Opinion of Total Construction	**$ 8,200,000**
				Contingencies	**$ 1,200,000**
				Sweeny WTP Capacity / System Development Fee	**$ 15,000,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 1,700,000**
				Administrative and Legal Services and Land Acquisition	**$ 250,000**
				Opinion of Total Project Cost [1, 2 & 3]	**$ 26,400,000**

[1] *Total project cost does not include the cost of purchasing potable water, which could be approximated at $2 per 1,000 gallons. A system development fee of $2.50 per gpd was used for estimating purposes in the total project cost.*

[2] *Total project cost are provided in 2005 dollars.*

[3] *Potential capacity limitations.*

Disadvantages:

- This amount of capacity could be more cost-effectively obtained by construction of a County-owned facility.
- Capacity issues are associated with this option. Upgrades to the Sweeney Facility would be required at a cost to the County.
- It is anticipated that the Sweeny Water Treatment Plant is physically limited for expansion due to land constraints. It is unlikely that this plant will be able to supply both future City needs and County needs with this facility.

This option is not recommended because it does not provide a County-wide solution, and is less cost-effective than purchasing bulk raw water and constructing a County-owned water treatment facility, as recommended in this report.

Continue Purchase Of Finished Water from Town of Wallace

Pender County maintains an agreement with the Town of Wallace to purchase a supply of 800,000 gallons per day of finished water for the RPTWSD; however, additional capacity from Wallace was not considered available at the time of this report. If the County chooses to construct a water treatment facility to serve the majority of the County, including the RPTWSD, the 800,000 gallon per day capacity from Wallace can be re-routed from the RPTWSD to the US 117 corridor in the northern portion of the County. This interconnection could be beneficial to Pender County if faced with an emergency situation.

Advantages

- A water purchase agreement is currently in place between Wallace and the County.
- The water allocation can easily be routed from RPTWSD to the US 117 corridor in the northern portion of the County.
- This option can be used as a backup supply once the County-owned treatment facility is in place.

Disadvantages

- Only 800,000 gallons per day of capacity is available at the time of this report.
- County infrastructure along US 117 from Wallace is limited and would require significant upgrades in the event additional capacity was available.

It is recommended that Pender County maintain its agreement for supply with Wallace; however future water sources should be implemented as recommended in Section 5.

Table 3.7 provides a comparison of purchased water source cost and water treatment facility construction cost. Note that the cost provided for constructing a water treatment facility includes a credit for co-location of water and wastewater treatment facilities. Costs provided are in year 2005 dollars for comparison purposes. Reference Section 5 for an in-depth discussion of the proposed water treatment facility.

Table 3.7 – Water Source Cost Summary

Capacity (MGD)	Plant Cost (Co Location)	New Hanover Co.	City of Wilmington	Brunswick Co.
0.5	N/A*	N/A*	$6,400,000	N/A*
0.8	N/A*	N/A*	N/A*	N/A*
2	N/A*	$6,500,000	N/A*	N/A*
4	$11,000,000	N/A*	N/A*	N/A*
5	N/A*	N/A*	$26,400,000	$22,900,000
8	$22,000,000	N/A*	N/A*	$32,200,000
12	$33,000,000	N/A*	N/A*	$42,800,000

*N/A indicates that capacity is not available or was not considered for this report. Costs provided in this table are in Year 2005 dollars for comparison purposes.

3. Finished Water Source Recommendations

The most feasible purchased water source alternatives include purchasing bulk potable water from New Hanover County or Brunswick County. Approximately 1-2 MGD capacity from New Hanover County could supply potable water to portions of Rocky Point/Topsail Water District and Scott's Hill. If the County chooses to purchase bulk raw water and construct the proposed water treatment facility, it would be recommended that the County investigate the potential to connect to the New Hanover County system in the event the proposed facility can not be constructed in time to meet increasing demands of the RPTWSD.

Purchasing 12 MGD capacity from Brunswick County's Northwest Water Treatment Facility is the most feasible solution for providing purchased potable water to the County; however, constructing a County-owned water treatment plant to serve the County would be more cost-effective than purchasing bulk potable water and is the recommended County-wide water source solution, as discussed in Section 5.

It is recommended that the County continue its utilization of the Wallace water supply. However, the additional water source alternative is construction of a new water treatment facility as recommended by the report.

D. Section 4 – Water Transmission System

1. Purpose

This section details the methodology used in and results obtained from water transmission system modeling. Opinions of probable project costs are provided for the recommended water transmission system for each district, as well as regulatory issues associated with constructing

the recommended water system are discussed. Additionally, the potential to supply bulk potable water to Topsail Beach was evaluated as part of this study.

2. Water Transmission System

The proposed Pender County water system was hydraulically modeled using Water-Cad software. Projected Year 2030 demands for each township, with a peaking factor of 1.6 were used in the analysis. (Reference Table 1.7 for projected water demands by township). Exhibit E shows existing structure locations, and was used to apply projected demands spatially within each township. Large mains (12-inch diameter and greater) were placed along major highways, which are assumed to be potential growth corridors, as indicated in Exhibit F. Smaller distribution mains were placed along secondary roads.

The water model was based on three pressure zones and two water sources, located in Wallace and near US 421 at the Pender County / New Hanover County Line. Pump stations and water storage tanks have been placed on large transmission lines as required to convey water to each district. The recommended water system is provided in Exhibit G and includes booster pump station, water tank, and source locations and line sizing. Elevated water storage tanks are sized to provide a system-wide minimum of ½ day's storage, as dictated by NCDENR regulations. Fire flow requirements of 500 gpm at 20 psi residual pressure at peak flow, as stipulated by NCDENR, were considered in the model; however, line sizing is approximate and further hydraulic investigation is necessary prior to construction of each District.

The incorporated towns of Burgaw and Surf City operate their own water systems and were not considered as potential customers in this analysis. Additionally, Maple Hill is an existing water district and the proposed County-Wide water system was not designed to supply water to or interconnect the Maple Hill System.

3. District Analysis

It is anticipated that each water district will be constructed and phased as voluntary signups dictate. It is possible that some lines that were modeled will not be constructed due to a lack of signups, while some lines that were not modeled in this study may potentially be constructed in the future. District build-out may dictate that tanks or pump station locations be adjusted prior to final design for both size and location. The recommended distribution systems allow for interconnections between districts. As previously discussed, it is noted that a density of 15 customers per mile is typically required to provide for the costs of construction, debt service, and operations/maintenance of the system. It is recommend that Pender County continue with this approach for implementation of water systems in other areas/districts in the County.

To facilitate construction of each District, encroachment agreements from NCDOT would be necessary. It is anticipated that the majority of the water transmission mains could be placed along existing DOT-owned Right-of-Way. The County could require that each user provide a

utility easement as a condition of signup. The purchase of remaining easements along pipeline routes would also be required. A fee simple land acquisition would likely be required for each water booster pump station and water storage tank.

General environmental permits under the jurisdiction of the North Carolina Department of Environment, Health and Natural Resources (NCDENR), including storm water, erosion control, and water line extension, would be required for this option. Additionally, it is anticipated that a very limited number of wetlands pipeline crossings would be required and would be allowed under general CAMA permitting. An environmental assessment addressing potential impacts and mitigation measures for each District would need to be prepared and a subsequent 'Finding of No Significant Impact' (FONSI) would need to be issued prior to construction of each District. Detailed designs of each District would be required to determine the specific permitting issues that would need to be addressed.

a) Moore's Creek Water & Sewer District

Exhibit H shows the proposed Moore's Creek District water transmission system. This system includes construction of approximately 1 million feet of pipe, 2 million gallons of elevated water storage tank, and a water booster pump station at a total project cost of $45 million. A detailed opinion of probable project cost for this district is provided in Table 4.1.

Note that the Moore's Creek District opinion of cost does not include the portion of high-service transmission main that would be installed along US 421 from the Proposed US 421 Water Treatment Plant to NC 210 and along NC 210 to the RPTWSD. The cost of the high-service transmission mains is included in the cost of the Proposed US 421 Water Treatment Plant, as discussed in Section 5.

Table 4.1 – Moore's Creek District Engineer's Opinion of Probable Project Cost

Item No.	Description	Qty.	Unit	Unit Price	Extension
1.	2,000,000 Gallon Ground Water Storage Tank	1	EA	$ 2,000,000	$ 2,000,000
2.	Booster Pump Station	1	EA	$ 500,000	$ 500,000
3.	Potable Water Mains	1,027,200	LF	$ 30	$ 30,816,000
				Opinion of Total Construction	**$ 33,300,000**
				Contingencies	**$ 4,800,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 6,300,000**
				Administrative and Legal Services and Land Acquisition	**$ 600,000**
				Opinion of Total Project Cost [1, 2, 3]	**$ 45,000,000**

[1] *Total project cost are provided in 2005 dollars.*

[2] *Connects to Rocky Point, Columbia-Union, and Central Districts.*

[3] *Cost of high-service transmission main from Proposed US 421 Water Treatment Plant along Hwy 421 to existing RPTWSD 12-inch main on Hwy 210 included in Water Treatment Plant Opinion of Cost.*

b) Central Water & Sewer District

Exhibit I shows the proposed Central District water transmission system. This system includes construction of approximately 600,000 feet of pipe, and two 500,000 gallon elevated water storage tanks, at a total project cost of approximately $27 million. A detailed opinion of probable project cost for this district is provided in Table 4.2.

Table 4.2 – Central District Engineer's Opinion of Probable Project Cost

Item No.	Description	Qty.	Unit	Unit Price	Extension
1.	500,000 Gallon Elevated Water Storage Tank	2	EA	$ 800,000	$ 1,600,000
2.	Potable Water Mains	600,000	LF	$ 30	$ 18,000,000
				Opinion of Total Construction	**$ 19,600,000**
				Contingencies	**$ 3,000,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 3,900,000**
				Administrative and Legal Services and Land Acquisition	**$ 500,000**
				Opinion of Total Project Cost [1, 2]	**$ 27,000,000**

[1] *Total project cost are provided in 2005 dollars.*

[2] *Connects to Line along 117 from Wallace and Rocky Point/ Topsail District.*

c) Columbia / Union Water & Sewer District

Exhibit J shows the proposed Columbia / Union District water transmission system. This system includes construction of approximately 970,000 feet of pipe, two 500,000 gallon elevated water storage tanks, and two water booster pump stations at a total project cost of approximately $44 million. A detailed opinion of probable project cost for this district is provided in Table 4.3.

Table 4.3 – Columbia / Union District Engineer's Opinion of Probable Project Cost

Item No.	Description	Qty.	Unit	Unit Price	Extension
1.	500,000 Gallon Elevated Water Storage Tank	2	EA	$ 800,000	$ 1,600,000
2.	Booster Pump Station	2	EA	$ 500,000	$ 1,000,000
3.	Potable Water Mains	970,000	LF	$ 30	$ 29,100,000
				Opinion of Total Construction	**$ 31,700,000**
				Contingencies	**$ 4,800,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 6,400,000**
				Administrative and Legal Services and Land Acquisition	**$ 800,000**
				Opinion of Total Project Cost [1, 2]	**$ 44,000,000**

[1] *Total project cost are provided in 2005 dollars.*

[2] *Connects to Central and Grady/Long Creek Districts.*

d) <u>Scott's Hill Water & Sewer District</u>

Exhibit 4.7 shows the proposed Scott's Hill District water transmission system. This system includes construction of approximately 100,000 feet of pipe at a total project cost of approximately $3 million. A detailed opinion of probable project cost for this district is provided in Table 4.4.

Table 4.4 – Scott's Hill District Engineer's Opinion of Probable Project Cost

Item	Description	Qty.	Unit	Unit Price	Extension
1.	Potable Water Mains	100,000	LF	$ 23	$ 2,300,000
				Opinion of Total Construction	**$ 2,300,000**
				Contingencies	**$ 375,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 300,000**
				Administrative and Legal Services and Land Acquisition	**$ 25,000**
				Opinion of Total Project Cost [1, 2]	**$ 3,000,000**

[1] *Total project cost are provided in 2005 dollars.*

[2] *Connects to Rocky Point/Topsail District.*

e) Rocky Point / Topsail Water & Sewer District

The Rocky Point/Topsail Water and Sewer District, which is currently under the final stages of design and construction as discussed in Section 1B was modeled in previous studies. Demands in this district have been included in this report, however, additional modeling was not performed.

f) Provide Topsail Beach Bulk Potable Water

The potential for the County to provide bulk potable water to Topsail Beach was considered in this study. A year 2030 demand of 1 MGD for Topsail Beach was included in the water system analysis (Reference Section 1). This alternative involves construction of approximately 15,000 feet of water line along Sloop Point Road from US 17 to Topsail Beach, including a directional drill under the Intracoastal Waterway, a 500,000 gallon ground water storage tank and water booster pump station, as indicated in Exhibit L. The opinion of total project cost for this alternative is approximately $6.05 million. A detailed engineer's opinion of probable project cost for this district is provided in Table 4.5.

Table 4.5 – Provide 1 MGD Potable Water to Topsail Beach Opinion of Probable Project Cost

Item No.	Description	Qty.	Unit	Unit Price	Extension
1.	500,000 Gallon Ground Storage Tank	1	EA	$ 750,000	$ 750,000
2.	Booster Pump Station	1	EA	$ 500,000	$ 500,000
3.	12-Inch Potable Water Main	15,000	LF	$ 75	$ 1,125,000
4.	16-Inch Directional Drill Beneath ICW	1	LS	$ 2,000,000	$ 2,000,000
				Opinion of Total Construction	**$ 4,400,000**
				Contingencies	**$ 660,000**
				Eng. Planning, Design, Bidding and Construction Related Services	**$ 880,000**
				Administrative and Legal Services and Land Acquisition	**$ 110,000**
				Opinion of Total Project Cost [1]	**$ 6,050,000**

[1] *Total project cost is provided in 2005 dollars.*

4. Transmission System Cost Summary & Recommendations

Table 4.6 below provides a summary of the linear footage of pipe, number of water booster pump stations and water storage tanks, and total cost for each district.

Table 4.6 – District Water Transmission System Summary

District	Total LF Pipe	No. Tanks	No. Booster Pump Stations	Total Project Cost
Moore's Creek	1,027,200	1	1	$45,000,000
Columbia / Union	970,000	2	2	$44,000,000
Central	600,000	2	0	$27,000,000
Scott's Hill	100,000	0	0	$3,000,000
District Total				**$119,000,000**
Provide 1MGD Water to Topsail Beach	15,000	1	1	$6,050,000

[1] *Total project cost are provided in 2005 dollars.*

Table 4.6 indicates that the opinion of total project cost to construct the water transmission system for all districts is approximately $120 million. It should be noted that costs provided in this table are in Year 2005 dollars for comparison purposes and includes infrastructure for complete district build-out. However, it is likely that the districts will be phased and constructed as voluntary signups reach densities sufficient to support the necessary infrastructure.

The opinion of total project cost includes approximately 2.7 million feet of pipe, five water storage tanks, and three water booster pump stations, contingencies, engineering, planning, design, bid, construction phase services, administration, legal services, and land acquisition. This table does not include the cost of water production or operations and maintenance (O&M), as that is considered part of plant operations, which is discussed in Section 5.

As discussed in Section 4.1.B, Pender County could potentially sell 1 MGD of finished water to Topsail Beach at a total project cost of approximately $6.05 million, which would be in addition to the costs projected for the districts.

E. Section 5 – Water Treatment

1. Purpose

This section details the water treatment alternatives for Pender County and is corollary to the recommendations of Section 2, *Raw Water Supply.* An opinion of probable project cost is provided for the recommended water treatment facility and a discussion of regulatory issues associated with constructing the recommended facility are discussed.

2. Water Treatment Alternatives

A. US 421 Water Treatment Facility

It is recommended (*Reference Section 2, Raw Water Supply*) that the County purchase bulk raw water from the LCFWSA and construct a water treatment facility located on US 421 near the New Hanover County and Pender County Line. The water treatment facility can be constructed in four phases, as indicated in Table 5.1 below. Phase IA would be constructed by approximately 2008 and would entail construction of a new 2 MGD water treatment facility. It would be beneficial to co-locate the water treatment facility with the proposed wastewater treatment facility to provide process sharing with a resulting cost savings of approximately $28 million over the study period. Table 5.2 below provides a comparison of costs for co-located facilities with stand alone facilities.

As part of Phase IA, a high-service water transmission main, as shown in Exhibit L, would be installed along US-421 and Hwy 210 to convey water from the plant the RPTWSD, at a total project cost of $17.5 million. For the purposes of this study this main is sized to convey the ultimate plant capacity.

Phase IB, to be constructed by the year 2010, involves a 2 million gallon per day upgrade to the Phase IA plant, providing a total plant capacity of 4 million gallons per day. As part of Phase IB, a high-service transmission main should be installed along NC 210, parallel to the existing 12-inch RPTWSD line, extending to US 17. The total project cost for Phase I B is $45.2 million.

Phase II of this option would be constructed in 2020 and would entail an upgrade of 4MGD (for a total facility capacity of 8 MGD) and an additional segment of high-service transmission main along Hwy 17 at a total project cost of $28.4 million. Phase III, to be constructed in 2030, would involve an additional 4 MGD plant upgrade (to a total facility capacity of 12 MGD) at a total cost of $23 million. Note that costs provided are for a water treatment plant co-located with the proposed wastewater treatment facility.

Table 5.1 – Recommended Water Treatment Facility Summary Table

Phase	Capacity	Plant Cost (No Co-Location)	High Service Transmission Main Cost	Total Cost	Remarks
IA - 2008	2 MGD	$8,000,000	$9,500,000	$17,500,000	• 2 MGD Plant • 20″ Main from Plant to RPTWSD
I B - 2010	4 MGD	$7,900,000	$37,300,000	$45,200,000	• 2MGD Plant Upgrade • Parallel Segments of 36″ and 30″ on NC 210 from RPTWSD to US 17
II- 2020	8 MGD	$17,200,000	$11,200,000	$28,400,000	• 4 MGD Plant Upgrade • Parallel 20″ Main along US 17 from NC 210 to Sloop Point Rd.
III - 2030	12 MGD	$23,000,000	$0	$23,000,000	• 4 MGD Plant Upgrade

Table 5.2 – Water Treatment Facility Summary Table without Co-Location

Phase	Capacity	Plant Cost (No Co-Location)	High Service Transmission Main Cost	Total Cost	Remarks
IA - 2008	2 MGD	$14,700,000	$9,500,000	$24,200,000	• 2 MGD Plant • 20″ Main from Plant to RPTWSD
I B - 2010	4 MGD	$14,900,000	$37,300,000	$52,200,000	• 2 MGD Plant Upgrade • Parallel Segments of 36″ and 30″ on NC 210 from RPTWSD to US 17
II- 2020	8 MGD	$24,200,000	$11,200,000	$35,400,000	• 4 MGD Plant Upgrade • Parallel 20″ Main along US 17 from NC 210 to Sloop Point Rd.
III - 2030	12 MGD	$30,000,000	$0	$30,000,000	• 4 MGD Plant Upgrade

Table 5.2 indicates that the water treatment facility total build-out would be approximately $28 million more expensive if not co-located with the wastewater treatment facility recommended as part of the Pender County Wastewater Master Plan. Operation and Maintenance (O & M) costs for the water treatment facility are not reflected in the tables above, but are provided in section 5.4.

Parallel High-Service Transmission Main Alternatives

As discussed in meetings with staff, if the County chooses to construct total-build-out sized high-service water transmission mains, as shown in Exhibit G, the County will need to identify customers (in addition to those considered in Year 2010 water demand projections) to avoid water turnover and water quality concerns.

In an effort to address water quality concerns and to make initial Phase IA construction costs more feasible, McKim & Creed evaluated the possibility of constructing the high-service transmission main in parallel phases. It is most likely more cost effective to construct a large main for long term needs, but may be necessary to construct a smaller main due to economic considerations.

It is recommended that a 20-inch main be constructed for the Phase 1A 2 MGD Facility at projected probable project cost of $17.5 M. It is noted that ultimate sizing for this main was determined to be a 42-inch main and capacity requirements above the initial 2 MGD will dictate another main be constructed parallel to the 20-inch. Other phasing alternatives should be addressed as demand and growth dictate.

Table 5.3 – Parallel Pipe Capacity by Diameter

Capacity	Pipe Diameter
1 MGD	16″
2 MGD	20″
3 MGD	24″
4 MGD	30″

Operations: Maintenance Costs

Table 5.4 indicates O&M costs for a 2 MGD treatment facility in Year 2005 dollars would be approximately $1.15 per 1,000 gallons.

Table 5.4 –Water Treatment Facility Projected O& M Cost

Item			Year 2005
1	**Energy**		**2 MGD**
	a.	Raw Water Pump Station	
	b.	Water Treatment Plant	
	c.	Finished Water Pump Station	
	d.	*Total Demand Load (annual)*	
	e.	Cost per kw	**$260,000**
	f.	Deisel Fuel (Annual Testing) Standby Generator	**$6,000**

Item			Year 2005
		Total Cost of Energy	
2	**Chemicals cost per year**		
	a.	Acid	
	b.	Powder Activated Carbon	
	c.	Alum	
	d.	Flouride	
	e.	Polymer	
	f.	Sodium Hypochlorite Chlorine	
	g.	Corrosion Inhibitor	
	h.	Caustic Soda	
		Annual Chemical Cost (with 15% surcharge for fuel cost)	**$115,000**
3	**Contract Services**		
	a.	Professional Services (Programming/Logic/Control)	
	b.	Misc. Maintenance Contracts (Grounds, Equipment, Pumps, etc)	
	c.	Equipment Rental	
		Total Contract Services	**$39,000**
4	**Repair Parts and Lubricants**		
	a.	Water Treatment Plant/spare pipe and valves/generator overhaul	
		Total Repair Parts & Lubricants	**$40,000**
5	**Vehicles**		
	a.	Water Treatment PlantTrucks (2) /Equipment tools	
		Total Vehicles	**$30,000**
6	**Office Supplies and Telephone**		
	a.	Office and Printing Supplies, Computers	
	b.	Emergency Planning/Training/Personnel Protec. Equip.)	
	c.	Consumables/grounds maintenance/painting	
	d.	Telephone (Cell Phones and Office Phone)	
	e.	Training/ OSHA	
	f.	Vehicle Maintenance and Fuel	

Item			Year 2005
		Total Office Supplies & Telephone	**$15,0000**
7	**Laboratory Cost (annual)**		
	a.	Laboratory Supplies	
	b.	Sub-contracted Testing	
		Total Laboratory Cost	**$25,000**
8	**Sludge Handling**		
	a.	Sludge Wasting	
	b.	Handling and Hauling (Clean Residuals Basin Once in Three Years)	
		Total Disposal and Hauling	**$50,000**
9	**Clean Intake Once Every three Years**		
	a.	Labor, Equipment, Disposal, etc.	
			$25,000
10	**Subtotal**		**$600,000**
11	**On hand replacement parts and security budget**		**$20,000**
12	**Staff (Annual)**		
		ORIC	
		Grade Surface Water /Lab Tech	
		Grade Distribution and Backflow	
		Grade Distribution /Mechanic	
		Administrator	
		Operator in Training	
		Total plus benefits at 21%	**$300,000**
13	**Total O&M Costs**		**$920,000**
14	**O&M Costs per 1,000 Gallons**		**$1.26**

Note that projected O&M costs are estimates only and will vary depending upon Plant processes, location, and economic conditions.

3. Water Treatment Alternatives Summary and Recommendation

It is recommended that the County purchase raw water from the LCFWSA and construct a water treatment facility on US 421 co-located with the proposed wastewater treatment facility. The water treatment facility can be constructed in four phases. Phase IA would be constructed by approximately 2008 and would entail construction of a new 2 MGD water treatment facility. As part of Phase IA, a 20-inch high-service water transmission main would be installed along US-421 and Hwy 210 to convey water from the plant to the RPTWSD, at a total project cost of $17,500,000.

Phase IB would be constructed by 2010 and would entail a 2 MGD upgrade (for a total facility capacity of 8 MGD) to the Phase 1A water treatment facility. As part of Phase IB, a high-service water transmission main would be installed along Hwy 210 to convey water along the RPTWSD to US 17, at a total project cost of $45,200,000.

Phase II would be constructed in 2020 and would entail an upgrade of 4MGD (for a total facility capacity of 8 MGD) and an additional segment of high-service transmission main along Hwy 17 at a total project cost of $28.4 million. Phase III, to be constructed in 2030, would involve an additional 4 MGD plant upgrade (to a total facility capacity of 12 MGD) at a total cost of $23 million.

It is also recommended that the County seek customers (in addition to those included in projections of year 2010 demands) to be served by Phase 1A and Phase 1B of the water treatment facility and high-service transmission mains.

END OF REPORT