SECTION 5. FUTURE SITUATION

5.1 Introduction

The design of any wastewater treatment improvement is dependent upon the water quality standards and effluent limits, as discussed in Section 3, and upon the projected wastewater influent characteristics. Projected flows are dependent upon future population trends. The permanent population resides in the Town of Oak Island year-round. The seasonal population resides in the Town of Oak Island primarily during the summer months, as well as on weekends in the late spring and early fall seasons. Significant growth is expected within the Town of Oak Island wastewater service area during the 20-year planning period, with or without the construction of the recommended wastewater treatment improvements.

After the merger of Yaupon Beach and Long Beach in July 1999, a Consolidated CAMA Land Use Plan was prepared in 1999 and adopted in 2000. A key provision of the consolidated plan is the implementation of a sewer system to the former areas of Long Beach. The reason for this provision is "restoring the health of the community's surface waters." Additional provisions include the replacement of existing septic tanks and the requirement for connection to the Town's central sewer system when it is available. Oak Island is continuing to experience significant growth as evidenced by the significant number of housing starts through 2003. Housing starts have been significant even during the economic slowdown during the last two years as indicated in Table 4-5 of Section 4. Significant numbers of new residences are being constructed in the un-sewered areas with septic tanks, some with alternative onsite treatment systems. This growth is occurring even though existing septic tanks experience frequent failure resulting in risk of contamination. Due to the cumulative adverse environmental effects resulting from long term operation of on-site wastewater treatment systems, the potentially high cost for retrofits and repairs, as well as the future impacts associated with the predicted growth, the continued use of septic tank systems was eliminated from further consideration. Consequently, change from the current method of wastewater treatment is required. This section will discuss future permanent and seasonal populations, flows, and wastewater characteristics.

5.2 Land Use

Prior to their consolidation, the Towns of Yaupon Beach and Long Beach each had recently adopted and CRC-certified Coastal Area Management Act (CAMA) Land Use Plans. The Yaupon Beach Plan was certified in November 1998 and the Long Beach Plan was certified in March 1999. As a result of the consolidation effective July 1, 1999, it was necessary to make amendments to the plans so that the Town of Oak Island would have consolidated and consistent land use and development policies for the five-year period covered by the land use plans. The *Oak Island CAMA Land Use Plan, Consolidation of Land Use*

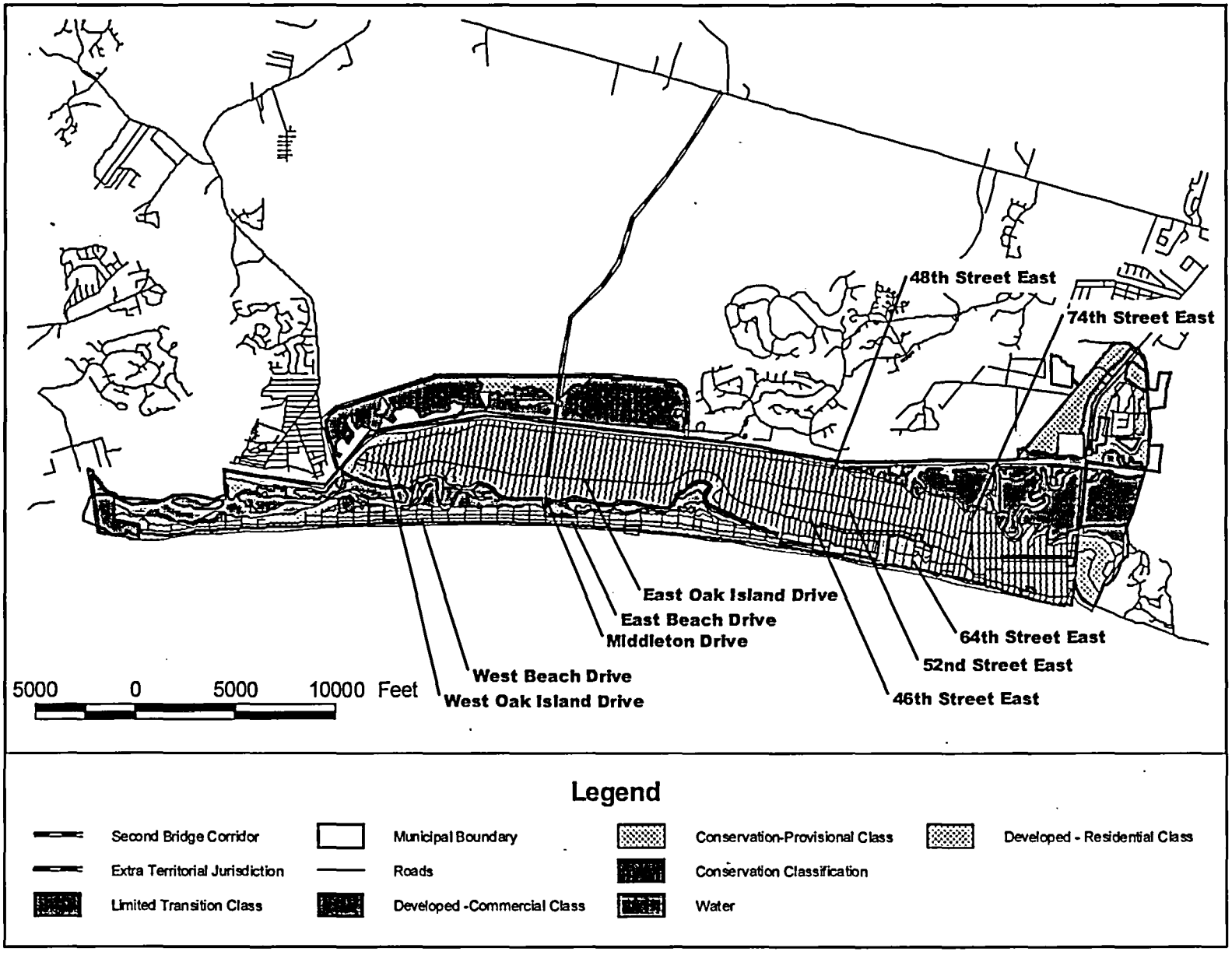
and Development Policies for Long Beach and Yaupon Beach was prepared in 1999 and approved in 2000.

A major goal for consolidation of the plans was to respect the planning research and policy development that was undertaken by the citizens and elected officials in each community during the process of developing the plans. To achieve this goal, the consolidated plan includes population projections and forecasts for the Town of Oak Island that include update and consolidation of the individual projections for Yaupon Beach and Long Beach; amendments to the policies contained in the Yaupon and Long Beach Plans to reflect the consolidation, particularly the availability of the Yaupon sewer system; and a consolidated land classification map.

The land classification map is illustrated on Figure 5-1, and contains the following classifications:

- Developed Residential (DR)
- Developed Commercial
- Limited Transition (LT)
- Conservation (CON)

Figure 5-1. Land Classification Map



5.2.1 Developed

The major land use in the Developed Residential (DR) class is residential. These areas are provided with all urban services; however, only a small portion is provided with central wastewater collection and treatment. Most of the residentially zoned and subdivided land on the island is included in this class. Densities in the DR class are in the range of 5 to 7 dwelling units per acre because these areas are fully subdivided. The typical uses expected in the DR class are single-family residences and accessory uses, duplexes, schools, churches, public parks, playgrounds, community centers, private marinas, and piers. The Town of Oak Island zoning ordinance determines specific uses permitted in this class.

The predominant land use in the Developed-Commercial (DC) class is retail and services. Like the DR class, DC is served by all urban services; however, only a portion is provided with central wastewater collection and treatment. The typical lot size is 6,000 square feet. Current development practices will require combination of lots to construct commercial facilities and to provide adequate off-street parking in most cases.

The areas classed as DC are concentrated in the commercial strip along East Oak Island Drive, from 64th Street East and 46th Street East, and extend south from Oak Island Drive to East Beach Drive between 52nd Street East and 48th Street East. The typical uses expected in the DC class are retail sales, personal and professional services, banks, convenience stores, restaurants, service stations, commercial marinas and piers, and residences.

5.2.2 Limited Transition

The Limited Transition (LT) class is intended for areas that will experience increased development during the planning period and will have some services but not the full range of urban services. Except for Areas of Environmental Concern and "404" wetlands, the Town's extra territorial jurisdiction (ETJ) on the mainland is included in the LT class. Residential densities are expected to be modest, approximately 1.5 dwelling units per net developed acre, generally exclusive of amenities. Uses in the LT area include the full range of housing types (single-family, duplex, and multi-family) community businesses, and services. The use of residential clustering and flexible site planning is encouraged. Business and service uses will be guided to "village clusters" at major intersections along the Second Bridge Corridor Access Road. Industrial areas are confined to mainland areas served by the Southeast Brunswick Sanitary District, with the exception of car washes and dry cleaners.

5.2.3 Conservation

The Conservation (CON) class is intended to provide for effective long-term management and protection of significant, limited, or irreplaceable natural resources. The management of these areas is designed to protect and enhance their natural, cultural, recreational, productive, and scenic values. In addition, management is intended to reduce the risk to life and property from hazards in these areas.

Five natural systems in the Town of Oak Island are included in the Conservation class: coastal wetlands; estuarine shoreline; estuarine and public trust waters; ocean hazard areas; and "404" wetlands. Development in each of these areas must be consistent with the applicable CAMA use standards, the policies contained in the Town's Land Use Plan, and the local codes of the Town of Oak Island. A special provisional subclass of the Conservation class is used for "404" wetlands. This subclass recognizes that mapping may not be reliable in some areas and that the quality of the wetland resource is dependent on habitat type, the amount of contiguous area, and other factors. These areas will not be impacted in terms of the proposed project.

5.3 Development Trend

The significant population increase is reflected in the increase in total housing units as reported on the US Census 2000. The distribution of added units between permanent and seasonal use is an estimate based on the US Census 2000 and the average number of persons per housing units of 2.14, and that there must be sufficient year-round units to accommodate the estimated permanent population. The permanent population is steadily increasing, and the Town's water sales during off-season months confirm these general trends. A copy of the Town's monthly billing detail for water and sewer is included in Appendix B.

Due to the growth of the community, the number and type of local businesses is changing rapidly. The number of businesses increased rapidly in the last decade, including a surge in food stores, restaurants, retail shops, and construction-related businesses. The economy will continue to be heavily seasonal and tourism-related. However, the gap between permanent and seasonal population is expected to narrow, as the permanent population is steadily increasing based on water billing information. Most of the commercial areas are already close to being fully developed. The commercial areas will likely be redeveloped with upgraded buildings and retail space. This will expand the number of community-serving retail operations and the availability of services on the island.

At the present rate of growth with the existing infrastructure and onsite treatment systems, build-out on the island will occur around 2018. This rate of growth is expected to occur regardless of whether a

wastewater collection system is constructed. Nearly the entire island is already subdivided and there are no large, vacant tracts remaining. Most of the vacant lots on the island are owned by numerous individuals, causing the island to continue its present growth trends. The *Second Bridge to Oak Island EIS, 2002* concluded that an increase in total housing units on the island between no construction and construction of the second bridge and access road is approximately 3% through 2025. A similar finding was concluded for housing on the mainland. Therefore, construction of the second bridge may increase development to a limited extent. A similar result is expected for construction of a wastewater collection system. Development is continuing on vacant lots with onsite wastewater treatment, and alternative treatment systems are being used for sewage treatment and disposal on some lots with difficult conditions. Therefore, construction of new housing will continue in any case, and a wastewater collection system would only result in a limited increase in development.

5.3.1 Water Conservation Ordinance Evaluation

Many communities in the United States are experiencing demands on their water systems that are approaching their available supply. Some of these communities struggle with inadequate supply sources and limited water treatment capacity. As a result of limited supplies and increasing water demands, many communities are implementing water conservation ordinances. Water conservation ordinances provide the framework for water conservation programs. Once implemented, these programs can reduce water usage, reduce water treatment costs, and prolong the operating life of water treatment facilities.

The Town of Oak Island has developed and implemented a water conservation ordinance to promote primary water conservation and to support demand management goals. The Town of Oak Island intends to maximize the existing water supply sources by reducing the increase in overall water usage throughout the Town. The water conservation ordinance defines water wasting activities and regulates usage of outdoor water usage. A copy of the ordinance is included in Appendix G.

5.4 Population Projections

Planning major wastewater system improvements is linked to an understanding of the future service area, development patterns, population served, and development policies of the Town. The following excerpt is from the article, "What a Good Local Development Plan Should Contain," by Kaiser and Davies, from Carolina Planning, Vol. 24, No. 2, Summer 1999.

> "A community's population and economy are its twin engines of growth and change. Population size and employment determine the amount of land needed, and its location. They also dictate the

demand for public and private services and infrastructure (such as public water supply and wastewater treatment, schools, and recreation)."

Facilities need to be properly sized and adequate to meet the Town's needs. To do this, the service area and population projections need to be understood.

5.4.1 Baseline Population Projections for the Town of Oak Island

As was presented in Section 4, the average growth rate for Brunswick County from 1970 to 2000 was 44.6 percent, or an average annual growth of 3.76 percent. The Town of Oak Island experienced a growth rate of 44.4 percent from 1990 to 2000, or an average annual growth rate of 3.74 percent. Based upon these two historical trends, it would seem initially that the annual growth rate should be established at approximately 3.75 percent for the purposes of projecting future population. However, Section 4 also established that the annual housing starts have averaged approximately 3.0 percent from 1994 to 2003. Therefore, there may be other conditions that are impacting growth, and other data and projections need to be considered to establish the growth rate for the Town of Oak Island.

The Town of Oak Island has excellent records on the number of platted parcels, the parcels containing housing units, and parcels without any structures or housing units. The entire island portion of the Town has been subdivided and platted. Using the Town's housing unit growth rate of 3.0 percent per year, the island portion of the Town will be built-out in approximately 2018. Using the finite number of platted parcels available and the average number of persons per household from the US Census 2000 data of 2.14, projections indicate that the permanent population of the island at build-out is in the range of 11,150 to 11,450. This assumes that the permanent population housing unit to total housing units remains in the 46 percent to 47 percent range, as determined by census data. Any projection must use this ceiling for the island population based on these assumptions.

The trend indicates an increase in permanent population to total seasonal population. However, this increase is small and its impacts are insignificant. Since an increase in permanent population housing units causes a corresponding decrease in seasonal population housing units, the impact of this trend will be negligible on the total flow projections.

The North Carolina Office of State Planning has issued population projections for Brunswick County by decade from 2000 through 2030. The projections are listed below:

2000 through 2010: 28.2 percent population increase
2010 through 2020: 20.5 percent population increase
2020 through 2030: 15.7 percent population increase

The average annual growth rate from the Office of State Planning for the decade of 2000-2010 would be 2.52 percent. The average annual growth rate for the decade of 2010 to 2020 would be approximately 1.89 percent. The average annual growth rate for the decade of 2020 to 2030 would be approximately 1.47 percent. Based upon historical trends, these estimates appear to be too low for the Town of Oak Island; nonetheless, these average annual growth rates will be used in determining population projections to establish population increases.

The Office of State Planning did establish an annual growth rate of 4.2 percent for 2001 to 2002. As was discussed in Section 4, the Office of State Planning estimated the growth rate of the Town of Oak Island from April 2000 to July 2001 at 5.0 percent. The annual growth rate of 4.2 percent may be too aggressive based on other data, but it will also be used to assist in establishing a realistic population growth for the island. Town of Oak Island Planning personnel have been using this rate as part of their short-term planning for revenues and services.

The CAMA Consolidated Land Use Plan projected an increase 39.9 percent for the decade of 2000 to 2010. The CAMA Consolidated Land Use Plan projections were based on historical trends for both the Yaupon Beach and the Long Beach areas, considering seasonal and transient population impacts. This projection will also be used in determining realistic population increases.

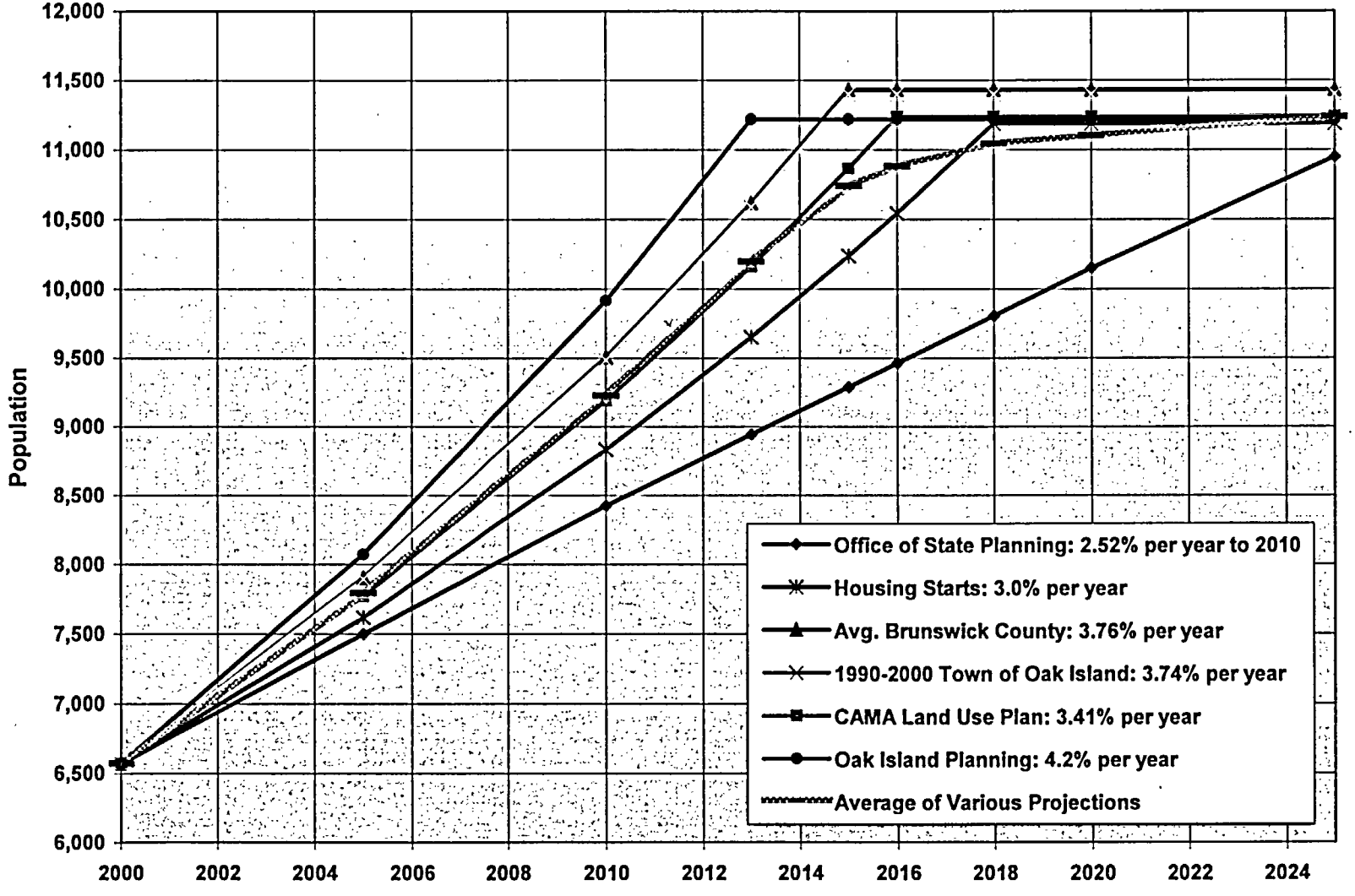
It should be noted that the 201 Facilities Plan for the West Brunswick WSA, under review by Construction Grants and Loans Section at the time of the preparation of this report, projected 21.4 percent increase for the entire service area for the decade of 2000-2010, but projected an increase for Holden Beach of 120.5 percent for the same decade. Therefore, the West Brunswick WSA 201 Facilities Plan projects significant growth of its beach community areas as compared to other areas of Brunswick County. Likewise, growth rates for the Town of Oak Island will be also be higher compared to Brunswick County.

All of the various projections and historical trends were compared and the various projection methods are listed in Table 5-1. Figure 5-2 is a graph of the different projection methods and the average of all of the various projection methods. The year 2013 was used in the projection as one of the methods reached build-out in this year and the potential for establishing a ten-year horizon for an initial phase of the treatment facilities. The year 2016 was used in the projections because one of the methods reached build-out in this year, and the year 2018 was used for the same reason.

Table 5-1. Permanent Population Projections for Oak Island

Population Projection Methods	Percent Growth per Year	2000	2005	2010	2013	2015	2016	2018	2020	2025
Office of State Planning for Brunswick County	2.52%	6,571	7,498	8,424	8,942	9,287	9,460	9,805	10,150	10,947
Housing Starts	3.00%	6,571	7,618	8,831	9,650	10,237	10,544	11,187	11,187	11,187
Historical Brunswick County Rate	3.76%	6,571	7,903	9,504	10,617	11,431	11,431	11,431	11,431	11,431
Historical Town of Oak Island Rate	3.74%	6,571	7,895	9,486	10,591	11,398	11,398	11,398	11,398	11,398
CAMA Land Use Plan	3.41%	6,571	7,770	9,189	10,161	10,866	11,237	11,237	11,237	11,237
State Planning and Oak Island Short Term Planning	4.20%	6,571	8,072	9,915	11,217	11,217	11,217	11,217	11,217	11,217
Average	3.44%	6,571	7,793	9,225	10,196	10,739	10,881	11,046	11,103	11,236

Figure 5-2. Permanent Population Projections for Oak Island



The line that represents the average of the different projection methods on Figure 5-2 closely resembles a curve that could be expected for community growth, especially in an area that is experiencing a higher growth rate. The line of the average of the different projection methods also is very close to the projections used in the CAMA Land Use Plan, and is roughly in the middle of all of the methods. For these reasons, the average appears to be a realistic projection of the island areas of the planning area. Therefore, the average from Table 5-1 will be used for the permanent population projections for the island portions of the Town of Oak Island planning area. Additional information on the population projections can be found in Appendix F.

5.4.2 Seasonal Population

As was discussed in Section 4, significant increases to the population occur during the summer months, especially on weekends and during the week of the fourth of July. As this additional seasonal population does generate wastewater, the number of people during these seasonal periods must be considered. Based on historical data and surveys, a factor of 3.2 was established as the ratio of seasonal population to permanent population. Using the average population projection figures from above, Table 5-2 displays the seasonal population that is projected for the 20-year planning period.

Table 5-2. Permanent and Seasonal Population Projections for Oak Island

Population Universe	2000	2005	2010	2013	2015	2016	2018	2020	2025
Permanent Population	6,571	7,793	9,225	10,196	10,739	10,881	11,046	11,103	11,236
Seasonal Population Increment	21,027	24,937	29,519	32,628	34,366	34,820	35,347	35,531	35,956
Total Permanent plus Seasonal Population	27,598	32,729	38,744	42,825	45,105	45,701	46,393	46,634	47,192

The seasonal population listed in Table 5-2 will be used for projecting flow contributions during the 20-year planning period. Additional information on the population projections can be found in Appendix F.

5.4.3 Planning Area Mainland Population

As discussed previously in this report, the existing corporate boundaries on the mainland are served by the Southeast Brunswick Sanitary District, and are not considered in planning for future wastewater collection and treatment needs.

As discussed in Section 4, a portion of the 201 Facilities plan area boundary is on the mainland in an area bordered by Sunset Harbor Road, the Town of St. James, and the Intracoastal Waterway. As was discussed in Section 4, this area is within the Town's ETJ, and the Town is responsible for providing services. Therefore, it is necessary to formulate population projections for this area in addition to the island areas.

Historical data and trends indicate that the demographic profile for the mainland area will be different from the island area. The mainland area is most likely to develop in same manner as the Town of St. James. This is due to the proximity of the mainland area to the Town of St. James. Therefore, it is instructive to look at the profile of the Town of St. James. According to US Census 2000 data, the Town of St. James had approximately 60 percent permanent population housing units to approximately 40 percent seasonal population housing units. According to census data, St. James has 2.09 persons per household in the permanent housing units as compared to 2.14 persons per household for Oak Island. For the purposes of projecting population on the mainland, it will be assumed that 60 percent of housing will be permanent and 40 percent will be seasonal. For permanent population housing units, 2.1 persons per household will be used.

The *Second Bridge to Oak Island, Corridor Land Use and Development Plan* prepared with funds provided through CAMA states a goal to maintain an overall residential density limit in the corridor planning area within the range of 2.0 to 6.0 dwellings per gross project acreage. To account for supporting facilities, this plan uses 1.5 dwellings per acre to project residential land needs, which is on the lower end of the range reported in the *Bridge to Oak Island, Corridor Land Use and Development Plan.* This projection of residential land needs appears to be in conformance with the development of the Town of St. James. Further, the *Draft Environmental Impact Statement for the Second Bridge to Oak Island, Brunswick County, North Carolina, From SR 1104 (Beach Drive) to NC 211* references the *Second Bridge to Oak Island, Corridor Land Use and Development Plan* and supports the conclusions in the land use and development plan. For these reasons, 1.5 housing units per acre will be assumed for developed residential housing areas on the mainland. The mainland area within the 201 Facilities planning area is 2,230 acres.

Based on the documents referenced above, along with the Consolidated Long Beach and the Yaupon Beach CAMA Land Use Plans, seasonal population is estimated in the range of 4.0 to 4.5 persons per household for areas on Oak Island and the mainland, except for the Long Beach area which is 6.5 persons per household. Population estimates performed for the *West Brunswick WSA 201 Facilities Plan* support seasonal household population within this range. For the purposes of estimating seasonal population on the mainland, 4.0 persons per household will be used to be in conformance with the previous reports.

Housing unit development for the mainland planning area is unknown at this time. However, based on the experience of St. James, a period of 20 years for build-out, or the year 2025, is not unreasonable. Development starting in 2005 can be expected because of the demand of housing units like those in St. James. The 2005 starting date is reasonable based on recent development trends and real estate transactions in the area. Additional information on the population projections can be found in Appendix F.

Using the assumptions stated above, Table 5-3 indicates the permanent and seasonal population on the mainland in the planning area that will be provided with sanitary sewer service.

Table 5-3. Mainland Population Projections

Population	2000	2005	2010	2013	2015	2016	2018	2020	2025
Permanent Population	-	211	1,054	1,686	2,107	2,318	2,740	3,161	4,215
Seasonal Population Increment	-	268	1,338	2,141	2,676	2,944	3,479	4,014	5,352
Total Permanent plus Seasonal Population	-	479	2,392	3,827	4,783	5,262	6,219	7,175	9,567

5.4.4 Total Population Projections in the Planning Area

Table 5-4 presents the total for both the island and the mainland areas for population projection for the 201 Facilities plan area.

Table 5-4. Total Population Projections

Population Universe	2000	2005	2010	2013	2015	2016	2018	2020	2025
Permanent Population	6,571	8,004	10,279	11,882	12,846	13,199	13,786	14,264	15,451
Seasonal Population Increment	21,027	25,205	30,857	34,769	37,042	37,764	38,826	39,545	41,308
Total Permanent plus Seasonal Population	27,598	32,208	41,136	46,652	49,888	50,963	52,612	53,809	56,759

These population projections will be used for flow projections for development of projected facilities and for the cost-effective analysis. Additional information on the population projections can be found in Appendix F.

5.5 Projected Wastewater Flow

Sections 5.3 and 5.4 indicate that the population connected to Oak Island's publicly owned treatment works will increase significantly during the planning period. The increases will result from housing starts in existing un-sewered areas and projected increases in the population within the planning area. The development of flow projections is discussed in this section.

5.5.1 Wastewater Flow

Wastewater flow projections were made based on the existing wastewater flows and on the projected population for the planning area presented in Section 5.4. The Town presently serves 904 sewer customers, including approximately 20 commercial customers. There are no industrial or institutional customers. The historical wastewater flows are presented in Table 5-5.

Table 5-5. Historical Average Daily Wastewater Flows

Year	Permanent Average Daily Flow (gpd)	Permanent Maximum Month Daily Flow (gpd)	Permanent Peak Daily Flow (gpd)	Total Seasonal Average Daily Flow (gpd)	Total Seasonal Maximum Month Daily Flow (gpd)	Total Seasonal Peak Daily Flow (gpd)
1999	71,000	73,000	100,000	120,000	134,000	172,000
2000	70,000	71,000	110,000	162,000	178,000	267,000
2001	90,000	100,000	153,000	143,000	175,000	240,000
2002	82,000	99,000	170,000	166,000	190,000	256,000

The historical average daily wastewater flows indicate that the existing permanent average daily flow is approximately 80,000 gpd, and the existing seasonal average daily flow is approximately 150,000 gpd, with a maximum daily flow during peak vacation season of approximately 250,000 gpd. This yields a per capita flow of 85 gpcd for permanent residents, and a per capita flow of 50 gpcd for seasonal residents. These per capita flows include infiltration/inflow. The historical data shows the per capita flows to be very consistent over the four year period analyzed. The per capita flows correspond reasonably to US EPA published values of 70 gpcd for residential flow and 15 gpcd for commercial flow.

Infiltration/inflow results from high groundwater and wet weather that occurs in the coastal areas, particularly tropical storms and hurricanes. Influent flow for the existing East Oak Island WRF and precipitation data for the Town from the years 1999 to 2002 were evaluated to ascertain the impact of wet weather on the maximum month and peak daily flows. The data suggest that maximum month and peak daily flows do not occur during wet weather or immediately after wet weather conditions. Therefore, peak wastewater flows are not the result of wet weather conditions, and I/I was deemed insignificant on Oak Island. Maximum month and peak daily flows are related to a seasonal influx of people. Daily operating data, precipitation data, and graphical analyses are included in Appendix D.

The Town of Oak Island has a stated goal to provide phased centralized sewer collection services to all of its residents. Currently, the Town has 6,895 water customers, including the 904 that have sewer service. If all the water customers were tied into the sewer system, the average daily flow to the wastewater treatment plant would be approximately 1.3 mgd.

Section 5.4 projects the future permanent and seasonal populations in the planning area to be 15,451 and 41,308 respectively. This results in a total population of 56,759 for the planning period. To develop

wastewater flow projections, the permanent population projections were multiplied by 85 gpcd, and the seasonal population projections were multiplied by 50 gpcd. As stated above, the per capita wastewater flows were based on existing flows and 85 gpcd is in line with published US EPA of 70 gpcd for residential flow and 15 gpcd for commercial flow. The 50 gpcd complies with published information from US EPA that was provided in Construction Grants 85 (CG85) that seasonal populations be converted to equivalent full-time residents using a multiplier of 0.5 to 0.8 for seasonal visitors. A rate of 50 gpcd is a multiplier of 0.59 times 85 gpcd. Since the analysis in Section 4 indicated that infiltration/inflow is insignificant for the existing sewer system, and industrial areas would be confined to mainland areas served by the Southeast Brunswick Sanitary District, 85 gpcd is valid for flow projections for the proposed sanitary sewer service areas.

Multiplying the per capita usage by the future connected population yields a future permanent average daily wastewater flow of 1.31 mgd and a future average daily total seasonal wastewater flow of 3.38 mgd. Wastewater flow projections are illustrated graphically in Figure 5-3, and listed in Table 5-6.

Figure 5-3. Wastewater Flow Projections

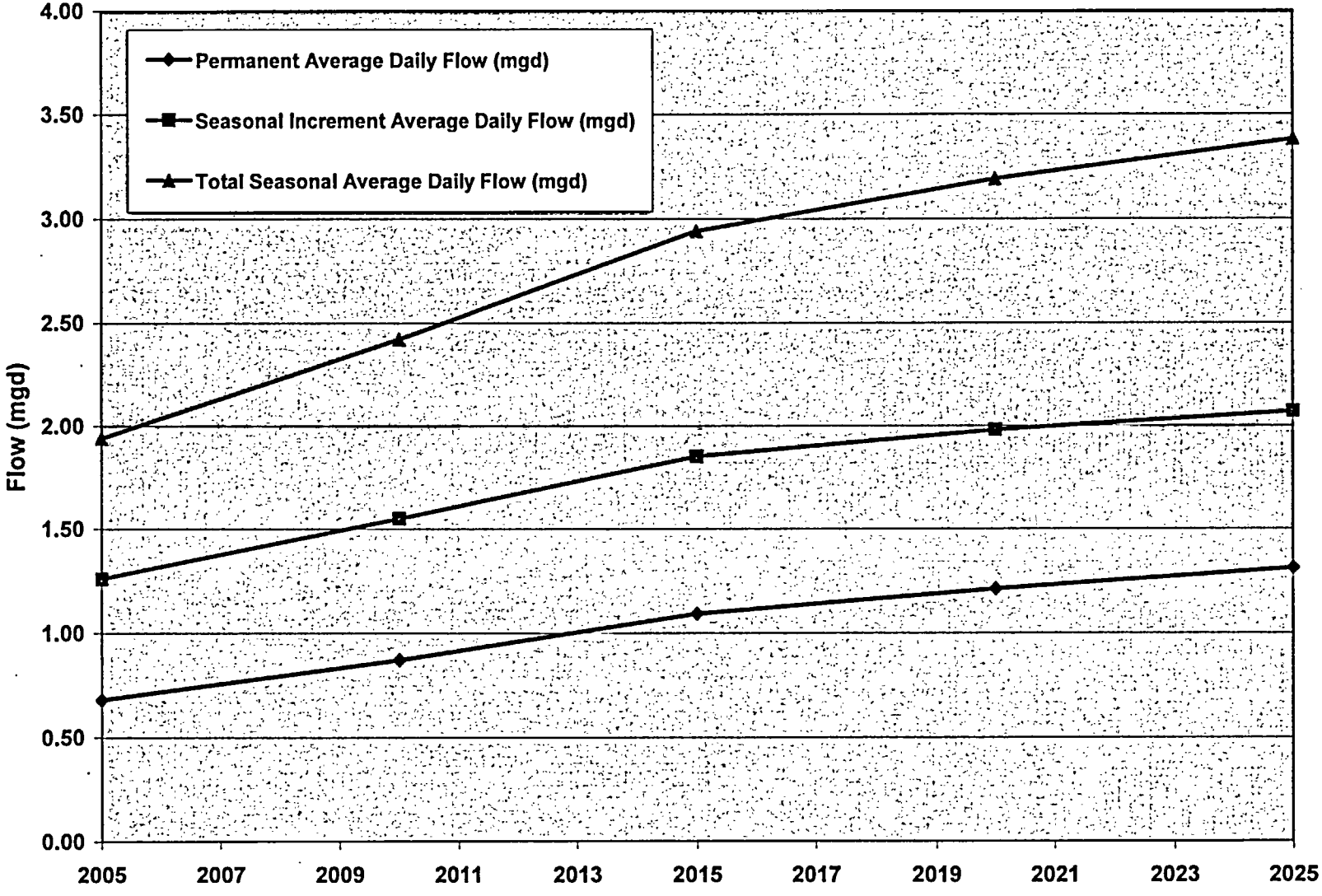


Table 5-6. Wastewater Flow Projections

Year	Permanent Average Daily Flow (mgd)	Seasonal Increment Average Daily Flow (mgd)	Total Seasonal Average Daily Flow (mgd)
2005	0.68	1.26	1.94
2010	0.87	1.55	2.42
2013	1.01	1.74	2.75
2015	1.09	1.85	2.94
2020	1.21	1.98	3.19
2025	1.31	2.07	3.38

Peaking factors were calculated for both maximum month and peak daily flows compared to the average daily flow for both the permanent and seasonal flow conditions from historical data. Calculated peaking factors for both permanent and seasonal maximum month and peak day were 1.2 and 1.8, obtained from the historical flow data. Peak flows and loads occur during the seasonal months. Table 5-7 and Table 5-8 display the peaking factors for maximum month and peak day.

Table 5-7. Development of Maximum Month Peaking Factor

Year	Permanent/ Total Seasonal	Average Daily Flow (gpd)	Maximum Month	Max Month Average Daily Flow (gpd)	Peaking Factor
1999	Permanent	71,000	March	73,000	1.1
1999	Total Seasonal	119,000	July	134,000	1.1
2000	Permanent	70,000	January	71,000	1.0
2000	Total Seasonal	162,000	July	178,000	1.1
2001	Permanent	90,000	March	100,000	1.1
2001	Total Seasonal	143,000	July	175,000	1.3
2002	Permanent	82,000	March	99,000	1.2
2002	Total Seasonal	166,000	August	190,000	1.2
Average					*1.2*

Table 5-8. Peak Day Peaking Factor

Year	Permanent/ Total Seasonal	Average Daily Flow (gpd)	Peak Day	Peak Daily Flow (gpd)	Peaking Factor
1999	Permanent	71,000	March 2, 1999	100,000	1.4
1999	Total Seasonal	119,000	July 5, 1999	172,000	1.5
2000	Permanent	70,000	January 17, 2000	110,000	1.6
2000	Total Seasonal	162,000	July 4, 2000	267,000	1.7
2001	Permanent	90,000	March 21, 2001	153,000	1.7
2001	Total Seasonal	143,000	July 7, 2001	240,000	1.7
2002	Permanent	82,000	March 31, 2002	170,000	2.1
2002	Total Seasonal	166,000	August 22, 2002	256,000	1.6
Average					*1.8*

It is noted that the peak day to average daily flow factor is less than a typical value of 2.0 that is often used in wastewater treatment plant design. However, it is noted that this factor is applied to the seasonal flow. Since the high seasonal flows occur during the relatively dry summer season, the value of 1.8 developed from the historical data is appropriate. The calculated flows were compared to the actual flows to confirm the validity of the number of persons per permanent and seasonal household and the permanent and seasonal per capita usage. Additional documentation provided in Appendix D.

5.5.2 Total Projected Wastewater Flow

To develop the wastewater treatment plant basis of design, the permanent and seasonal average daily flow projections were combined with the maximum month and peak day peaking factors. In addition, historical peak hour peaking factors were evaluated to develop flows for hydraulic purposes. The historical data indicate that the peak hour flow was approximately 1.30 times the peak day flow and approximately 2.34 times the annual average flow. NCDENR suggests a peak hour factor of 2.5 times the annual average daily flow. Therefore, the peak hour flow was calculated based on the total seasonal average daily flow multiplied by 2.5. The total projected wastewater flows for the entire planning area are presented in Table 5-9, and will be used for development of the plan, evaluations, and comparisons.

Table 5-9. Projected Wastewater Flows for the Entire Planning Area

Year	Permanent Average Daily Flow (mgd)	Permanent Maximum Month Daily Flow (mgd)	Permanent Peak Daily Flow (mgd)	Permanent Peak Hour Flow (mgd)
2005	0.68	0.82	1.22	1.70
2010	0.90	1.04	1.57	2.18
2013	1.01	1.21	1.82	2.53
2015	1.09	1.31	1.96	2.73
2020	1.21	1.45	2.18	3.03
2025	1.31	1.57	2.36	3.28
Year	**Total Seasonal Average Daily Flow (mgd)**	**Total Seasonal Maximum Month Daily Flow (mgd)**	**Total Seasonal Peak Daily Flow (mgd)**	**Total Seasonal Peak Hour Flow (mgd)**
2005	1.94	2.33	3.49	4.85
2010	2.42	2.90	4.36	6.05
2013	2.75	3.30	4.95	6.88
2015	2.94	3.53	5.29	7.35
2020	3.19	3.83	5.74	7.98
2025	3.38	4.06	6.08	8.45

The projected wastewater flows presented in Table 5-9 are the total flows for the entire planning area. To develop the flow projections to the proposed West Oak Island WRF, the flow to the existing East Oak Island WRF and the flow to the Oak Island Satellite WRF have been proportioned from the total flow. The capacity of the existing East Oak Island WRF is discussed in Section 4. The Oak Island Satellite WRF will be able to discharge 0.2 mgd through contractual agreements or Town owned land as will be discussed in Section 9. The average flow to the West Oak Island WRF was calculated by subtracting the average flow to the existing East Oak Island WRF and the average flow to the Oak Island Satellite WRF. The maximum month flow to the West Oak Island WRF was calculated by subtracting the maximum month flow to the existing East Oak Island WRF and the average flow to the Oak Island Satellite WRF. The peak day flow to the West Oak Island was calculated by subtracting the peak day flow to the existing East Oak Island WRF, and the peak hour flow to the West Oak Island WRF was calculated by subtracting the peak hour flow to the existing East Oak Island WRF. The Oak Island Satellite WRF is accounted for at average and maximum month conditions. Peak day and peak hour events could result from rain events thereby preventing water reuse. It is assumed that the satellite facility may not be treating flow during

peak day and peak hour events. The projected wastewater flows for the West Oak Island WRF are presented in Table 5-10.

Table 5-10. Projected Wastewater Flows for the West Oak Island WRF

Year	Permanent Average Daily Flow (mgd)	Permanent Maximum Month Daily Flow (mgd)	Permanent Peak Daily Flow (mgd)	Permanent Peak Hour Flow (mgd)
2005	0.15	0.22	0.63	0.88
2010	0.34	0.44	0.97	1.35
2013	0.48	0.61	1.22	1.70
2015	0.56	0.71	1.37	1.90
2020	0.68	0.85	1.58	2.20
2025	0.78	0.97	1.76	2.45
Year	**Total Seasonal Average Daily Flow (mgd)**	**Total Seasonal Maximum Month Daily Flow (mgd)**	**Total Seasonal Peak Daily Flow (mgd)**	**Total Seasonal Peak Hour Flow (mgd)**
2005	1.41	1.73	2.90	4.03
2010	1.89	2.30	3.76	5.23
2013	2.22	2.70	4.36	6.05
2015	2.41	2.93	4.70	6.53
2020	2.66	3.23	5.15	7.15
2025	2.85	3.46	5.49	7.63

A new facility would be sized based on the maximum month flows and loads in order to accommodate sustained peaks and because a number of the NPDES permit limits are based on monthly average. Historical daily flow charts from 1999 to 2002 indicate that the Town of Oak Island does not experience sustained peaks in flow. The facility would also need to be designed to accommodate lower flows that occur during the off-peak portions of the year. Flows that are generated only by the permanent population are significantly lower than total seasonal flows; therefore, the facilities will need to be designed to take unit processes out of service to treat the lower flows efficiently. The flows generated by the permanent population exhibit a more significant diurnal flow curve compared to the flows generated by the seasonal population. Diurnal flow curves for a typical winter weekday and a typical summer weekday are shown in Appendix D.

5.6 Projected Wastewater Characteristics

To develop the projected wastewater characteristics for the 201 Facility plan area, influent data from the existing East Oak Island WRF were reviewed from late 2002. Influent characteristics are not regularly monitored; therefore, little historical influent data were available. In support of facility plan development, supplemental data were collected in September and October 2002 (Appendix D). The following parameters were examined at the plant influent:

- Five-day biochemical oxygen demand (BOD_5)
- Total suspended solids (TSS)
- Volatile suspended solids (VSS)
- Chemical oxygen demand (COD)
- Total Kjeldahl nitrogen (TKN)
- Daily flow

The following parameters were examined at the plant effluent.

- Five-day biochemical oxygen demand (BOD_5)
- Total suspended solids (TSS)
- Ammonia (NH_3-N)
- Nitrate (NO_3-N)
- Fecal coliform
- Chlorine residual (Cl_2)
- Total dissolved solids (TDS)
- Total organic carbon (TOC)

5.6.1 Organic and Nutrient Loads

Organic loads are comprised of BOD_5 and TSS. There also is an inorganic component to the TSS that typically ranges from 15 to 35 percent of the TSS. Under their current effluent discharge permit, the Town of Oak Island is required to nitrify to reduce ammonia. Therefore, it is necessary to incorporate TKN loads into the basis for design. The concentrations of these organic parameters of the wastewater are not expected to change significantly over the 20-year planning period.

The influent data and current connected population were used to develop unit loading factors for BOD_5, TSS, and TKN. The unit loading factors for BOD_5 and TKN were within published ranges. It is noted that the solids concentrations were consistently low. However, since influent samples analyzed were collected in a short time period (no seasonal variation), typical unit loading factors were used to project

future solids load projections. Load projections were developed using unit load factors, population projections, and unit loading factors from references such as *Manual of Practice No. 8 (Water Environment Federation, 1998) and Recommended Standards for Wastewater Facilities (Ten States Standards, 1997)*. Since the majority of the un-sewered area is zoned residential, the use of textbook values is justifiable. The design parameters are listed in Table 5-11.

Table 5-11. Total Seasonal Influent Wastewater Characteristics

Parameter	Unit Loading Factor (lb/cap/d)	Permanent Average Load (lb/d)	Permanent Average Concentration (mg/L)	Total Seasonal Average Load (lb/d)
BOD_5	0.18	2,775	254	7,160
TSS	0.20	3,081	282	7,949
TKN	0.027	415	38	1,071

Note:
Total seasonal average loads are based on average flow of 3.38 mgd.

5.6.2 Other Loads

According to plant personnel, the East Oak Island WRF has not had any difficulty meeting effluent toxicity limits. Toxicity is not expected to be a future issue because there are no industrial dischargers. Industrial areas are confined to mainland areas served by the Southeast Brunswick Sanitary District, with the exception of one car wash and one dry cleaner.

The Town of Oak Island has implemented a program to aid in the prevention of sanitary sewer blockages and obstructions from contributions and accumulation of fats, oils, and greases into the sewer system from commercial establishments, particularly food preparation and serving facilities. A copy of the ordinance is included in Appendix G.

The Town code that regulates utilities includes a section on surcharges for excess pollutant loading. A surcharge is imposed on any customer that exceeds concentrations of 250 mg/L for either TSS or BOD_5. The intent of the surcharge is to control excess loads into the collection system. The surcharges comply with US EPA requirements. A copy of the code is included in Appendix G. The existing collection and treatment systems have not experienced any problems with excess and unusual loads. This is a result of virtually all customers being residential or commercial.

In conclusion, other loads will not be a factor in the development, evaluation and sizing of process alternatives, with the exception of anticipating occasional elevated levels of oil and grease from out of compliance commercial dischargers.

5.7 Design Loads and Peaking Factors

In addition to the annual average flow and loading conditions, it was necessary to examine historical plant pollutant loads and develop peaking factors for use in the new wastewater plant design. The available influent data was collected in late 2002, and includes no industrial dischargers. Peak flows and peak loads both occur during the seasonal months. Because of the impact of the seasonal population on peak flow and loading rates, the maximum month and peak day loads were taken to coincide with peak flows. Maximum month and peak day flow factors of 1.2 and 1.8 were developed from flow projections. The future design concentrations are listed in Table 5-12. The values indicated in Table 5-11 will be used for further development and evaluations of processes.

Table 5-12. Future Design Parameters

Parameter	Total Seasonal Average Load (lb/d)	Total Seasonal Maximum Month Load (lb/d)	Total Seasonal Peak Day Load (lb/d)
BOD_5	7,160	8,600	12,880
TSS	7,949	9,549	14,299
TKN	1,071	1,287	1,927
Parameter	**Permanent Average Load (lb/d)**	**Permanent Maximum Month Load (lb/d)**	**Permanent Peak Day Load (lb/d)**
BOD_5	2,775	3,326	4,957
TSS	3,081	3,692	5,503
TKN	415	498	742

5.8 Regionalization Potential

The Town of Oak Island is willing to participate in regionalization with adjacent municipalities, institutions, and other parties. Initiatives were made by the Town of Oak Island to the Town of Caswell Beach, the City of Southport, and other municipalities in the area. Discussions also occurred with a nearby institution for inclusion into the expanded sanitary sewer system of the Town. As discussed in Section 4.3, a contiguous area to the Town was included in the Town of Oak Island planning area.

As previously discussed in Section 4, the Southeast Brunswick Sanitary District provides sanitary sewer service to those residential, commercial, and institutional customers in the corporate limits of the Town of Oak Island located on the mainland generally along Long Beach Road. The Southeast Brunswick Sanitary District is unable to provide sanitary sewer service to those residents located on the island portion of the Town due to inadequate capacity at its existing wastewater treatment facilities. This became especially true after the Southeast Brunswick Sanitary District decided to provide sanitary sewer service to the Town of Southport as discussed below. The district also has no method to serve the island due to a lack of a pipeline across the Intracoastal Waterway to transport wastewater to the treatment plant.

5.8.1 Analysis of Regionalization Potential

Discussions were conducted with representatives of the Town of Caswell Beach for inclusion into an island-wide sanitary sewer system. These discussions were conducted over many months. At the time of the preparation of this report, the Town of Caswell Beach was not able to commit to a decision on regionalizing with the Town of Oak Island. Therefore, no flow component was included in the estimate of flows for the planning period. The Town of Oak Island remains committed to a discussion of providing sanitary sewer service to the Town of Caswell Beach should any future interest be expressed. The flow component from the Town of Caswell Beach will be considered if and when further discussions occur. In order to address the needs of the citizens of Oak Island, the Town of Oak Island made the decision to move forward.

Discussions were conducted with representatives of the City of Southport for inclusion of flow into the Town of Oak Island's sanitary sewer system. These discussions were conducted over many months, also. The Town of Southport concluded it was in its best interest to transfer wastewater to the treatment facilities of the Southeast Brunswick Sanitary District based on a long-standing relationship. Therefore, no flow was included in the estimated flows for the planning period for the City of Southport.

Other municipalities in the area have some expressed an interest to regionalize with the Town of Oak Island. As of the date of this report, no municipality has reached a decision to be included in the Town of Oak Island sanitary sewer system and no flows have been included in the estimates of flow for the 20-year planning period. The Town of Oak Island remains committed to discussions with other municipalities and governmental organizations in the area, and the proposed facilities will be designed for the addition of flows should any entity decide to be included.

5.8.2 Inclusion into the Brunswick County Regional Sewer System

The Town of Oak Island considered inclusion into the Brunswick Regional Sewer System proposed by Brunswick County. An evaluation determined that this approach was not cost-effective for the Town of Oak Island. This is demonstrated by the user costs developed for both the County system and the system proposed in this report. The average user cost for the Brunswick County system was estimated to be approximately $80.00 per month, as determined by engineering consultants for Brunswick County. As will be demonstrated in Section 11, the comparable average user cost for recommended project in this 201 Facilities Plan will be approximately $35.00 per month. Therefore, the Town of Oak Island has decided to proceed with the installation of its expanded wastewater treatment system because it is the cost-effective alternative.