FILE

Outer Cape Capacity Study

Prepared for the Outer Cape Capacity Study Steering Committee

Prepared by

The Cape Cod Commission in cooperation with
Whiteman and Taintor, Planning Consultants

December 1996

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Overview Report

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SUMMARY

The Outer Cape is approaching—and perhaps has reached—a threshold past which continued incremental growth will degrade groundwater quality and create serious traffic congestion. These changes will exact a heavy price on the region's character and quality of life, and may actually stall development.

These thresholds are difficult to anticipate and many people assume that the future of the Cape will be like the last 20 years: gradually increasing population levels with gradually increasing but manageable problems. This study suggests that while that scenario will be true for some problems, other problems will mushroom in size and force Cape communities to make expensive choices that might have otherwise been avoided.

The central problems that will challenge the Outer Cape are traffic congestion and water quality deterioration. Traffic levels and delays will reach unheard-of dimensions as the capacity of the "one pipe" system of Route 6 on the Outer Cape is exceeded and the entire system slows to a crawl. Trips that once took 20 minutes in the winter will take 45 minutes within 20 years or less.

Water quality has already been degraded in some areas and is projected to decline in other areas as development reaches and exceeds the capacity of the land to process the septic system effluent. As infill development proceeds, private wells may become contaminated in more neighborhoods and towns may be forced to put in public water systems.

However, the Outer Cape cannot support future growth through providing public water systems for everyone because too much pumping would dewater important streams, wetlands and ponds in the region. Nor are there sufficient sites to install wastewater treatment plants to avoid the need for public water systems.

The Outer Cape does face real limits to its ability to grow and it will face a changing ·uality of life if growth proceeds as currently defined by the human and natural ·tems in place today.

O. MUCH GROWTH CAN THE OUTER CAPE ABSORB?

· Cape Capacity Study was an effort to develop an approach to explore the s (growth on the municipal finances, public facilities, water supply, road space and ecology of the Outer Cape. The fundamental question posed rk ·as whether there exist thresholds or constraints to future growth in t· ·ries that will either cost the region significant amounts of money to ·ı ' suggest that the cost of growth's impacts may be too high for ·ıdents to tolerate.

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The project's findings demonstrate that the expected 50% increase in the number of houses on the Outer Cape over the next 20 years will push the region past thresholds in the road system and groundwater quality. Fiscal capacity appears to be adequate if the current pattern of development continues. Changes in the type or mix of development could create fiscal problems for communities. Finally, while there are outer limits to the degree that development can occur without impacting the Cape's plant and wildlife systems, those limits are difficult to define at the regional level.

The Traffic System

This study identifies traffic as an aspect of the Outer Cape's future that is potentially unmanageable, or at least manageable only with great cost and difficulty. More public transit will help to some degree as will reconfigurations of the land use pattern to discourage more curb cuts and encourage fewer car trips. These mitigation efforts will not, however, be sufficient to prevent extreme traffic congestion. The analysis performed for this study suggests that at buildout, the average daily traffic on Route 6 in the Outer Cape in the winter will approach the levels now found only during the summer.

This traffic system threshold results from the already high levels of traffic that exist today combined with the limits available to expand the system. The Outer Cape is a "one road" region; Route 6 is the only through-road serving the entire region. As Route 6 becomes more congested, it places more and more traffic on side roads which have limited capacities for higher traffic levels. In other words, once Route 6 is near capacity, there are limited options for other roads to relieve that burden. In addition, due to immediately adjacent sensitive environmental areas, it would also be difficult to widen Route 6 in many areas.

Route 6 has been gradually nearing its capacity for the last 20 years. As this process continues, traffic problems grow slowly and incrementally in direct relation to the increasing congestion. The road system functions less efficiently, but it functions.

When Route 6's capacity is reached, however, the system breaks and the problems grow at a pace and severity much greater than what the road has experienced before. Traffic often comes to a full halt, the volume of cars mushrooms on side roads and turning movements take a very long time. Witness the difference in peak Saturday traffic today versus ten years ago. While Route 6 functions well in the off-season today, the anticipated 50% growth in homes will on its own be sufficient to create summer-like conditions in the winter by the year 2020.

The Water System

Cross-contamination (when groundwater contaminated with effluent intercepts a well) periodically occurs in all areas of the Outer Cape. This is an inevitable result having private wells and septic systems on lots that are generally less than three quarters of an acre.

Analysis shows that some of the higher density areas on the Outer Cape contain private wells that have remained seemingly unaffected by septic systems. Some people cite this as evidence that smaller lots adequately serve their wastewater and drinking water needs. The irregular occurrence of private well contamination is due, in part, to the difference between "lot sizes" and "actual densities." "Lot size" is the amount of land on an individual lot whereas "actual density" refers to the total number of houses within a defined area of land.

Many neighborhoods in the Outer Cape are surrounded by or interspersed with some undeveloped land. These lands function as a water quality "buffer" in the sense that they essentially decrease the chance that septic system effluent will intercept nearby private wells. As infilling occurs and these lands are developed, however, the number of wells that provide high quality drinking water is predicted to decrease. From 1990 to 1994, 1 of every 28 wells in Truro and 1 of every 10 wells in Wellfleet and Eastham exceeded nitrate levels of 5 mg/L. At 100 percent buildout with existing seasonal occupancy, the model predicts that 1 of every 16 wells in Truro, 1 of every 6 wells in Wellfleet, and 1 of every 4 wells in Eastham will exceed nitrate levels of 5 mg/L. At 100 percent buildout and year-round occupancy increasing by 25 percent, the model predicts that 1 of every 9 wells in Truro, 1 of every 5 wells in Wellfleet, and 1 of every 3 wells in Eastham will exceed nitrate levels of 5 mg/L.

Under current conditions, Wellfleet Center and the Rt 6 corridor in Eastham warrant consideration for the development of public water supply systems. Future growth and the replacement of seasonal households with year round occupancy may significantly impact drinking water quality of private wells on the Outer Cape, especially in high density areas of Eastham and Wellfleet, and may require the expansion of public water services into other residential areas. An advantage to establishing public services to Wellfleet Center and along the Rt 6 corridor and landfill area in Eastham in the near future is there will be a greater likelihood that future expansion could be subsidized by federal and state grants phased in over several years. It is not possible to predict the exact geographic extent or time that problems may occur in the future. For this reason a private well monitoring program should be established so that water quality problems can be planned for as they develop as opposed to reacting to them after they occur.

Capital Facilities and Fiscal Systems

Thresholds also exist for municipal fiscal conditions and capital facilities, although these thresholds are less clearly defined and their impacts vary due to the ability or willingness of households to pay the associated higher costs.

The analysis performed for this study created a model that allows towns to look at the difference in average single family tax bills caused by future growth. While residential and commercial growth expands a town's property tax base and therefore its revenue generating potential, it also results in two kinds of costs: major *capital* expenditures are needed to provide the additional or expanded facilities to serve the

new residents (e.g., new schools, playgrounds and public water supplies), and school and non-school *operating* costs increase in relation to population growth.

The analysis indicates that Outer Cape towns have a complex relationship with growth. New growth will incur some new facility costs on most towns, particularly in the areas of school construction. However, the majority of large capital costs identified by town officials represent investments needed to serve the existing population—including deferred or scheduled renovations as well as existing capacity deficiencies. In these cases, new residential growth will provide increased tax revenues without a corresponding facility impact.

This analysis has also found that each town has made most of the big investments that will be needed to carry it through to buildout. Police, fire, administrative and other public buildings are mostly of sufficient size and health that they can be expected to meet the Town's needs through buildout. In addition, due to the linear nature or small size of each town, the geographic location of the key facilities will be suitable for all future growth. In other words, there will be no need to relocate a fire station in order to serve an area of town that was previously undeveloped; each town is experiencing infill rather than new neighborhood development. Thus, recent investments will continue to provide efficient service well into the future.

However, growth will impose capital costs in two areas of infrastructure investments, identified in the transportation and water elements of the capacity study. All four towns will need to improve local roads as a result of the traffic increases projected under the growth scenarios, although the costs of these improvements are modest when spread out over the 20-year forecast period. More important will be the large investments in public water supply systems that Eastham and Wellfleet may have to face, that will overshadow all other capital facility investments in these two towns. As a result, Eastham and Wellfleet are expected to experience moderate increases in average property tax bills as growth continues. In contrast, growth in Truro and Provincetown is not anticipated to result in any significant difference in tax bills.

Overall, this analysis suggests that fiscal burdens will not be a great worry for most Outer Cape towns—if there is not a significant shift of seasonal homes to year-round homes with a commensurate increase in the proportion of families with children. In other words, if Outer Cape towns can continue along the path of recent years and pay off the long term investments they have made, and plan for meeting traffic and water needs, the financial future looks manageable.

Natural Resources and Open Space

While the Outer Cape has more open space than average for Cape Cod, new growth and development will inevitably result in degradation of natural systems. Many of the critical natural resources are protected within open space areas in the majority of towns on the Outer Cape. However, some critical resources still need protection, including cedar swamps and fish runs. In addition, development will continue to

reduce the amount of forestland on the Outer Cape, resulting in fragmentation of existing habitat areas.

The Natural Resources and Open Space section of the Capacity Study explores the impact of future development on regional natural resources. The study includes a town by town inventory of critical natural resources and these areas are mapped for future reference. In addition, the study examines the Level of Service (LOS) of protected open space in each of the towns (i.e the number acres of protected open space per capita). The findings of this section indicate that without a continuing commitment to land protection, each of the towns on the Outer Cape will experience a decline in the LOS of protected open space. This effect will be particularly pronounced if there is a significant shift from seasonal to year-round residency. However, the Outer Cape towns will still have a greater than average amount of open space, primarily due to the presence of the National Seashore. The study notes the importance of prioritizing future land acquisitions to ensure that critical natural resources and linkages between them are protected.

WHAT DO THE FINDINGS MEAN?

This Study suggests that the Outer Cape has been gradually approaching thresholds for traffic congestion and water quality, and that the region is about to exceed those capacities. While exceeding the thresholds will not immediately create major economic or environmental problems, residents and businesses will begin to see the strain of living with these problems grow. Traffic congestion may decrease summer tourist visitation, frustration will increase with off-season traffic levels which could affect home sales and commuters, water quality problems may arise in more neighborhoods—and towns will be expected to find solutions.

Within 10 to 20 years, these problems may become severe. Options for significantly increasing Route 6's capacity involve serious environmental and community character decisions. Water quality problems could require the expansion of public water services. This will have fiscal implications for town government. All of these changes will place more and more pressure on ecosystems.

What is changing now, and will change to an even greater degree in the future, is the nature of the experiences we have as we encounter and live with each other on the Outer Cape. Our numbers are changing the pace of life on the Outer Cape. At an increasing rate, the pace of life on the Outer Cape mimics the pace of life in suburbia or in urban areas: slow traffic; lots of cars; waiting in long lines; not enough parking; frustrated drivers, bicyclists and walkers; leaving early to avoid traffic; stores that are too crowded to enjoy; and ... less elbow room for everyone.

STUDY DESCRIPTION

THE PURPOSE OF THE STUDY

The scope of services for this project was to "dèvelop a model and conduct a capacity analysis of the four Outer Cape towns." This analysis looked at several specific resources: 1) water supply versus demand, 2) automobile traffic levels versus road capacity, 3) the capacity of critical natural resource types to accommodate nearby construction and human activity, 4) municipal building and departmental capacities to provide services, and 5) the impact of growth on tax bills.

The underlying purpose behind the scope of services was to prepare a conceptual model and associated analytical tools that would take the first steps to understand three questions:

1. How much additional growth can the natural and governmental service systems of the Outer Cape accommodate before the quality, integrity or efficiency of those systems is negatively impacted?

2. What will be the demands for natural and municipal resources if each town reaches its currently defined "buildout" (i.e. maximum construction of all allowed houses and businesses)?

3. If a system is already or will be negatively impacted by growth, what will it cost the towns, in general terms, to remedy the problem through either restricting growth to a level that matches the resource's current capacity or by expanding the capacity of the resource to match growth?

The words ***first steps*** are important to define the purpose and scope of this project. Each of the above topics could be explored in great detail over a long period of time. This project provided the funds and resources to examine the issues in sufficient detail to allow one to measure the general impacts of growth on water, traffic, sensitive ecosystems, open space, capital facilities and general town budgets. As the Study proceeded, it became evident that more analysis and review was needed to achieve even the preliminary results that were originally anticipated, and so the project was extended to allow more detailed evaluation of the fiscal, environmental and water supply issues. This model will provide the foundation for later work to explore the policy, regulatory and detailed cost implications of future land use, growth and conservation decisions.

THE STRUCTURE OF THE MODEL

The Outer Cape Capacity Model is not a unified, seamless computerized impact model, but rather a set of separate analytical tools joined together by overlapping objectives and assumptions on how the impacts of growth should be measured. The Model has five elements:

- The Growth Projection element estimates what types and how much additional growth are likely to occur. The growth projection used the variables of available land, local zoning requirements, past growth rates, regional household sizes, and number of lodging units to estimate future growth. It should be noted that the growth projections were initially developed for the year 2020 and buildout. These numbers were used to prepare the transportation and water resources analyses. It was later decided that some more interim scenarios would be useful for looking at fiscal impacts, so a second set of projections was developed for the years 2005, 2010 and 2015.

- The second part of the Capacity Model is the Cape Cod Commission Regional Traffic Model. This computerized traffic simulation program allows the Commission to estimate the expected future traffic volumes for Outer Cape roads based on existing and projected growth. This model used information from the growth projections to estimate future traffic volumes and the degree to which the existing road system will be able to handle expected traffic levels. An important part of the traffic model is that it makes predictions at the Traffic Analysis Zone (TAZ) level. These TAZ's correspond to U.S. Census block groups. This was the smallest geographic level of analysis performed in the Capacity Model (i.e., individual sites were not analyzed).

- The Water Resources element of the Capacity Model is a condensed version of the Final Report of the Lower Cape Water Management Task Force and is a contribution of the Lower Cape Water Management Task Force. The Task Force consists of representatives from Eastham, Wellfleet, Truro, Provincetown, Cape Cod National Seashore, and Cape Cod Commission. It formed in 1992 under the premise that the natural hydrogeologic boundaries and objective dialogue should be the key ingredients for managing the Outer Cape's water resources. The present status of private well water quality was assessed by compiling over 6,000 private well samples taken from 1985 to 1994 and linking them to the Cape Cod Commission's Geographic Information System (GIS). Future water quality conditions were assessed by analyzing the relation between development density and private well water quality for 16 Central Block District (CBD) subregions of the Outer Cape. An optimization model was developed to find the well locations and pumping rates which best meet the management goals of (1) providing sufficient water to areas of private well impairment, (2) preserving the ecological function of surface waters, (3) preventing contamination from saltwater upconing and other sources, and (4) minimizing the financial cost of well site development. Optimization analysis was also used to show why providing public water to everyone on the Outer Cape is unlikely and how and why cooperation between the towns and National Seashore are needed to most effectively manage the Outer Cape's water resources.

- The Fiscal Analysis of the Capacity Study includes a public facility assessment that inventories the major public facilities in each town as to their current level of capacity and their ability to handle expected future growth. Target dates for investments driven by population or housing growth are identified. The Fiscal

Analysis also includes budget forecasts which provide general estimates of the degree to which future total budget levels can be attributed to growth. These forecasts isolate the growth-related costs from non-growth costs and show how revenues, costs and average tax bills are impacted by expected growth.

- The Natural Resources and Open Space Assessment inventories the sensitive habitats and species in each town and outlines the ways in which future growth may impact these natural systems. This information played a role in developing a Route 6 Environmental Sensitivity Index which indicates the areas along Route 6 that may, due to nearby critical environmental resources, be sensitive to road improvements and/or widening. This section also examines the impacts of future growth on the Level of Service (LOS) of protected open space.

The Model's results can be used to guide land use, fiscal, capital facility, water and conservation policies and actions. This product is not a planning strategy: it does not explore policy implications or present recommendations as to how the towns should deal with capacity and growth. In other words, this study does not suggest how the towns *should* react to future growth impacts, but rather it produces a tool to inform those discussions.

The Model can serve as the underpinning for a system of impact fees or development mitigation procedures. The Model can establish capacities for major infrastructure systems, the levels of growth that can be accommodated by these systems, and the existing relationships between demand and capacity. These are all essential elements in the baseline studies that are necessary for calibrating an impact fee system that assesses fees proportionate to the actual impacts and takes into account existing excess or deficient capacity conditions.

Finally, there may be a temptation to use the Model to predict the impacts of specific developments. This would be inappropriate because of the general nature of the analysis. The assessments and scenarios may be used to estimate general levels of magnitude of traffic generation, water quality impacts, and municipal service demands, but these estimates will not be accurate at the site-specific level.

FINDINGS

THE OUTER CAPE TODAY

The Outer Cape has an area of 64.6 square miles. It consists of the towns of Eastham, Wellfleet, Truro and Provincetown. There are over 15,000 houses in the region and 13,000 people live here throughout the year. The National Seashore holds approximately 75% of the Outer Cape's land area. This land is protected as a National Park.

The primary access road to the Outer Cape is Route 6, a state highway. Within the Outer Cape, only Route 6 provides a multilane, continuous route from one end of this narrow stretch of land to the other. In each town, numerous roads are laid out laterally to Route 6 and connect this central arterial to the villages, neighborhoods and beaches of the region. In most areas, Route 6 is the only north-south route available to travelers.

The region is characterized by its closeness to the water. No portion of the Outer Cape is more than four miles wide; in some areas, that width decreases to less than one mile. Kettle ponds of fresh water are common within the scrub pine uplands that lie between the ocean and the bay.

This unusual land mass is host to many unusual ecosystems and habitats. The dunes and dune grasses, the tidal marshes, the rivers, the inland vernal pools, the shellfish beds and pine forests all provide habitats that are rare for New England and unusual throughout the world. People live in and visit this place because of its closeness to the water and its dramatic differences from other environments.

For centuries, the Outer Cape was a place removed and remote. In the past, the trip was accomplished only by foot or boat, then by train and then by a many-hour-long car ride. Even today, it is at least a one-hour drive to reach the Outer Cape from the mainland. One is literally driving out into the Atlantic Ocean for an hour when one travels to the Outer Cape.

For many years, this remoteness meant space and quiet and—if desired—seclusion for those who traveled to the Outer Cape. Today, however, that remoteness and quiet is eroding. On a peak summer day, over 90,000 people live on or visit the Outer Cape. The population of the place multiplies by a factor of seven during the summer compared with the winter population. Today, expected summer peak water demand for the entire Outer Cape is approximately nine million gallons. On a good beach day in the summer, over 25,000 cars will travel on Route 6.

Prior to the 1980s, one could comfortably use Route 6 on any day of the week, with the exception of occasional mid-summer Saturday morning slowdowns. Within the last ten years, Route 6 has become congested during the peak season. Today,

summer traffic jams are common not just on Saturdays, but on other days of the week as well.

Ten years ago, one could enjoy the ponds of Wellfleet with a moderate number of other people; today, the shores are packed with people. Ten years ago, there were plenty of parking spaces at the ocean beaches in Truro; today, one must get there early to get a space. In the past, one could go to Provincetown in the evening and find a parking space; today, this can be a major challenge on a summer night.

Ten years ago, traveling along Route 6 through Eastham was safer; today it is an area of significant numbers of accidents due to the high traffic levels and the number of curb cuts. Ten years ago, one could fish the shellfish beds of the entire Outer Cape; today, many have to be closed seasonally, mostly due to septic system pollution although stronger wastewater management techniques are moving the beds towards reopening.

Despite these changes, the Outer Cape continues to be a beautiful, appealing place. On average, 200 new homes are built and purchased each year. As evidenced by the crowds, visitors continue to find the region a popular vacation spot and their presence supports thousands of jobs each tourism season. Despite the growth of the Hyannis area into a more established, year-round place, the Outer Cape continues to have a seasonal character and a seasonal economy. Retirees consistently find the region to be attractive, and they make up 22% of the population compared with an average of 14% for the overall Massachusetts population.

Overall, the Outer Cape has changed considerably from the past but it still offers a pleasing place to live and visit. The questions are whether the water, traffic and other systems can support continued growth and how the character of the region will change as growth proceeds.

THE POTENTIAL FOR CHANGE: RESULTS FROM THE GROWTH PROJECTION ELEMENT

The Growth Projection element of the Capacity Model provides estimates of future winter and summer populations at both the town and TAZ/CBG levels. The base data for the estimates include, (1) 1990 Census data on the number of year-round and seasonal housing units at the TAZ/CBG level; (2) Cape Cod Commission inventories of lodging units at the TAZ/CBG level; (3) Census data on average household size (population per year-round housing unit) at the town level; (4) residential growth rates for each Town based on building permit records for the previous 13 to 20 years; and (5) estimates of residential buildout in each TAZ based on the amount of undeveloped and underdeveloped land and local land use regulations. The Growth Projection element originally looked at four future scenarios:

- Scenario #1: Current conditions in 1995.

- Scenario #2: Estimated conditions in the year 2020 (i.e, twenty-five years into the future).

- Scenario #3: Estimated conditions at buildout, assuming that the current mixture of year-round to seasonally-occupied dwelling units remains the same.

- Scenario #4: Hypothetical conditions at buildout, assuming the same total number of dwelling units as in Scenario #3 but only half the number of seasonally-occupied housing units. This scenario is included to estimate the impact on each community of a hypothetical shift toward more of a year-round housing stock.

Subsequent revisions to the Study modified the future scenarios for the purpose of estimating fiscal impacts. The fiscal impact analysis looks at:

1. Existing conditions (1995);

2. Conditions in the interim years of 2005 and 2010;

3. In the year 2015, assuming that the current mix of year-round and seasonal homes in each town remains the same; and

4. In the year 2015, assuming that the current percentage of seasonal units is reduced by half, representing a significant growth in housing used year-round.

As shown in the table and graph, the total number of housing units today on the Outer Cape is 15,481; by the year 2015 it is expected to rise to 19,022. In other words, it is likely that the number of houses will increase by about 3540 units or 23%. The region's year-round population will rise to at least 16,000 people and perhaps as high as 25,400 if more seasonal units are used as year-round homes. This may be likely as the baby boomer generation retires and the Cape continues to move in the direction of becoming a year-round community.

Housing and Population Growth Scenarios

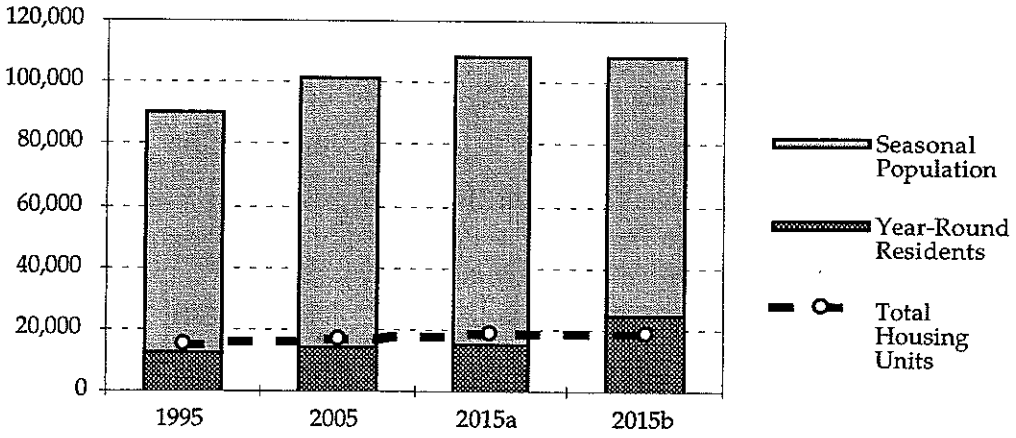

Table 1

Housing and Population Estimates by Town and Region for Each of the Four Scenarios

Scenarios	Housing Units Total	Housing Units Year-Round	Housing Units Seasonal	Seasonal %	Population (Peak) Year-Round	Population (Peak) Total Summer
Scenario 1						
Existing Conditions (1995)						
Provincetown	3,942	2,474	1,468	37%	3,686	20,917
Truro	2,375	873	1,502	63%	1,685	18,485
Wellfleet	3,801	1,402	2,399	63%	2,650	19,014
Eastham	5,363	2,543	2,820	53%	5,010	31,991
TOTAL	15,481	7,292	8,189	53%	13,031	90,407
Scenario 2						
Projected Conditions in 2005						
Provincetown	4,222	2,650	1,572	37%	3,948	22,038
Truro	2,775	1,020	1,755	63%	1,969	20,909
Wellfleet	4,251	1,568	2,683	63%	2,964	21,044
Eastham	6,363	3,017	3,346	53%	5,944	37,684
TOTAL	17,611	8,255	9,356	53%	14,825	101,675
Scenario 3						
Year 2015 With Existing Split Between Year-Round and Seasonal Occupancy						
Provincetown	4,502	2,825	1,677	37%	4,209	23,169
Truro	3,175	1,167	2,008	63%	2,252	23,222
Wellfleet	4,701	1,734	2,967	63%	3,278	23,078
Eastham	6,644	3,150	3,494	53%	6,206	39,286
TOTAL	19,022	8,876	10,146	53%	15,945	108,755
Scenario 4						
Year 2015 With 50% Shift from Seasonal to Year-Round Occupancy						
Provincetown	4,502	3,664	838	19%	5,459	23,459
Truro	3,175	2,171	1,004	32%	4,190	22,720
Wellfleet	4,701	3,217	1,484	32%	6,081	23,981
Eastham	6,644	4,897	1,747	26%	9,648	38,988
TOTAL	19,022	13,949	5,073	27%	25,378	109,148

Due to zoning restrictions and a limited amount of vacant business land, the number of lodging units is predicted to hold steady at 5,681 rooms. During a peak summer day, the model estimates a total resident and visitor population of 90,000. By the year 2015, this may rise to over 108,000 persons.

At the most simplistic level, these data suggest a 50% increase in all costs, services, traffic and resource use on the Outer Cape. While water use and wastewater generation will grow proportionally with this growth, other services and facilities will increase less than 50% since there is excess capacity in the system. Traffic levels will increase by more than 50% due to the fact that Route 6 is already at and above its capacity during the summer months. Any extra burden on the traffic system will result in exponential increases in congestion and delay.

Commercial development potential was also estimated by the Growth Projection element. The amount of existing and potential additional business land was inventoried and estimates were made of the current and potential number of employees in each TAZ. There are 836 acres of business land in the region today and 108 acres of potential additional business land. Current employment in the retail and service sectors ranges between 2200 jobs in the winter to over 3100 jobs in the summer. By buildout, winter employment levels are expected to rise to current summer levels.

THE TRAFFIC ELEMENT: THE WORST IS YET TO COME

The Cape Cod Commission Traffic Model is built around Route 6 as the spine for transportation on the Outer Cape. The Model divides Route 6 into short segments to understand how each segment responds to different traffic scenarios. The Model also includes key side roads that empty onto Route 6.

The traffic model uses *vehicles per hour per roadway segment* as the basic measure for traffic activity. The capacity of a road segment is based on the functional classification and geometric characteristics of the segment. When the ratio of traffic volume to capacity reaches 80% this is considered "congested"; at 100% and above, traffic "exceeds" this theoretical capacity. Approximately 15 of the 27 miles from Provincetown to Eastham are currently considered to be "congested" in the summer condition. Another 5.5 miles have already "exceeded" capacity. In the winter, none of the mileage is considered congested. Relative to local roads, 4% fall into the congested category in the summer and none exceed capacity at this time.

The traffic element suggests that Route 6 and other roads will experience sharp rises in the mileage of automobile travel as well as the amount of time motorists spend on the roads. A 46% increase in the number of houses results in a 66% increase in travel mileage and a 196% increase in travel time. This is due to the high levels of congestion that already exist on the highway. Route 6's capacity is already exceeded in many areas; adding more traffic will create significantly worse conditions.

Another way of looking at traffic volumes and capacity is in "vehicle miles traveled" (VMT) and "vehicle hours traveled" (VHT). VMT represents the total mileage traveled by all the vehicles on the road network during the modeled hour. VHT represents the total amount of time that all these vehicles spent on the network. Table 2 gives the VMT and VHT for the four scenarios analyzed in the model. Table 2 indicates that winter conditions at buildout under scenario #4 will approach today's summer conditions.

Table 2

Traffic Conditions for Each of the Four Scenarios

		Vehicle Miles Traveled	Vehicle Hours Traveled
Scenario A - Existing Conditions (1995)			
	Summer	76,735	2,187
	Winter	33,902	829
Scenario B - The Year 2020			
	Summer	117,621	5,327
	Winter	48,723	1,245
Scenario C - Buildout with Current Year-Round/Seasonal Mix			
	Summer	127,582	6,472
	Winter	52,281	1,358
Scenario D - Buildout with More Year-Round Units			
	Summer	127,582	6,472
	Winter	73,205	2,179

Overall, this analysis suggests that if no improvements are made to the roadway system and no transportation demand or management improvements are made, then future winter conditions will resemble the current summer conditions and the future summer conditions will be unlike anything seen before on the Cape.

Along with these estimates of future travel congestion, vehicle miles and vehicle hours traveled, the traffic element also performed an analysis of the sensitivity of Route 6 to roadway improvements. The Environmental Sensitivity Index summarizes the quantity and proximity of environmental resources within a 100 meter range to each side of Route 6.

In summary, the traffic congestion situation presents serious challenges for Outer Cape communities. Strategies for doing something about this situation can be divided into four broad categories: (1) adding new road capacity, (2) providing transportation alternatives, "soft" solutions and minor modifications of the existing system, (3) managing demand through land use controls, and (4) doing nothing.

If Outer Cape towns want to accommodate the projected additional traffic through roadway improvements, a comprehensive improvement program will be needed consisting of additional lanes with access management including signalization of major intersections and medians to restrict turns at other intersections. Upgrades and signalization of intersections of local roads which serve as bypasses of Route 6 would also be necessary.

The Capacity Study's steering committee indicated during the course of this project that major widening of Route 6 would be unacceptable. This stance is supportable on two levels. The natural environment is incapable of absorbing the effects of new construction at many locations along Route 6 as indicated on the Environmental Sensitivity Index map. On a second level, if the environment is defined to include attractive elements of infrastructure (such as scenic country roads), or protection against unattractive changes (such as multi-lane freeways), then the decision on what to do becomes narrower.

Adding new road capacity, strategies such as better management of the transportation system, and providing alternatives like public transit, bike paths and pedestrian amenities can only address a fraction of the demand. A greater effect would result from the reduction of overall future travel demand through the application of new land use controls, to encourage relocation of existing strip and sprawl patterns, and village centered development patterns which are transit/bicycle/pedestrian friendly.

The final option is to do nothing and to allow the current roadway system to function as a growth control device. It is unclear how effective this strategy would be given that growth will continue at some pace, the situation is already poor, accidents and fatalities may increase and state and local government may be forced from a moral or liability perspective to provide improved roadway conditions.

THE WATER ELEMENT: IMPAIRED PRIVATE WELL WATER AND LIMITED PUBLIC WELL OPTIONS

Is public water needed for the Outer Cape? Is it needed now? Will it be needed in the future? Is it hydrologically possible? What are the financial costs? Where are the best places for locating wells? The Lower Cape Water Management Task Force formed in 1992 to answer these questions in collaboration with the Outer Cape Capacity Study.

Water Quality

Groundwater is the sole source of drinking water for everyone on the Outer Cape. All of Provincetown and parts of North Truro rely on public wells for their drinking water. The remaining population of Truro, Wellfleet, and Eastham depend on private and small volume wells for their drinking water and reside on lots that are generally less than three quarters of an acre. As shown in Figure 2, all households and businesses on the Outer Cape use onsite septic systems to dispose of their wastewater. This means that effluent from septic systems is being discharged into the water table below the same lots where drinking water is being pumped by private wells. The close spacing of private wells and onsite septic systems has become a concern for the Outer Cape, especially in areas of high housing density and as growth continues in the future.

The current status of private well water quality was assessed by compiling a database of over 6,000 private well water quality samples taken between 1985 and 1994 and linking them to the Cape Cod Commission's Geographic Information System (GIS). Nitrate was used as the primary parameter of this analysis because it is both a contaminant in drinking water and a useful indicator for assessing how well effluent from septic systems is being mixed with surrounding groundwater.

The well water quality analysis shows that from 1985 to 1994, 3 of every 4 wells did not exceed nitrate levels of 2.7 mg/L in Eastham, 2.0 mg/L in Wellfleet, and 1.4 mg/L in Truro. This means that the vast majority of private wells provide high quality drinking water. Analysis also shows that cross-contamination periodically occurs in all areas of the Outer Cape. This is an inevitable result of having onsite septic systems and private wells on lots which are generally under three quarters of an acre. "Lot-by-lot" efforts to correct these problems (such as relocating the affected well or drilling deeper) are not long-term solutions when lots are less than a half acre and surrounding wells are already impaired.

Wellfleet Center and the Rt 6 corridor and landfill area in Eastham should be considered for the development of public water supply systems. The median lot size in Wellfleet Center is a third of an acre. From 1985 to 1994, 1 of every 3 wells in Wellfleet Center and as many as 1 of every 5 wells along the Rt 6 corridor in Eastham exceeded nitrate levels of 5 mg/L.

Analysis indicates that the majority of private wells will still provide high quality drinking water into the future but it will be a considerably smaller majority than exists presently on the Outer Cape. From 1990 to 1994, 1 of every 28 wells in Truro and 1 of every 10 wells in Wellfleet and Eastham exceeded nitrate levels of 5 mg/L. At 100 percent buildout with existing seasonal occupancy, our analysis predicts that 1 of every 16 wells in Truro, 1 of every 6 wells in Wellfleet, and 1 of every 4 wells in Eastham will exceed nitrate levels of 5 mg/L. At 100 percent buildout and year-round occupancy increasing by 25 percent, our analysis predicts that 1 of every 9 wells in Truro, 1 of every 5 wells in Wellfleet, and 1 of every 3 wells in Eastham will exceed nitrate levels of 5 mg/L. (Future predictions do not include Wellfleet Center since it is assumed that drinking water in this area will be provided from public wells). This may require the expansion of public water services into residential areas.

Water Quantity

Identifying suitable locations for public wells is difficult on the Outer Cape because the region's political boundaries do not coincide with its hydrogeologic boundaries and because there are several (and often contradictory) management criteria that have to be simultaneously considered. An optimization model was developed to find the well locations and pumping rates which best meet the management goals of (1) providing sufficient water to areas of private well impairment, (2) preserving the ecological function of surface waters and streams, (3) preventing contamination from saltwater upconing and other sources, and (4) minimizing the financial cost of well site development.

The model indicates that well sites are hydrologically capable of pumping large amounts of water, often in excess of 1 Mgal/day, when only saltwater upconing is defined as a limiting factor. Pumping yields are significantly reduced, however, when impacts to nearby surface waters are also defined as limiting factors. The model indicates the best combinations of wells for providing public water to current areas of private well impairment: Provincetown Water Department (PWD) should continue using Paul Daley, Knowles Crossing, and North Truro Air Force Station (NTAFS) wells to provide public water to Provincetown and North Truro. South Dyer Pond site is considered the best location for providing public water to Wellfleet Center. Eastham should consider using either the Northeast Eastham or Eastham Water Protection District (EWPD) site for providing water to the Rt 6 corridor and landfill area. The model indicates that while it is hydrologically possible to provide public water to everyone on the Outer Cape, it would be financially and environmentally unwise to do so.

Cooperation between the towns and National Seashore is needed to most effectively manage the Outer Cape's water resources. Cooperation will be especially important in the future since growth toward buildout and shifts in seasonal occupancy are predicted to significantly impact private well water quality and may require the expansion of public water services into residential areas.

Recommendations

Wellfleet Center and the Rt 6 corridor and landfill area in Eastham should be considered for the development of public water supply systems. Providing public water to Wellfleet Center is estimated to cost from $4 to $6 million in capital expenses and around $250,000 in annual operational expenses. Providing public water to the Rt 6 corridor and landfill area is estimated to cost from $6 to $9 million in capital expenses and around $500,000 in operational expenses. Further cost analysis – including site-specific surveys, financial assistance planning (grants and low-interest loans), and establishing the institutional framework (i.e. determining what are the fiscal benefits of regionalization in terms of avoiding redundant costs and competing for available grants) is the next step of this planning process. An advantage of establishing water supply systems for Wellfleet and Eastham in the near future is that there will be a greater likelihood that future expansion of the system into residential areas could be subsidized by federal and state grants phased in over several years. This is less of a possibility if there is not an existing system.

A private well water quality monitoring program should be established in order to track water quality conditions into the future. Our analysis suggests that future growth and the replacement of seasonal households with year round occupancy may significantly impact drinking water quality of private wells on the Outer Cape, especially in high density areas of Eastham and Wellfleet, and may require the expansion of public water services into residential areas. It not possible to predict the exact geographic extent or time that problems may occur in the future. The benefit of establishing a monitoring program is that water quality problems can be planned for as they develop rather than reacting to them after they occur.

The potential impacts of groundwater pumping on the hydrology and ecology of vernal pools and kettle ponds should be considered in greater detail. Although the optimization model is instructive for identifying locations which will minimize impacts to surface waters, it offers a rather broad view that cannot be used to infer local-scale hydrologic and ecologic responses. For this reason, the National Seashore has recently initiated indepth investigations regarding the local-scale impacts of groundwater pumping on the hydrology and ecology of vernal pools and kettle ponds.

THE CAPITAL FACILITIES ELEMENT:
WATER PROJECTS WILL CREATE FISCAL STRAINS

A consistent theme of the Capital Facilities analysis is that the four Outer Cape towns have already made most of the investments in facilities that will serve them through buildout. Police, fire, administrative and other public buildings are mostly of sufficient size and health that they can be expected to meet the Town's needs through buildout. This is largely the result of recent or planned additions and improvements to these facilities.

In addition, due to the linear nature or small size of each town, the geographic location of the key facilities will be suitable for all future growth. In other words, there will be no need to relocate a fire station in order to serve an area of town that was previously undeveloped. Each town is experiencing infill rather than new development in large vacant removed parts of town. Thus, recent investments will continue to provide efficient service well into the future.

Despite this overall positive picture, there are fiscal challenges ahead, particularly in the towns of Eastham and Wellfleet. The capital needs identified by local officials did not include potential local road expansion projects or development of public water system; and without such facility investments all of the Outer Cape towns face favorable fiscal conditions. However, the traffic and water resources elements of this Study suggest that all four communities will face the need to invest in expansion of local road capacities, and that Eastham and Wellfleet will need to make major investments in public water supply systems.

Largely as a result of projected expenditures for water systems, Eastham and Wellfleet may experience significant increases (approximately 15–20%) in average residential tax bills. However, tax bills are projected to hold steady in Truro and perhaps even decline in Provincetown as current debt levels are paid off and as the taxable base of the community grows with development.

Town Buildings

Each town will face some major building needs over the next 20 years, but all the towns are also in good shape on this issue. Wellfleet, Eastham and Truro are all rehabbing or about to rehab their town halls. Provincetown and Truro have new fire stations. Police and fire stations are either healthy or plans are underway for expansions/new construction. Senior centers are planned in some towns. All the models include costs for highway garage construction. Landfill capping is already budgeted by most towns.

Schools

Each Town faces the prospect of more families who thus bring more children. This is partially due to the current baby boom, which will subside, but it is also due to the Outer Cape becoming less remote as the Hyannis area is becoming more urbanized. Add to this the prospect of charter schools, and the job of forecasting future school demand is very difficult.

This study takes the following position on the prospects for future school needs:

- Provincetown appears to have adequate capacity for the future given its low growth potential and excess capacity. No major growth related school expenses are foreseen.

- Truro is facing the need for more elementary space and therefore an investment is estimated. This additional space should meet the Town's needs through buildout.

- Wellfleet will also need additional elementary space by the year 2005. This space will be adequate through buildout. Regionalizing some of the elementary classes in Truro and Wellfleet should be considered.

- Eastham is in the process of adding more elementary space. These additional classrooms may meet expected demand, but the model includes funds for an investment during the second decade of the next century to account for the potential need for additional space.

Along with school facilities, the school department is the department in these small towns with an operating budget that is most directly related to growth. Most other town departments have adequate excess capacity in their systems to handle future growth. The school department faces mandatory spending levels per student and constantly increasing costs associated with new regulations and school improvement efforts.

This situation means that if the number or proportion of year-round homes increases beyond the baseline growth level described in this element, then school costs will force tax bill increases. The model indicates that town budgets could be $5 million to $8 million higher if a 50% shift of seasonal to year-round units occurs.

Wastewater Treatment

Provincetown and Wellfleet both face the potential of a high investment to build wastewater treatment plants. Wellfleet Center's sewering project was estimated at approximately $10 million in 1990. The model assumes that full $10 million in costs with a $5 million subsidy from the state. Provincetown's project has not been priced, but will cost at least as much as Wellfleet's and is estimated at $6 million of local costs in the model.

Will these investments be budget busters? The analysis indicates that even if each of these projects come on line within 10 years, the average tax bill in each community will not rise by more than $100 to pay for the projects. Will the extra expenditure hurt? Yes, for some. Will it be impossible to manage? No.

Of greater concern is the fact that there appear to be very few sites on the Outer Cape where wastewater disposal facilities could be constructed and then discharge the effluent. This is another real environmental limitation to hoping that technological fixes will offer solutions to groundwater quality problems. It should also be noted that installing wastewater disposal facilities does not immediately improve drinking water quality in high density areas; thus, public water may still be needed in these areas.

Neither Truro nor Eastham appear to face the need for sewerage systems down the road, although the model does impose a $500,000 charge to Truro assuming that if Provincetown builds a treatment plant, Beach Point may be sewered. In Truro, the sewer system charge, even with other investments will not result in more than a $50 annual increase in the tax bills.

Public Water Systems and/or Treatment

New public water supply systems or system expansions may be in the future for each of the towns due to either degraded water quality from septic systems or from salt water intrusion. In general, due to the high quality of the underground sources, water treatment facilities should not be required—although Provincetown is now planning a $300,000 expenditure to address corrosion (it is assumed that this expenditure will be financed from water fees). In addition, it is likely that regional cooperation will be used to minimize the costs of new well development and piping.

Major water supply investments will be required in Eastham and Wellfleet over the next two decades. In Eastham, the Study indicates that an initial investment of approximately $7.5 million (in 1996 dollars) will be required by the year 2000 to address existing (non-growth) demand in the Route 6 corridor and the landfill area. Additional expenditures (growth-related) could also be required over the following 15 years to expand the system to residential areas, with the total system cost reaching $24 million by the year 2015. These are "rule of thumb" cost estimates; more site specific analysis will be needed to determine actual costs. The towns may be able to offset some of these costs by obtaining grant funds for water system improvements.

Wellfleet's model includes a similar investment program to Eastham's. An initial investment of $5 million, to address existing needs in the Central Village area, is projected for the year 2000. Subsequent growth-related expansions of the system into residential areas could total $5.5 million over the following 15 years, for a total investment (in 1996 dollars) of $10.5 by the year 2015. Again, some of these costs could be offset with grants.

Truro's model includes $1,000,000 for wellhead and distribution expenditures in the event that salt water intrusion occurs.

Local Road Improvements

In order to expand capacity to meet projected traffic growth, each of the four towns will have to make expenditures for improvements to their local road systems. As in the case of water facilities, the largest road expenditures will be required in Eastham and Wellfleet, which will be faced with bills of $3.61 million and $4.37 million, respectively, over the next two decades.

During the same period, Truro will need to spend a total of $2.89 million and Provincetown $1.29 million. Although these future investments are above current

expenditure levels, they are not great enough to impose major fiscal impacts on local budgets.

FISCAL IMPACT ELEMENT: A COMPLEX RELATIONSHIP WITH GROWTH

The fiscal impact analysis element measures fiscal strain through estimated single family average tax bills. Even under the heaviest investment burdens imposed in the model, no Outer Cape town is expected to have average annual tax bills of more than $2700—even in 20 years and even assuming a much larger school burden than today. Most towns will stay under the $2000 level for the next 20 years. Tax bills are actually predicted to fall in Provincetown and Truro due to forthcoming growth revenues and the declining need for major new facility investments. However, it should be noted that the model does not include inflation, so there may well be inflation-related increases in municipal expenditures and tax bills in the future.

It should also be noted that the estimates of future capital expenditures rely on town projections. Since most towns' capital outlay programs are geared to a five, or perhaps ten year time period, the estimates of future capital expenditures may be more reliable in the near term and less reliable further into the future.

The analysis highlights a complex relationship between town finances and local development that is well known by boards of assessors and finance committees, but less well understood or appreciated by most townspeople: On the one hand, due to Proposition 2-1/2's constraints on raising tax revenues, most towns have only been able to avoid budget overrides during the last 15 years due to new development of homes and businesses. "New growth," as it is known, has paid for steadily rising operating budgets. On the other hand, that new growth has created a demand for new facilities and services that the towns are now having to provide and pay for.

The fiscal impact portion of this study suggests the following conclusions on the role that municipal finances will play in the Outer Cape's capacity for future growth.

- One of the reasons why the forecasted fiscal burden is not great is that Outer Cape towns have limited growth potentials. Even at buildout, populations will still be defined as "small towns" by most observers. Though the percentage growth potential may seem high, the real numbers are not great. At buildout, no town's population will exceed 10,000 persons; most will not exceed 7,000 persons.

- The ability to handle future growth is also due to recent public facility investments made in each community. New police and fire stations, new Town Halls and other facilities all mean that these investments will not need to be revisited for several decades. These facilities are sized to handle projected growth.

- Outer Cape towns have particular fiscal costs and benefits that result from their orientation to tourism. On the cost side, these towns must pay more per year-round household for the public services needed to manage high summer season

populations: more police are needed, more equipment is needed, recreation budgets are higher, more public bathrooms are needed. All of these costs translate to larger budgets than in similar sized year-round communities.

However, this "oversizing" of municipal budgets may also mean that Outer Cape communities currently have excess capacity to handle continued second-home and year-round housing development. Outer Cape communities appear to have sufficient facilities and staffing to handle many of the impacts of expected growth.

- Outer Cape towns currently enjoy a favorable balance between the type of development that is occurring and the resulting fiscal impacts of that development. A high proportion of the towns' housing units are built or occupied as second homes, and a large segment of their year-round populations is comprised of retirees. As a result, school costs are lower than in similar-sized communities that have entirely year-round populations. Since school costs make up a very large part of most budgets, this land use and sociodemographic balance translates into lower costs for Outer Cape communities.

Despite this situation, Outer Cape communities do face the threat of the balance shifting. Scenario analysis within the study indicated that more families with children in year-round housing would require signficant tax bill increases in the future.

- Finally, the presence of the National Seashore is a savior for Outer Cape towns in some respects in that it provides a real and lasting deterrent to growth on over 75% of the Outer Cape land base. If Outer Cape towns had to service all the land within the Seashore built to its maximum capacity, every aspect of these communities would be different. Moreover, the National Park Service provides a variety of public services—including public safety, public works and recreation—which supplement the corresponding municipal services provided by the host communities.

NATURAL RESOURCE AND OPEN SPACE CAPACITY: SITE-BY-SITE WORK WILL BE NEEDED

Relative to environmental resources, "carrying capacity" is typically defined as a measure of food supply over a given area and the number of animals that can be supported by this food source. For the purposes of this Capacity Model, this type of an approach is not useful as it requires detailed studies at the site level. Given the size of the region, this is not possible. Instead, a more practical approach is to look more generally at critical natural resources, the level of protection of these resources, and the threats that they face from growth and development presssures.

To reach this objective, this element used existing data on critical natural resources, habitats and species. Data sources included sensitive areas identified within the National Seashore, Areas of Critical Environmental Concern, rare and endangered species, wetlands and vernal pools. A complete inventory of all such species and

areas was performed and compiled for the Outer Cape. This analysis demonstrated that some types of critical habitats, such as sphagnum bogs and vernal pools are well protected on the Outer Cape; however, others, such as fish runs and cedar swamps are not.

Development poses a variety of potential problems to sensitive species and habitats including the following: clearing of land; impervious surfaces that prohibit groundwater infiltration; drainage changes; fragmentation or loss of habitat; groundwater pollution through the introduction of nitrogen into ground water from septic systems; the introduction of phosphorus into surface water bodies; changes in groundwater flow due to the introduction of a large number of private wells in an area; noise pollution; light pollution; visual impacts; and changes in community and rural character. The most critical of these, and the most damaging impact to the stability of the resources on the Outer Cape, is habitat alteration and/or removal.

It is clear that the land base necessary to support plant and wildlife habitat and natural communities is reduced due to increasing human populations and the pressure exerted by the development that follows. The difficulty with identifying the specific natural resource capacity of an area is that habitat manipulation affects different species in different ways. The interaction between humans and other animal species is not clearly understood at the macro level. What is understood is that unless some form of habitat sensitive planning occurs during development, the integrity of natural systems will decline. This decline not only reduces the quality of wildlife and plant habitat, but leads to a lessening of human quality of life as well.

Given the complex and site specific nature of development's impact on natural systems, this assessment does not present clear conclusions on the fate of the Outer Cape's plant and wildlife as growth proceeds. It is clear that the most effective way to ensure the health of the Outer Cape's sensitive species and critical natural resources is to pursue an assertive open space acquisition effort to permanently protect these sites and habitats. Without this effort, allowable development will reduce the biodiversity of the Outer Cape and reduce the Level of Service of both protected and perceived open space. In addition to increased acquisition efforts, this report makes several recommendations regarding natural resources management for each of the towns to consider.

THE ISSUE OF TOLERANCE LEVELS

While the study was designed to address the question of *capacity*, it became clear that an equally pressing question concerns the *levels of tolerance* in systems where demand may not exceed the technically attainable capacity, or where demand cannot be precisely measured. This issue is especially important as the Outer Cape considers how the findings from the Capacity Study might influence policy decisions.

As the Steering Committee struggled to define the term "capacity," Committee members realized that if the water supply is not a finite ceiling on growth then there

are no clearly defined ceilings. It was also clear that the issue of how much traffic, congestion, crowding and activity the people and ecology should handle is a matter of tolerance levels.

For example, if Route 6 is not improved over time, the levels of congestion will become even worse. Today, most year-round Outer Cape residents avoid the peak traffic hours during the summer. If this level of traffic becomes typical during a longer period of the year, would it be tolerable? While life on the Outer Cape would continue, would it be pleasing? What levels of inconvenience will people tolerate? There is no way to measure this issue of tolerance as people live with and tolerate conditions significantly worse than those predicted for the Outer Cape.

This same issue is true for water and other natural systems. If groundwater becomes degraded, is it acceptable to provide chemical treatment or drink bottled water? While we know that direct fragmentation or destruction of a habitat will force species to migrate or disappear, we do not understand how much incremental disturbance the species can tolerate. At some point, for some species, human activity will pass a tolerable threshold and then a part of the Outer Cape's character and biodiversity will be lost. Unfortunately, the typical manner in which we learn of these tolerance levels is when the species suddenly declines, but then it is too late. The Lower Cape Water Management Task Force's work predicts where public well pumping activity may place surface water strains on ecosystems. This is one way to measure the tolerance levels of water dependent species.

There are few clear answers to the questions of what people and ecosystems will be able to tolerate as the Outer Cape becomes more dense. The only certainty is that if residents and wildlife wish to remain on the Outer Cape, both will learn to tolerate more activity than that experienced today.

CONCLUSIONS

In the past, many communities have assumed that growth capacity is equal to the amount of development allowed under zoning. As this study indicates, full build out under current zoning regulations could seriously tax both the natural resources and infrastructure of the Outer Cape towns. While the towns appear able to handle the financial costs of growth, this growth will precipitate changes both in infrastructure and in the rural nature of these communities.

On the Outer Cape, the finite quality of natural resources and infrastructure is perhaps more striking than in other places: water borders the towns and gradually changes those borders through erosion and accretion; the groundwater lenses are clearly defined and overuse induces salt water contamination; Route 6 is the single artery serving the Outer Cape—when it is congested, there are few other options. Cape Codders know better than most people the importance of conserving and protecting resources due to the fragility of the region's resources.

However, the Outer Cape is approaching—and perhaps has already reached—a threshold in its growth. Beyond this threshold, continued incremental growth will pollute the groundwater and create traffic congestion to such a degree that the region's character and quality of life will be impacted. At some point, these impacts may actually stall development.

This Capacity Study provides a tool for Outer Cape communities to use to complement or refine their efforts to manage those resources. This project directly addresses key topics that lie at the heart of Cape towns' abilities to manage future growth and change: traffic, water, natural resources and open space, capital facility investments and municipal budgets/tax bills.

Many people assume that the future of the Outer Cape will be like the last 20 years: gradually increasing population levels with gradually increasing but manageable problems. This study suggests that while that scenario will be true for some problems, other problems will "mushroom" in size and force Outer Cape communities to make expensive choices that might have otherwise been avoided.

The central problems that will challenge the Outer Cape are traffic congestion and water quality deterioration:

- Traffic levels and delays will steadily worsen as the capacity of the "one pipe" system of Route 6 on the Outer Cape is exceeded and the entire system slows to a crawl. Trips that once took 20 minutes in the winter may take 45 minutes within 20 years or less.

• Water quality will decline in a number of areas as development exceeds densities that can safely support on-site wells and septic systems. As infill development proceeds, private wells may become contaminated in more neighborhoods and towns may be forced to put in public water systems. However, the capacity of the Outer Cape to support public water systems is limited—it is not possible to provide public water to serve the entire Outer Cape population without harm to surface water resources. Nor are there sufficient sites to install wastewater treatment plants to avoid the need for public water systems.

Thus, the Outer Cape does face real limits to its ability to grow; and it will face a changing quality of life if growth proceeds as currently defined by the human and natural systems in place today.

Seasonal to Year-Round Trends

One of the most striking findings of this study is that conversion of seasonal residences to year-round use could have enormous impacts on transportation, water quality and municipal finances. Capacity constraints are most clearly presented in the results of the scenario which assumes a significant increase in the percentage of year round housing units in each town. Not surprisingly, the seasonal shift reveals the financial cost of additional school infrastructure needed to support an expanded school-age population. Given this shift, the tax bills in the Outer Cape towns would rise significantly. Towns will need to consider how public policy decisions may encourage or discourage this trend and make some hard decisions. The potential for impact fees to address some of the costs of growth attributed to new development should be considered.

Community Character

There are further implications of the analysis in terms of the impact of future development on the community character of the individual towns and of the region. Community character is a complex term comprising many attributes -- the scale and concentration of development, the style of buildings, types of resources, transitions from developed to less developed areas, etc. -- and it is not conducive to scientific analysis. Yet several of its components have been addressed in sections of this study, such as roadway scale and the amount of open space. Perhaps one of the most significant issues raised by the analysis is the change in character of the communities as they grow in terms of the amount of land that is developed, the form of transportation infrastructure needed to serve that level of development, and the amount of open space per capita in each town.

Communities must determine the extent and type of infrastructure that is acceptable when evaluating how to match their resources with growing demands. They should define a vision for the community and review the issues and choices identified by this study when determining whether the changes required to accommodate various levels of growth are consistent with the desired sense of place.

Regional Impacts/Coordination

It is not enough to plan for one town alone. In each of the resource sections of this study, the analysis identifies how growth in one community will directly affect its neighbors. In terms of water resources, communities must work with neighboring towns and the Seashore to insure both the availability and the quality of their water supplies. In terms of the transportation network, each town's development will increase the demand on the region's roadways and thus increase pressure on local roadways which serve as alternate routes. In terms of natural resources, the protection of regional wildlife corridors and habitat diversity is necessary to maintain the existing diversity of species. As development increases in each town, it slowly diminishes the habitat and open space available to the region.

What Can Management Options Achieve?

Each resource section of the report has identified management techniques or strategies for addressing future capacity concerns. The water resources analysis stresses the need to identify and protect potential future well sites; the transportation section suggests potential zoning changes, land acquisition, or transit and travel demand management systems to address increased demand; the natural resources and open space section suggests purchase or easements on sensitive resource areas to protect habitat and maintain a significant proportion of open space in the region. A common thread in all of these sections is the further protection of open developable land.

No cost for further open space purchases was projected in the future in the fiscal impact analysis. Fiscal analysis of the benefits of open space acquisition is outside the realm of this study, but it is an important next step to consider fiscal impacts of this in the long term. Other studies have shown the fiscal and tax benefits of limiting developable residential lands because of the tax implications of year round use. Without a means of limiting use to seasonal occupancy or of preventing conversion from seasonal to year round use, these towns will eventually be faced with the same concerns. Considering that acquisition or protection would also help to limit impacts on water resources, transportation infrastructure, natural resources and open space and community character, the fiscal benefits are much increased.

A combination of management strategies is the key to successfully addressing capacity constraints.

Next Steps

Land Use: Because land use decisions impact each of the resources analyzed in this study, zoning regulations should be reevaluated in areas where significant future development potential was identified. This can insure that land use and zoning regulations provide for the desired level of development in each area.

Water Resources: Since groundwater is the only source of drinking water in the region, thorough protection is essential to ensure the quality of this resource into the future.

- Public water should be provided to Wellfleet Center and the Route 6 corridor and landfill area in Eastham;

- A private well monitoring program should be established in order to track water quality conditions in the future and determine if other areas may need public water;

- Potential impacts of groundwater pumping on the hydrology and ecology of kettle ponds and vernal pools should be studied in greater detail.

Transportation: This is a first cut at studying the transportation impacts of currently projected growth from now until buildout on the Oute Cape region. In producing this report, it became clear how much more there was to examine before making definitive recommendations or even cost estimates for various alternatives. Specifically, the following steps could be taken in a more detailed study:

- Creation of a more detailed traffic model that includes the next level of functionally classified roads, in order to give a sense of the specific effects of growth on town roads. This model would also include a mode choice element to examine possible future transit, bikeway and walkway alternatives to road widening.

- Further study of the costs of each possible alternative, including a more detailed study of how much of the costs would be borne by local, state and federal governments and by private parties.

- A more detailed study of travel behavior in the region based upon a closer examination of the regional economy.

Natural Resources and Open Space: Beyond the recommendation that towns consider resource driven acquisition of open space for the purposes of protecting and preserving available natural communities and habitat and maintaining current protected open space Levels of Service, there are other potential recommendations that should be considered by the four towns to maintain and enhance the protection of natural resources and open space. These are:

- Increased efforts at regional protection and management of natural resources in cooperation with the National Seashore;

- Updating of open space and recreation plans (in order to qualify for state acquisition matching funds) and integration of open space planning efforts into implementation of Local Comprehensive Plans. Such open space plans should identify priority parcels for acquisition;

- Adopting formal policies regarding the need for a comprehensive community approach to the acquisition of open space;

- Revising local wetlands protection bylaws to provide a higher level of protection, including buffer areas, for critical natural resources (sphagnum bogs, quaking bogs, vernal pools, cedar swamps, barrier beaches, coastal plain ponds and salt marshes);

- Increasing public education about the need to protect critical natural resources and maintain Levels of Service of protected open space;

- Developing bylaws that provide incentives for the provision of high priority open areas in exchange for reduced standards (increased density or reduced setbacks).

It is widely believed that the manner in which communities respond to the next spurt of development will determine the future of Cape Cod. Unless a significant effort is made to acquire and protect open space, the region's conservation areas will become isolated open areas surrounded by development. It is important for each of the Outer Cape towns to examine its options with regard to protection of open space and critical natural resources and to make a decision about which path it will follow into the future. Consideration should be given to the short and long term cost of land protection versus the short and long term costs of growth -- with its requirements for water, roads, schools and other improvements. It is important that this decision be both a financial one and a determination about the desired character of the community.

Outer Cape Capacity Study

Growth Projections

Prepared for the Outer Cape Capacity Study Steering Committee

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The Build-Out Analysis and Growth Projections

This element of the model consists of estimates for each town on the number of people, houses, and commercial acreage that each town is likely to experience as growth proceeds. Four scenarios are presented:

- Scenario #1: Current conditions in 1995.
- Scenario #2: Estimated conditions in the year 2020 (i.e, twenty-five years into the future).
- Scenario #3: Estimated conditions at buildout, assuming that the current mixture of year-round to seasonally-occupied dwelling units remains the same.
- Scenario #4: Hypothetical conditions at buildout, assuming the same total number of dwelling units as in Scenario #3 but only half the number of seasonally-occupied housing units. This scenario is included to estimate the impact on each community of a hypothetical shift toward more of a year-round housing stock.

Within the model, each town grows according to a housing production rate based on recent average rates (over periods ranging from 13 to 20 years), except that the long-term growth rate for Provincetown is based on the town's building permit limit of 28 units per year. Average household size (persons per household) for each town is based on data from the 1990 U.S. Census. The mix of year-round and seasonally-occupied housing units is kept constant over time except in Scenario #4 where 50% of the seasonal units expected at buildout are shifted to year-round occupancy. Buildout data for residential and commercial sectors are based on comprehensive plan data, assessors records and Cape Cod Commission data.

The buildout analysis was performed to provide a base of current and maximum potential development levels for the entire region, by town and by subareas within the town. The subarea boundaries were defined by Census Block Group boundaries. All data were collected and categorized by Census Block Group (CBG). A total of 23 CBG's are located within the Lower Cape. Larger area (i.e., town and region) data figures are based on the aggregation of CBG data.

Two general steps were involved in the buildout analysis. The first was the organization and analysis of data from each Town's assessors files. The second was the use of that data to estimate buildout for each CBG.

Step One: Determining Vacant Land

CBG boundaries for Eastham and Provincetown were provided by the Cape Cod Commission, and boundaries for Wellfleet and Truro were digitized for the consulting team by Mapworks, a cartography firm. Each parcel in each town was identified by its CBG.

All the vacant parcels were then selected. These parcels were identified from the database using the Massachusetts land use codes 130 and 131 ("developable" and "potentially developable" vacant residential land). Unbuildable vacant land (code 132) was not selected. Large single family parcels (>5 acres) were also selected.

In addition, codes 390 and 391 ("developable" and "potentially developable" vacant commercial land) and codes 490 and 491 ("developable" and "potentially developable" vacant industrial land) were selected and aggregated for each CGB.

Since the predominant land use in the Lower Cape is housing and since detailed zoning and square footage data were not always available, the emphasis in the analysis is the residential sector. Although vacant business parcel and acreage figures were also determined, they were not broken down as finely as the residential data.

Following the selection of the data, estimates were made of the number of potential residential parcels (and thus the number of housing units) that might be built in each CBG. Tables A-D, on the following pages give the assumptions used for the development potential estimates for each Town. Minimum lot size, subdivision minimum thresholds and other factors were all used in the estimates. Tables 1 through 23 present the results of this first step in the buildout and give the number of parcels, the total acreage and the average parcel size for the distribution of vacant parcels in each CBG ranging from less than 1/4 of an acre of over 10 acres in size.

Step Two: Estimating Buildout

The second step was to take the estimated number of remaining housing units and the number of additional vacant business acres and produce buildout estimates. The format for the buildout was shaped by the Capewide Traffic Model and the way its data is organized. The basic spreadsheet used in the model was expanded by the consulting team in order to both provide the basic data needed for the traffic model but to also provide additional figures useful to the fiscal, environmental and water teams.

The fields contained in the buildout spreadsheet are described below. The following discussion provides information on each field shown and numbered in Table E on the following pages. All data was either gathered from secondary sources (e.g., the U.S. Census Bureau or the Cape Cod Commission) or estimated using the noted assumptions. The limitations column provides cautions on how the data can be interpreted and notes on why limitations exist. The numbers for each field correspond to the numbers above each column in the spreadsheet.

Alternative Methodology for Wellfleet Buildout

The buildout analysis carried out for Wellfleet's Local Comprehensive Plan used a more detailed methodology to estimate future residential and nonresidential development, because more information was available at the parcel level. Specifically, the database used in the analysis included the amount of wetland and upland area for each parcel, and so a much more precise estimation of development potential was possible.

Method and Assumptions
for the
Outer Cape Cod Capacity Study Buildout Analysis

Note: Column references are to the CBG buildout spreadsheet.

Col.	Variable	Data Source	Assumptions and Limitations
C	Existing single family units	1990 Census CBG data	This figure contains all single-family units (including seasonally-occupied units) These data were are 5 years old and thus do not reflect recent growth; however, they provide a consistent and reliable baseline.
D	Potential additional single family units	Step One data analysis of Town assessors files	The number of potential additional units identified in Step One was placed directly into this field. The greatest limitation is the lack of data on site specific development constraints such as wetlands. Therefore, these figures must be seen as upper level estimates of development potential.
E	Buildout single family units	Sum of columns C and D	The most tenuous aspect of this figure is the potential for cottage or two-family units in some zones in some towns. See column I for an adjustment to take this potential into account.
F	Existing multifamily units	1990 census CBG data	This figure contains all units in structures of two or more units per structure. This grouping assumes similar impacts from two family, three family and large multifamily structures. Since some impacts may be different, this limitation must be acknowledged.
G	Potential additional multifamily units	Consulting team and Town LCP estimates	Based on conversations with the Local Planning Committees and members of the Project Committee, estimates were made for each Town's likely additional multifamily units.
H	Buildout multifamily units	Sum of columns F and G	

I	Other potential units	Estimates by consultants and LCP's	Some towns may have particular situations that present the potential for even more housing units (e.g., Wellfleet's cottage colony provision). No adjustments were made in this column, but it is included for future adjustments to the model, if deemed necessary by the towns. This figure, as well as those from above, may include seasonal units. Columns J, K and L identify the current, potential and total seasonal units.
J	Total existing units	Sum of columns C and F	
K	Total additional units	Sum of columns D, G and I	
L	Total buildout units	Sum of columns J and K	
M	Existing seasonal units	1990 census CBG data	These units are those that were listed in the 1990 Census as "Vacant—Held for seasonal use". This definition includes housing constructed for year-round occupancy that is only used on a seasonal basis, and is thus not the same as a "seasonal unit" in the sense of a unit that is only usable during the summer.
N	Potential additional seasonal units at existing percentage of total units	Consulting team and LCP estimates	The proportion of year round to seasonal units indicated in the Step One data analysis drove this figure. It is assumed that overall job availability will remain low in the region and that while commuting younger families will increase in number, the majority of housing growth will come from retirees and second home development. With the approaching retirement of the baby boomers, it is difficult to know whether the second home market will dominate the relocator market or visa versa.
O	Buildout seasonal units at existing percentage of total units	Sum of columns M and N.	
P	Potential additional seasonal units with 50% shift to year-round	Divide column O by 2, and subtract column M.	In order to estimate the relative impacts of year-round vs. seasonally-occupied units, the total number of seasonal units at buildout was reduced by 50% from the number that would exist at their current percentage within the CBD.

Q	Buildout seasonal units with 50% shift to year-round	Column O divided by 2 (equals sum of columns M and P)	
R	Potential additional units in TAZ as % of total potential additional units in town	Column K divided by sum of column K figures for all TAZ's in the town (see column K at bottom of table)	
S	Growth rate (units/year)	Column R multiplied by the estimated growth rate for the town (see column S at bottom of table)	Assumes that future annual growth in each town will be allocated to TAZ's in proportion to the amount of development potential in each TAZ. This assumption does not take into account any preferences for development other than land availability.
T	Estimated 2020 total housing units	Column S multiplied by 25 (the number of years from 1995 to 2020), but not more than column L (buildout)	
U	Estimated 2020 year-round housing units	Column T multiplied by existing ratio of year-round to total units	Assumes that ratio of year-round to seasonally-occupied housing in 2020 will be equal to 1995 ratio
V	Estimated 2020 seasonal housing units	Column T multiplied by existing ratio of seasonal to total units	Assumes that ratio of year-round to seasonally-occupied housing in 2020 will be equal to 1995 ratio
W	Acres used for business activity	Town assessors data	Assumes that the the land used for the average business in each Town today will approximate the land per business averages of the future given that no dramatic changes in the Lower Cape economy are anticipated. Therefore, these figures are used as an approximate measure of business activity today and vacant business land is used as a general measure for future business activity. This is a very rough measure of business activity. The databases do not contain measures of built square feet per parcel; therefore, the actual level of business development cannot be specified.

X	Potential additional business acres	Step One buildout estimates	This figure will be used to estimate potential additional employment per CBG
Y	Proportional increase from current level	Column X as a percentage of column W	This proportional increase was used to estimate the potential additional employees that might be expected for each CBG (columns Z through AL). Assumes that the current estimated ratios of employees to business acreage remain constant in the future.
Z	Current non-retail employees	Cape Cod Commission estimates generated for the creation of the Cape Cod Traffic Model	These figures were based on data from the 1987 Census of Services and thus do not account for non-service and non-retail jobs such as wholesaling, manufacturing, and construction.
AA	Current retail employees	Cape Cod Commission estimates generated for the creation of the Cape Cod Traffic Model	These figures were based on data from the 1987 Census of Retail Trade and are an accurate picture of the total retail employment in each Town. The distribution of the jobs per CBG was as estimate by the Commission. No job data by CBG are available to check or improve these figures.
AB	Current non-retail employment distribution	CCC traffic model Total non-retail employment was summed for each town and then broken into percents by CBG	The non-retail job totals for each Town were divided into the non-retail jobs for each CBG in each Town. This figure represents each Town's percent of non-retail jobs that currently exist in each CBG. This distribution is subject to the same limitations mentioned above concerning the accuracy of the data.
AC	Current retail employment distribution	CCC traffic model Total retail employment was summed for each town and then broken into percents by CBG	The retail job totals for each Town were divided into the retail jobs for each CBG in each Town. This figure represents each Town's percent of retail jobs that currently exist in each CBG.
AD	Seasonality factor: ratio of March employment to June employment	Data from Mass. Department of Employment Security	Assumes that seasonality of employment in each TAZ is equal for each town, and that seasonality of employment in one year is representative of longer-term trend in the town.

AE	Estimated summer employment, non-retail	Column Z divided by column AD	Assumes that seasonality of non-retail employment is equal to seasonality of total employment within the Town. Assumes that all businesses are open during the summer, and that all non-retail business area corresponds to employment.
AF	Estimated summer employment, retail	Column AA divided by column AD	Assumes that seasonality of retail employment is equal to seasonality of total employment within the Town. Assumes that all retail businesses are open during the summer, and that all retail business area corresponds to employment.
AG	Buildout employment, non-retail (year-round)	Column Y (potential percent increase in business acres) multiplied by column Z (existing non-retail employment).	(See above assumptions relative to estimating job growth based on business land.)
AH	Buildout employment, retail (year-round)	Column Y (potential percent increase in business acres) multiplied by column AA (existing retail employment).	(See above assumptions relative to estimating job growth based on business land.)
AI	Estimated 1990-2020 job growth, non-retail	Total 1990-2020 non-retail job growth for the town, multiplied by the TAZ's percentage of the town's increase in non-retail employment at buildout.	Job growth estimates assume that total retail and non-retail floor area in the four Outer Cape will increase by 10,000 square feet per year, and that each town will share in this annual increase in proportion to its share of the total potential increase in business acres.
AJ	Estimated 1990-2020 job growth, retail	Total 1990-2020 non-retail job growth for the town, multiplied by the TAZ's percentage of the town's increase in non-retail employment at buildout.	(See above)

AK	Estimated 2020 employment, non-retail	Sum of columns Z and AI	
AL	Estimated 2020 employment, retail	Sum of columns AA and AJ	
AM	Existing public parking spaces	CCC traffic model	
AN	Buildout public parking spaces	Same as existing spaces	Assumes that no additional public parking spaces will be provided (i.e., no expansion of public beach parking areas or village public parking).
AO	Current lodging units	CCC traffic model	
AP	Buildout lodging units	Same as existing lodging units	Assumes that no additional lodging units will be built
AQ	Intrazonal travel time	CCC traffic model	(Not used in buildout analysis)

Growth Projection Summaries by Town

Eastham Growth Estimates

Population: The Town's population is expected to rise from its 1995 level of approximately 4915 persons to a level of 6496 persons by the year 2010 when buildout will occur. If, due to a shift in the 47% year-round and 53% seasonal settlement patterns, the Town's housing is occupied by year-round residents at a rate of 53%, then the population would rise to approximately 9500 persons.

Housing Units: Today, there are approximately 5363 total housing units in Town of which 2543 are occupied year-round and 2820 are occupied seasonally. The buildout figure for the maximum number of housing units feasible is 6644 units which will be reached in the year 2010. At that point there will be 3216 yearround units and 3428 seasonal units.

Commercial Acreage: There are 140 acres of land used for commercial purposes in Town today. It is assumed that there will be one acre developed each year on average, so therefore, there will be five additional acres of commercial value entering the market every five years. This translates to approximately 50,000 square feet of additional commercial space every five years.

Wellfleet Growth Estimates

Population: The Town's population is expected to rise from its 1995 level of approximately 2493 persons to a level of approximately 3400 persons by the year 2020. At buildout, under the current 37%:63% mix of year-round to seasonal housing units, the population will be 3660 persons. If, due to a shift in settlement patterns, the Town's housing is occupied by year-round residents at a rate of 68%, then the population would rise to approximately 6790 persons. This 3130 person difference would most severely affect the school budget. At a 1995 rate of one elementary school serving a population of 2493 persons, then a year-round population of 6790 would require almost three elementary schools, assuming similar child per household ratios.

Housing Units: Today, there are approximately 3800 total housing units in Town of which 1400 are occupied year-round and 2400 are occupied seasonally. The buildout figure for the maximum number of housing units feasible is 5251 units. By the year 2020, there will be 4920 housing units.

Commercial Acreage: There are 281 acres of land used for commercial purposes in Town today. It is assumed that approximately 0.8 acre of new land will be converted to commercial use each year on average, so therefore, there will be 4 additional acres of commercial value entering the market every five years.

Truro Growth Estimates

Population: The Town's population is expected to rise from its 1995 level of approximately 1690 persons to a level of 2362 persons by the year 2020. At buildout, under the current 37%:63% mix of year-round to seasonal housing units, the population will be 2831 persons. If, due to a shift in settlement patterns, the Town's housing is occupied by year-round residents at a rate of 62%, then the population would rise to approximately 4600 persons. This shift would most severely affect the school budget. At a 1995 rate of one elementary school serving a population of 1690 persons, then a year-round population of 4618 would require almost three elementary schools, assuming similar child per household ratios.

Housing Units: Today, there are approximately 2375 total housing units in Town of which 873 are occupied year-round and 1502 are occupied seasonally. The buildout figure for the maximum number of housing units feasible is 3978 units. By the year 2020, there will be 3375 housing units. Buildout will be reached 16 years later in the year 2036 when there will be 1452 units of year-round housing and 2526 units of seasonal housing. This assumes a continuation of the 37:63 year-round to seasonal ratio.

Commercial Acreage: There are 264 acres of land used for commercial purposes in Town today. There are only an additional 7 acres that can accept more commercial development. It is assumed that only 1/4th of an acre will be developed each year on average, so therefore, there will be only one additional acre of commercial value entering the market every four years.

Provincetown Growth Estimates

Population: The Town's population is expected to rise from its 1995 level of approximately 3600 persons to a level of 4343 persons by the year 2020. This represents the smallest pecentage increase in population of all the Outer Cape towns. At buildout, under the current 63%:37% mix of year-round to seasonal housing units, the population will be 5047 persons. Provincetown is the only Outer Cape community with more year-round housing units than seasonal. If, due to a shift in settlement patterns, the Town's housing is occupied by year-round residents at a rate of 81%, then the year-round population would increase to approximately 6200 persons.

Housing Units: Today, there are approximately 3942 total housing units in Town of which 2474 are occupied year-round and 1468 are occupied seasonally. The buildout figure for the maximum number of housing units feasible is 5148 units. By the year 2020, there will be 4642 housing units. Buildout will be reached 18 years later in the year 2038 when there will be 3172 units of year-round housing and 1976 units of seasonal housing. This assumes a continuation of the 63:37 year-round to seasonal ratio.

Commercial Acreage: There are 151 acres of land used for commercial purposes in Town today and that figure will not appreciable rise in the future due to the dense, builtup nature of Provincetown.

Appendix A

Growth and Buildout Estimates by Census Block Group

Outer Cape Capacity Study – Land Use Scenarios

	A	B	C	D	E	F	G	H	I	J	K	L
1	Traffic	Town	Existing, Potential and Buildout Residential Units (by Type of Unit)									
2	Analysis		Single-Family Units			Multifamily Units			Other Units	Total Housing Units		
3	Zone		Existing	Pot'l Add'l	Buildout	Existing	Pot'l Add'l	Buildout	Pot'l Add'l	Existing	Pot'l Add'l	Buildout
4	1	Prov'town	135	490	625	124	0	124	0	259	490	749
5	2	Prov'town	510	260	770	267	0	267	0	777	260	1,037
6	3	Prov'town	306	92	398	389	0	389	0	695	92	787
7	4	Prov'town	191	27	218	450	0	450	0	641	27	668
8	5	Prov'town	344	7	351	471	0	471	0	815	7	822
9	6	Prov'town	207	470	677	408	0	408	0	615	470	1,085
10	7	Truro	27	0	27	0	0	0	0	27	0	27
11	8	Truro	843	599	1,442	75	0	75	0	918	599	1,517
12	9	Truro	728	761	1,489	29	0	29	0	757	761	1,518
13	10	Truro	466	470	936	7	0	7	0	473	470	943
14	11	Wellfleet	574	241	815	19	0	19	0	593	241	834
15	12	Wellfleet	592	327	919	46	0	46	0	638	327	965
16	13	Wellfleet	417	70	487	92	0	92	0	509	70	579
17	14	Wellfleet	1,016	661	1,677	17	0	17	0	1,033	661	1,694
18	15	Wellfleet	783	376	1,159	20	0	20	0	803	376	1,179
19	16	Eastham	375	186	561	18	0	18	0	393	186	579
20	17	Eastham	664	223	887	20	0	20	0	684	223	907
21	18	Eastham	502	95	597	13	0	13	0	515	95	610
22	19	Eastham	650	169	819	34	0	34	0	684	169	853
23	20	Eastham	524	154	678	4	0	4	0	528	154	682
24	21	Eastham	522	224	746	9	0	9	0	531	224	755
25	22	Eastham	653	458	1,111	60	0	60	0	713	458	1,171
26	23	Eastham	773	272	1,045	42	0	42	0	815	272	1,087
27	Totals	Totals	11,802	6,632	18,434	2,614	0	2,614	0	14,416	6,632	21,048
28												
29	**Totals by Town**											
30	TAZ's	Towns										
31	1 to 6	Prov'town	1,693	1,346	3,039	2,109	0	2,109	0	3,802	1,346	5,148
32	7 to 10	Truro	2,064	1,830	3,894	111	0	111	0	2,175	1,830	4,005
33	11 to 15	Wellfleet	3,382	1,675	5,057	194	0	194	0	3,576	1,675	5,251
34	16 to 23	Eastham	4,663	1,781	6,444	200	0	200	0	4,863	1,781	6,644
35		Region	11,802	6,632	18,434	2,614	0	2,614	0	14,416	6,632	21,048

Outer Cape Capacity Study – Land Use Scenarios

	A	B	M	N	O	P	Q	R	S	T	U	V
1	Traffic	Town	Seasonal Units					Growth Allocation		Estimated 2020 Housing Units		
2	Analysis			at Existing % of Total		with 50% shift to YR		Pot'l Add'l	Growth Rate	Units in 2020		
3	Zone		Existing	Pot'l Add'l	Buildout	Pot'l Add'l	Buildout	% of Town	(Units/Year)	Total	Year-Round	Seasonal
4	1	Prov'town	98	185	283	44	142	36.40%	10	565	351	214
5	2	Prov'town	480	161	641	(160)	320	19.32%	5	939	359	580
6	3	Prov'town	194	26	220	(84)	110	6.84%	2	752	542	210
7	4	Prov'town	187	8	195	(90)	97	2.01%	1	658	466	192
8	5	Prov'town	223	2	225	(111)	112	0.52%	0	819	595	224
9	6	Prov'town	234	179	413	(28)	206	34.92%	10	908	563	346
10	7	Truro	27	0	27	*0*	*27*	0.00%	0	27	0	27
11	8	Truro	553	361	914	(96)	457	32.73%	13	1,311	521	790
12	9	Truro	453	455	908	1	454	41.58%	17	1,256	504	752
13	10	Truro	343	341	684	(1)	342	25.68%	10	781	215	566
14	11	Wellfleet	381	155	536	(113)	268	14.39%	6	787	281	506
15	12	Wellfleet	379	194	573	(92)	287	19.52%	9	902	366	536
16	13	Wellfleet	305	42	347	(132)	173	4.18%	2	565	227	339
17	14	Wellfleet	624	399	1,023	(112)	512	39.46%	18	1,566	620	946
18	15	Wellfleet	568	266	834	(151)	417	22.45%	10	1,106	324	782
19	16	Eastham	201	95	296	(53)	148	10.44%	10	579	283	296
20	17	Eastham	410	134	544	(138)	272	12.52%	13	907	363	544
21	18	Eastham	354	65	419	(144)	210	5.33%	5	610	191	419
22	19	Eastham	450	111	561	(169)	281	9.49%	9	853	292	561
23	20	Eastham	375	109	484	(133)	242	8.65%	9	682	198	484
24	21	Eastham	252	106	358	(73)	179	12.58%	13	755	397	358
25	22	Eastham	261	168	429	(47)	214	25.72%	26	1,171	742	429
26	23	Eastham	252	84	336	(84)	168	15.27%	15	1,087	751	336
27	Totals	Totals	7,604	3,646	11,250	(1,965)	5,639		213	19,587	9,151	10,436
28												
29												
30	TAZ's	Towns										
31	1 to 6	Prov'town	1,416	560	1,976	(428)	988	100.00%	28	4,642	2,876	1,766
32	7 to 10	Truro	1,376	1,157	2,533	(96)	1,280	100.00%	40	3,375	1,240	2,135
33	11 to 15	Wellfleet	2,257	1,056	3,313	(600)	1,657	100.00%	45	4,926	1,818	3,108
34	16 to 23	Eastham	2,555	873	3,428	(841)	1,714	100.00%	100	6,644	3,216	3,428
35		Region	7,604	3,646	11,250	(1,965)	5,639		213	19,587	9,151	10,436

Outer Cape Capacity Study – Land Use Scenarios

	A	B	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	Traffic		Distribution of Business Land			Employment Data from CCC				Seasonality Factors		
2	Analysis	Town	Business Acres			No. of Employees		TAZ Percent of Town		March/July	Est. Summer Empl.	
3	Zone		Existing	Pot'l Add'l	% Increase	Non-Retail	Retail	Non-Retail	Retail	Ratio	Non-Retail	Retail
4	1	Prov'town	63.55	0.01	0.02%	120	637	26.09%	63.70%	71%	169	897
5	2	Prov'town	31.35	0.29	0.93%	42	32	9.13%	3.20%	71%	59	45
6	3	Prov'town	3.75	0.00	0.00%	58	18	12.61%	1.80%	71%	82	25
7	4	Prov'town	21.55	0.14	0.65%	188	210	40.87%	21.00%	71%	265	296
8	5	Prov'town	12.68	0.28	2.21%	18	84	3.91%	8.40%	71%	25	118
9	6	Prov'town	18.61	0.08	0.43%	34	19	7.39%	1.90%	71%	48	27
10	7	Truro	0.00	0.00	0.00%	0	0	0.00%	0.00%	71%	0	0
11	8	Truro	231.75	7.31	3.15%	4	22	66.67%	68.75%	71%	6	31
12	9	Truro	24.89	0.00	0.00%	1	8	16.67%	25.00%	71%	1	11
13	10	Truro	7.51	0.00	0.00%	1	2	16.67%	6.25%	71%	1	3
14	11	Wellfleet	9.11	17.97	197.26%	29	56	30.53%	16.14%	74%	39	76
15	12	Wellfleet	127.84	11.58	9.06%	23	52	24.21%	14.99%	74%	31	70
16	13	Wellfleet	29.26	13.62	46.55%	16	75	16.84%	21.61%	74%	22	101
17	14	Wellfleet	34.87	15.60	44.74%	27	164	28.42%	47.26%	74%	36	222
18	15	Wellfleet	79.51	21.15	26.60%	0	0	0.00%	0.00%	74%	0	0
19	16	Eastham	37.60	18.30	48.67%	15	43	9.43%	25.90%	80%	19	54
20	17	Eastham	6.90	0.00	0.00%	16	15	10.06%	9.04%	80%	20	19
21	18	Eastham	0.00	0.00	0.00%	0	0	0.00%	0.00%	80%	0	0
22	19	Eastham	9.50	1.00	10.53%	2	10	1.26%	6.02%	80%	3	13
23	20	Eastham	1.10	0.00	0.00%	1	3	0.63%	1.81%	80%	1	4
24	21	Eastham	9.40	0.00	0.00%	112	7	70.44%	4.22%	80%	140	9
25	22	Eastham	21.20	0.80	3.77%	10	6	6.29%	3.61%	80%	13	8
26	23	Eastham	54.40	0.00	0.00%	3	82	1.89%	49.40%	80%	4	103
27	Totals	Totals	836.33	108.13	12.93%	720	1,545				984	2,132
28												
29												
30	TAZ's	Towns										
31	1 to 6	Prov'town	151.49	0.80	0.53%	460	1,000	100.00%	100.00%	71%	648	1,408
32	7 to 10	Truro	264.15	7.31	2.77%	6	32	100.00%	100.00%	71%	8	45
33	11 to 15	Wellfleet	280.59	79.92	28.48%	95	347	100.00%	100.00%	74%	128	469
34	16 to 23	Eastham	140.10	20.10	14.35%	159	166	100.00%	100.00%	80%	200	210
35		Region	836.33	108.13	12.93%	720	1,545				984	2,132

Outer Cape Capacity Study – Land Use Scenarios

	A	B	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
1	Traffic		Buildout Employment		Estimated 2020 Employment				Parking Spaces		Lodging Units		Intrazonal
2	Analysis	Town			Job Growth, 1990-2020		Employment in 2020						Travel
3	Zone		Non-Retail	Retail	Non-Retail	Retail	Non-Retail	Retail	Existing	Buildout	Existing	Buildout	Time
4	1	Prov'town	120	637	0	0	120	637	1,460	1,460	246	246	307
5	2	Prov'town	42	32	0	0	42	32	0	0	524	524	68
6	3	Prov'town	58	18	0	0	58	18	110	110	115	115	44
7	4	Prov'town	189	211	1	0	189	210	835	835	331	331	41
8	5	Prov'town	18	86	0	1	18	85	570	570	492	492	56
9	6	Prov'town	34	19	0	0	34	19	220	220	470	470	89
10	7	Truro	*20*	0	*20*	0	*20*	0	0	0	0	*50*	236
11	8	Truro	4	23	0	1	4	23	900	900	1,738	1,738	230
12	9	Truro	1	8	0	0	1	8	558	558	293	293	176
13	10	Truro	1	2	0	0	1	2	160	160	17	17	183
14	11	Wellfleet	54	144	5	20	34	76	365	365	23	23	222
15	12	Wellfleet	25	59	0	2	23	54	345	345	75	75	198
16	13	Wellfleet	41	162	5	20	21	95	690	690	46	46	146
17	14	Wellfleet	35	192	2	6	29	170	0	0	275	275	166
18	15	Wellfleet	101	350	22	81	22	81	708	708	376	376	186
19	16	Eastham	22	64	7	20	22	63	425	425	122	122	180
20	17	Eastham	16	15	0	0	16	15	20	20	41	41	143
21	18	Eastham	0	0	0	0	0	0	175	175	0	0	92
22	19	Eastham	2	11	0	1	2	11	20	20	3	3	99
23	20	Eastham	1	3	0	0	1	3	212	212	0	0	115
24	21	Eastham	112	7	0	0	112	7	52	52	9	9	143
25	22	Eastham	10	6	0	0	10	6	100	100	96	96	201
26	23	Eastham	3	82	0	0	3	82	185	185	339	339	184
27	Totals	Totals	911	2,132	63	152	783	1,697	8,110	8,110	5,631	5,681	
28													
29													
30	TAZ's	Towns											
31	1 to 6	Prov'town	462	1,004	1	1	461	1,001	3,195	3,195	2,178	2,178	
32	7 to 10	Truro	*26*	33	*20*	13	*26*	33	1,618	1,618	2,048	2,098	
33	11 to 15	Wellfleet	256	907	35	129	129	476	2,108	2,108	795	795	
34	16 to 23	Eastham	167	188	20	21	167	187	1,189	1,189	610	610	
35		Region	911	2,132	76	164	783	1,697	8,110	8,110	5,631	5,681	

Appendix B

Growth and Buildout Estimates by Town

OUTER CAPE CAPACITY STUDY
SCENARIOS SUMMARIZED BY TOWN

Scenario	Housing Units					Population (Peak)					Population (Average)				
	Total	Year-Round	Seasonal Units #	Seasonal Units %	Lodging Units	Year-Round	Visitors / Houseguests	Seasonal Units	Lodging Units	Total Summer	Year-Round	Visitors / Houseguests	Seasonal Units	Lodging Units	Total Summer
Scenario 1															
Existing Conditions (1990 Census)															
Provincetown	3,802	2,386	1,416	37%	2,178	3,561	5,932	4,991	5,075	19,559	3,561	3,955	2,994	3,806	14,316
Truro	2,175	799	1,376	63%	2,048	1,573	2,636	7,609	4,772	16,590	1,573	1,757	4,566	3,579	11,475
Wellfleet	3,576	1,319	2,257	63%	795	2,493	3,712	8,989	1,852	17,046	2,493	2,474	5,393	1,389	11,749
Eastham	4,863	2,308	2,555	53%	610	4,462	7,850	13,714	1,421	27,447	4,462	5,234	8,228	1,066	18,990
TOTAL	14,416	6,812	7,604	53%	5,631	12,089	20,130	35,303	13,120	80,642	12,089	13,420	21,181	9,840	56,530
Scenario 2															
Projected Conditions in 2020															
Provincetown	4,642	2,876	1,766	38%	2,178	4,290	7,150	6,220	5,070	22,730	4,290	4,770	3,730	3,810	16,600
Truro	3,375	1,240	2,135	63%	2,098	2,440	4,090	11,810	4,890	23,230	2,440	2,730	7,080	3,670	15,920
Wellfleet	4,926	1,818	3,108	63%	795	3,440	5,120	12,380	1,850	22,790	3,440	3,410	7,430	1,390	15,670
Eastham	6,644	3,216	3,428	52%	610	6,220	10,940	18,400	1,420	36,980	6,220	7,290	11,040	1,070	25,620
TOTAL	19,587	9,150	10,437	53%	5,681	16,390	27,300	48,810	13,230	105,730	16,390	18,200	29,280	9,940	73,810
Scenario 3															
Build-Out With Existing Split Between Year-Round and Seasonal Occupancy															
Provincetown	5,148	3,172	1,976	38%	2,178	4,730	7,890	6,960	5,070	24,650	4,730	5,260	4,170	3,810	17,970
Truro	3,978	1,452	2,526	63%	2,098	2,860	4,790	13,970	4,890	26,510	2,860	3,200	8,380	3,670	18,110
Wellfleet	5,251	1,938	3,313	63%	795	3,660	5,460	13,200	1,850	24,170	3,660	3,640	7,920	1,390	16,610
Eastham	6,644	3,216	3,428	52%	610	6,220	10,940	18,400	1,420	36,980	6,220	7,290	11,040	1,070	25,620
TOTAL	21,021	9,778	11,243	53%	5,681	17,470	29,080	52,530	13,230	112,310	17,470	19,390	31,510	9,940	78,310
Scenario 4															
Build-Out With 50% Shift from Seasonal to Year-Round Occupancy															
Provincetown	5,148	4,160	988	19%	2,178	6,210	10,350	3,480	5,070	25,110	6,210	6,900	2,090	3,810	19,010
Truro	3,978	2,705	1,273	32%	2,098	5,330	8,920	7,040	4,890	26,180	5,330	5,960	4,220	3,670	19,180
Wellfleet	5,251	3,594	1,657	32%	795	6,790	10,130	6,600	1,850	25,370	6,790	6,750	3,960	1,390	18,890
Eastham	6,644	4,930	1,714	26%	610	9,530	16,770	9,200	1,420	36,920	9,530	11,180	5,520	1,070	27,300
TOTAL	21,021	15,389	5,632	27%	5,681	27,860	46,170	26,320	13,230	113,580	27,860	30,790	15,790	9,940	84,380

ASSUMPTIONS USED IN DEVELOPING THE SCENARIOS:

–1– Year-round population estimates for 2020 and build-out assume existing ratios of persons per year-round housing unit for each town.

–2– Components of summer population assume the following ratios (persons per unit) for the Outer Cape as a whole:

	Peak	Average
• Visitors & Houseguests	8 per Year-Round Unit	2 per Year-Round Unit
• In Seasonal Units	5 per Seasonal Unit	3 per Seasonal Unit
• In Lodging Units	2.33 per Lodging Unit, 100% occupancy	2.33 per Lodging Unit, 75% occupancy

–3– Estimates for Visitors/Houseguests and occupants of Seasonal Units are further adjusted according to the average number of rooms per housing unit in each town:

	Rooms per Unit		Adjustment Factor	
Town	Year Round	Seasonal Units	Year Round	Seasonal Units
Provincetown	3.64	3.69	0.8287	0.7049
Truro	4.83	5.79	1.0996	1.1060
Wellfleet	4.12	4.17	0.9380	0.7965
Eastham	4.98	5.62	1.1338	1.0735
Outer Cape Average	4.39	5.24		

For example, in Provincetown –
- the estimated average number of houseguests is (2 x 0.8442) = 1.69 per year-round unit
- the estimated peak number of persons in seasonal units is (5 x 0.6931) = 3.47 per seasonal unit

–4– The projections for the year 2020 assume the following residential growth rates for each town:

	Units/Year
Provincetown	28
Truro	40
Wellfleet	45
Eastham	100

The residential growth rates are based on the median rates experienced by each town over periods of 13 to 20 years:

Provincetown	[Based on annual building permit cap]
Truro	1974-1993 (20 years)
Wellfleet	1979-1993 (15 years)
Eastham	1980-1992 (13 years)

–4– Population estimates for 2020 and buildout are rounded to the nearest 10.

Appendix C

Assumptions for Developable Land Analyses

Residential Build Out for Provincetown Based on Lot Size Distribution

The following assumption and variables drive the buildout projections that follow. The variables are figures that control the density of houses per acre and persons and children per household.

Variables	Assumptions:
	Vacant Residential Land
	1. Assume that all land classified as residential will be used for housing.
1	2. If lot size is <0.25 acre, assume that the noted percentage of total lots are buildable.
0.16	3. If Lot size is >0.25 to <=1 acre, then assume that each lot will be divided by the noted factor.
0.16	4. If lot size is >1 acre to <=3 acres, assume adequate frontage and buildable lots equal total acreage divided by the noted minimum lot size. Assume no subdivision.
0.16	5. If lot size is >3 acres, then assume that road will be needed and buildable lots equals total acreage minus a factor for roads divided by the noted minimum lot size.
	Large Single Family Lots
20	1. If lot with existing single family home is >5 to <=10 acres, assume that the noted number of lots will be created for each existing lot over time. The assumption is that the current owners of these moderately sized lots enjoy their large lots and would be reluctant to subdivide.
0.16	2. If lot is >10 acres, then assume that all acres over five acres will be decreased by 10% for roads and then divided by the noted minimum lot size.
	Other Residential Land
0.16	1. This category includes all other large parcels of land used for residential purposes. The assumption is that only parcels greater than 10 acres will be subdivided. All land above the ten acre level would be subdivided assuming buildable lots equal total acreage above ten acres minus 10% for roads divided by the noted minimum lots size.
	Other Potentially Developable Land
0	1. Commercial: Assume that all land is developed for commercial use.
0	2. Industrial: Assume that all land is developed for residential use at the noted minimum lot size.
0.16	3. Agricultural: Assume that all land is developed for residential at the noted minimum lot size.
0.16	4. Multiple Use Land: Assume that all land over ten acres will be subdivided using the noted minimum lot size.
	Growth and Development Assumptions
0.1	1. Road area factor: Assume that when land is subdivided, the noted factor will be used for road area.
0.32	2. Distribution of New Year-Round Households vs New Seasonal Units: Assume the noted ratio of year-round to total units.
2.2	3. Persons per Household: Assume that year-round persons per household will be as noted.
0.44	4. Children per Household: Assume that year-round population will generate the noted children per household.
6	5. Persons per Household in Seasonal Units at Peak of Season

Build Out Calculations for Truro Based on Total Developable Lot Inventory

The following assumption and variables drive the buildout projections that follow. The variables are figures that control the density of houses per acre and persons and children per household.

Variables	Assumptions:
	Vacant Residential Land
0.5	1. If lot size is <0.25 acre, assume that the noted percentage of total lots are buildable.
1	2. If Lot size is >0.25 to <=1 acre, then assume that each lot will be divided by the noted factor.
0.75	3. If lot size is >1 acre to <=3 acres, assume adequate frontage and buildable lots equal total acreage divided by the noted minimum lot size.
0.75	4. If lot size is >3 acres, then assume that road will be needed and buildable lots equals total acreage minus a factor for roads divided by the noted minimum lot size.
	Large Single Family Lots
1	1. If lot with existing single family home is >5 to <=10 acres, assume that the noted number of lots will be created for each existing lot over time. The assumption is that the current owners of these moderately sized lots enjoy their large lots and would be reluctant to subdivide.
0.75	2. If lot is >10 acres, then assume that all acres over five acres will be decreased by 10% for roads and then divided by the noted minimum lot size.
	Other Residential Land
0.75	1. This category includes all other large parcels of land used for residential purposes. The assumption is that only parcels greater than 10 acres will be subdivided. All land above the ten acre level would be subdivided assuming buildable lots equal total acreage above ten acres minus 10% for roads divided by the noted minimum lots size.
	Other Potentially Developable Land
0	1. Commercial: Assume that all land is developed for commercial use at the noted floor area ratio.
0.75	2. Industrial: Assume that all land is developed for residential use at the noted minimum lot size.
0.75	3. Agricultural: Assume that all land is developed for residential at the noted minimum lot size.
0.75	4. Multiple Use Land: Assume that all land over ten acres will be subdivided using the noted minimum lot size.
	Growth and Development Assumptions
0.1	1. Road area factor: Assume that when land is subdivided, the noted factor will be used for road area.
0.32	2. Distribution of New Year-Round Households vs New Seasonal Units: Assume that the noted ratio of year-round to seasonal units.
2.2	3. Persons per Household: Assume that year-round persons per household will be as noted.
0.44	4. Children per Household: Assume that year-round population will generate the noted children per household.
40	5. New Housing Units per Year: Assume that the noted number of new units will be built each year.
6	6. Persons per Household in Seasonal Units at Peak of Season
250	7. Truro Elementary School Maximum Capacity

Residential Build Out for Eastham Based on Lot Size Distribution

The following assumption and variables drive the buildout projections that follow. The variables are figures that control the density of houses per acre and persons and children per household.

Variables	Assumptions:
	Vacant Residential Land
	1. Assume that all land classified as residential will be used for housing.
0.5	2. If lot size is <0.25 acre, assume that the noted percentage of total lots are buildable.
1	3. If Lot size is >0.25 to <=1 acre, then assume that each lot will be divided by the noted factor.
1	4. If lot size is >1 acre to <=3 acres, assume adequate frontage and buildable lots equal total acreage divided by the noted minimum lot size. Assume no subdivision.
1	5. If lot size is >3 acres, then assume that road will be needed and buildable lots equals total acreage minus a factor for roads divided by the noted minimum lot size.
	Large Single Family Lots
2	1. If lot with existing single family home is >5 to <=10 acres, assume that the noted number of lots will be created for each existing lot over time. The assumption is that the current owners of these moderately sized lots enjoy their large lots and would be reluctant to subdivide.
1	2. If lot is >10 acres, then assume that all acres over five acres will be decreased by 10% for roads and then divided by the noted minimum lot size.
	Other Residential Land
1	1. This category includes all other large parcels of land used for residential purposes. The assumption is that only parcels greater than 10 acres will be subdivided. All land above the ten acre level would be subdivided assuming buildable lots equal total acreage above ten acres minus 10% for roads divided by the noted minimum lots size.
	Other Potentially Developable Land
0	1. Commercial: Assume that all land is developed for commercial use.
1	2. Industrial: Assume that all land is developed for residential use at the noted minimum lot size.
1	3. Agricultural: Assume that all land is developed for residential at the noted minimum lot size.
1	4. Multiple Use Land: Assume that all land over ten acres will be subdivided using the noted minimum lot size.
	Growth and Development Assumptions
0.1	1. Road area factor: Assume that when land is subdivided, the noted factor will be used for road area.
0.32	2. Distribution of New Year-Round Households vs New Seasonal Units: Assume the noted ratio of year-round to total units.
2.2	3. Persons per Household: Assume that year-round persons per household will be as noted.
0.44	4. Children per Household: Assume that year-round population will generate the noted children per household.
6	5. Persons per Household in Seasonal Units at Peak of Season

Appendix D

Detailed Developable Land Analyses by CBG

CBG 1

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	35	5.09	35	11	24	25	5
>0.25	<=0.5	31	11.21	194	62	132	136	27
>0.5	<=0.75	16	9.71	100	32	68	70	14
>0.75	<=1	4	3.47	25	8	17	18	4
>1	<=2	3	3.6	22	7	15	16	3
>2	<=3	1	2.98	19	6	13	13	3
>3	<=4	1	3.6	20	6	14	14	3
>4	<=5	1	4.38	25	8	17	17	3
>5	<=6	0	0	0	0	0	0	0
>6	<=7	0	0	0	0	0	0	0
>7	<=8	0	0	0	0	0	0	0
>8	<=9	1	8.89	50	16	34	35	7
>9	<=10	0	0	0	0	0	0	0
>10		0	0	0	0	0	0	0
Total		95	52.93	490	157	333	345	69

Large Single-Family Lots

>5	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		1	0.01	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		1	0.42	0	0	0	0	0

Total – CBG 1

	97	53.36	490	157	333	345	69

CBG 2

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	14	2.43	14	4	10	10	2
>0.25	<=0.5	9	3.45	56	18	38	40	8
>0.5	<=0.75	4	2.76	25	8	17	18	4
>0.75	<=1	0	0	0	0	0	0	0
>1	<=2	3	4.05	25	8	17	18	4
>2	<=3	1	2.37	15	5	10	10	2
>3	<=4	2	6.36	36	11	24	25	5
>4	<=5	0	0	0	0	0	0	0
>5	<=6	0	0	0	0	0	0	0
>6	<=7	0	0	0	0	0	0	0
>7	<=8	0	0	0	0	0	0	0
>8	<=9	0	0	0	0	0	0	0
>9	<=10	0	0	0	0	0	0	0
>10		1	12.17	68	22	47	48	10
Total		34	33.59	240	77	163	169	34

Large Single-Family Lots

>5	<=10	1	5.70	20	6	14	14	3
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		1	0.29	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		1	0.10	0	0	0	0	0

Total – CBG 2

		37	39.68	260	83	177	183	37

CBG 3

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	8	1.29	8	3	5	6	1
>0.25	<=0.5	3	1.01	19	6	13	13	3
>0.5	<=0.75	1	0.6	6	2	4	4	1
>0.75	<=1	0	0	0	0	0	0	0
>1	<=2	1	1.75	11	4	7	8	2
>2	<=3	2	4.38	27	9	19	19	4
>3	<=4	1	3.72	21	7	14	15	3
>4	<=5	0	0	0	0	0	0	0
>5	<=6	0	0	0	0	0	0	0
>6	<=7	0	0	0	0	0	0	0
>7	<=8	0	0	0	0	0	0	0
>8	<=9	0	0	0	0	0	0	0
>9	<=10	0	0	0	0	0	0	0
>10		0	0	0	0	0	0	0
Total		16	12.75	92	30	63	65	13

Large Single-Family Lots

>5	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		0	0	0	0	0	0	0
Industrial		0	0	0	0	0	0	0
Agricultural		0	0	0	0	0	0	0
Multiple Use		8	1.04	0	0	0	0	0

Total – CBG 3

	24	13.79	92	30	63	65	13

CBG 4

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	8	0.97	8	3	5	6	1
>0.25	<=0.5	0	0	0	0	0	0	0
>0.5	<=0.75	1	0.67	6	2	4	4	1
>0.75	<=1	0	0	0	0	0	0	0
>1	<=2	0	0	0	0	0	0	0
>2	<=3	1	2.02	13	4	9	9	2
>3	<=4	0	0	0	0	0	0	0
>4	<=5	0	0	0	0	0	0	0
>5	<=6	0	0	0	0	0	0	0
>6	<=7	0	0	0	0	0	0	0
>7	<=8	0	0	0	0	0	0	0
>8	<=9	0	0	0	0	0	0	0
>9	<=10	0	0	0	0	0	0	0
>10		0	0	0	0	0	0	0
Total		10	3.66	27	9	18	19	4

Large Single-Family Lots

>5	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		1	0.14	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		34	3.78	0	0	0	0	0

Total – CBG 4

		45	7.58	27	9	18	19	4

CBG 5

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	1	0.01	1	0	1	1	0
>0.25	<=0.5	1	0.34	6	2	4	4	1
>0.5	<=0.75	0	0	0	0	0	0	0
>0.75	<=1	0	0	0	0	0	0	0
>1	<=2	0	0	0	0	0	0	0
>2	<=3	0	0	0	0	0	0	0
>3	<=4	0	0	0	0	0	0	0
>4	<=5	0	0	0	0	0	0	0
>5	<=6	0	0	0	0	0	0	0
>6	<=7	0	0	0	0	0	0	0
>7	<=8	0	0	0	0	0	0	0
>8	<=9	0	0	0	0	0	0	0
>9	<=10	0	0	0	0	0	0	0
>10		0	0	0	0	0	0	0
Total		2	0.35	7	2	5	5	1

Large Single-Family Lots

>5	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		1	0.28	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		33	3.31	0	0	0	0	0

Total – CBG 5

		36	3.94	7	2	5	5	1

CBG 6

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	19	2.31	19	6	13	13	3
>0.25	<=0.5	15	4.92	94	30	64	66	13
>0.5	<=0.75	4	2.51	25	8	17	18	4
>0.75	<=1	1	0.89	6	2	4	4	1
>1	<=2	2	2.86	18	6	12	13	3
>2	<=3	1	2.22	14	4	9	10	2
>3	<=4	0	0	0	0	0	0	0
>4	<=5	1	4.08	23	7	16	16	3
>5	<=6	0	0	0	0	0	0	0
>6	<=7	0	0	0	0	0	0	0
>7	<=8	0	0	0	0	0	0	0
>8	<=9	0	0	0	0	0	0	0
>9	<=10	0	0	0	0	0	0	0
>10		0	0	0	0	0	0	0
Total		44	19.79	199	64	135	140	28

Large Single-Family Lots

>5	<=10	3	19.60	60	19	41	42	8
>10		2	37.60	212	68	144	149	30

Other Large Residential Parcels

>10	0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial	1	0.08	0	0	0	0	0
Industrial	0	0.00	0	0	0	0	0
Agricultural	0	0.00	0	0	0	0	0
Multiple Use	10	1.60	0	0	0	0	0

Total – CBG 6

	60	78.67	470	150	320	331	66

TOTAL

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	85	12	85	27	58	60	12
>0.25	<=0.5	59	21	369	118	251	260	52
>0.5	<=0.75	26	16	163	52	111	114	23
>0.75	<=1	5	4	31	10	21	22	4
>1	<=2	9	12	77	25	52	54	11
>2	<=3	6	14	87	28	59	61	12
>3	<=4	4	14	77	25	52	54	11
>4	<=5	2	8	48	15	32	34	7
>5	<=6	0	0	0	0	0	0	0
>6	<=7	0	0	0	0	0	0	0
>7	<=8	0	0	0	0	0	0	0
>8	<=9	1	9	50	16	34	35	7
>9	<=10	0	0	0	0	0	0	0
>10		1	12	68	22	47	48	10
Total		201	123	1,054	337	717	742	148

Large Single-Family Lots

>5	<=10	4	25.30	80	26	54	56	11
>10		2	37.60	212	68	144	149	30

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		5	0.80	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		87	10.25	0	0	0	0	0

Total – Town

		299	197.02	1,346	431	915	948	190

CBG 8

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	30	5.80	15	5	10	11	2
>0.25	<=0.5	15	5.63	15	5	10	11	2
>0.5	<=0.75	40	24.30	40	13	27	28	6
>0.75	<=1	136	114.69	136	44	92	96	19
>1	<=2	68	90.65	121	39	82	85	17
>2	<=3	7	16.01	21	7	15	15	3
>3	<=4	2	6.20	7	2	5	5	1
>4	<=5	2	8.07	10	3	7	7	1
>5	<=6	0	0.00	0	0	0	0	0
>6	<=7	1	6.42	8	2	5	5	1
>7	<=8	2	15.33	18	6	13	13	3
>8	<=9	2	17.57	21	7	14	15	3
>9	<=10	1	9.73	12	4	8	8	2
>10		4	54.90	66	21	45	46	9
Total		310	375.30	490	157	333	345	69

Large Single-Family Lots

>5	<=10	4	28.43	4	1	3	3	1
>10		2	24.82	30	10	20	21	4

Other Large Residential Parcels

>10		1	23.55	28	9	19	20	4

Other Potentially Developable Land

Commercial		5	7.31	0	0	0	0	0
Industrial		1	38.73	46	15	32	33	7
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		0	0.00	0	0	0	0	0

Total – CBG 8

		323	498.14	599	192	407	421	84

CBG 9

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	1	0.22	1	0	0	0	0
>0.25	<=0.5	5	1.54	5	2	3	4	1
>0.5	<=0.75	56	33.54	56	18	38	39	8
>0.75	<=1	168	143.13	168	54	114	118	24
>1	<=2	65	87.85	117	37	80	82	16
>2	<=3	12	28.08	37	12	25	26	5
>3	<=4	8	27.34	33	10	22	23	5
>4	<=5	7	32.03	38	12	26	27	5
>5	<=6	2	10.92	13	4	9	9	2
>6	<=7	3	19.81	24	8	16	17	3
>7	<=8	0	0.00	0	0	0	0	0
>8	<=9	1	8.54	10	3	7	7	1
>9	<=10	2	19.05	23	7	16	16	3
>10		4	60.78	73	23	50	51	10
Total		334	472.83	598	191	407	421	84

Large Single-Family Lots

>5.	<=10	6	35.20	6	2	4	4	1
>10		3	34.96	42	13	29	30	6

Other Large Residential Parcels

>10		2	26.19	31	10	21	22	4

Other Potentially Developable Land

Commercial		0	0.00	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		2	69.36	83	27	57	59	12
Multiple Use		0	0.00	0	0	0	0	0

Total – CBG 9

		347	638.54	761	243	517	536	107

CBG 10

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	2	0.25	1	0	1	1	0
>0.25	<=0.5	7	2.99	7	2	5	5	1
>0.5	<=0.75	16	9.63	16	5	11	11	2
>0.75	<=1	48	40.10	48	15	33	34	7
>1	<=2	30	40.78	54	17	37	38	8
>2	<=3	15	37.33	50	16	34	35	7
>3	<=4	7	23.38	28	9	19	20	4
>4	<=5	3	12.67	15	5	10	11	2
>5	<=6	2	11.23	13	4	9	9	2
>6	<=7	4	26.54	32	10	22	22	4
>7	<=8	0	0.00	0	0	0	0	0
>8	<=9	0	0.00	0	0	0	0	0
>9	<=10	0	0.00	0	0	0	0	0
>10		1	10.07	12	4	8	9	2
Total		135	214.97	277	89	188	195	39

Large Single-Family Lots

>5	<=10	22	154.02	22	7	15	15	3
>10		7	106.52	128	41	87	90	18

Other Large Residential Parcels

>10	2	35.95	43	14	29	30	6

Other Potentially Developable Land

Commercial	0	0.00	0	0	0	0	0
Industrial	0	0.00	0	0	0	0	0
Agricultural	0	0.00	0	0	0	0	0
Multiple Use	0	0.00	0	0	0	0	0

Total – CBG 10

	166	511.46	470	150	319	331	66

NO CBG

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	1	0.18	1	0	0	0	0
>0.25	<=0.5	0	0.00	0	0	0	0	0
>0.5	<=0.75	0	0.00	0	0	0	0	0
>0.75	<=1	0	0.00	0	0	0	0	0
>1	<=2	0	0.00	0	0	0	0	0
>2	<=3	1	2.66	4	1	2	2	0
>3	<=4	1	3.03	4	1	2	3	1
>4	<=5	0	0.00	0	0	0	0	0
>5	<=6	0	0.00	0	0	0	0	0
>6	<=7	0	0.00	0	0	0	0	0
>7	<=8	0	0.00	0	0	0	0	0
>8	<=9	0	0.00	0	0	0	0	0
>9	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0
Total		3	5.87	8	2	5	5	1

Large Single-Family Lots

>5	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		0	0.00	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		0	0.00	0	0	0	0	0

Total – NO CBG

		3	5.87	8	2	5	5	1

TOTAL

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	34	6.45	17	5	12	12	2
>0.25	<=0.5	27	10.16	27	9	18	19	4
>0.5	<=0.75	112	67.47	112	36	76	79	16
>0.75	<=1	352	297.92	352	113	239	248	50
>1	<=2	163	219.28	292	94	199	206	41
>2	<=3	35	84.08	112	36	76	79	16
>3	<=4	18	59.95	72	23	49	51	10
>4	<=5	12	52.77	63	20	43	45	9
>5	<=6	4	22.15	27	9	18	19	4
>6	<=7	8	52.77	63	20	43	45	9
>7	<=8	2	15.33	18	6	13	13	3
>8	<=9	3	26.11	31	10	21	22	4
>9	<=10	3	28.78	35	11	23	24	5
>10		9	125.75	151	48	103	106	21
Total		782	1,068.97	1,373	439	934	966	193

Large Single-Family Lots

>5	<=10	32	217.65	32	10	22	23	5
>10		12	166.30	200	64	136	140	28

Other Large Residential Parcels

>10		5	85.69	103	33	70	72	14

Other Potentially Developable Land

Commercial		5	7.31	0	0	0	0	0
Industrial		1	38.73	46	15	32	33	7
Agricultural		2	69.36	83	27	57	59	12
Multiple Use		0	0.00	0	0	0	0	0

Total – Town

		839	1,654.01	1,837	588	1,249	1,293	259

WELLFLEET – CBG 11

BUILD-OUT SUMMARY BY CURRENT LAND USE

CURRENT LAND USE	LAND USE CODE	NO. OF PARCELS	TOTAL AREA (ACRES)	AVERAGE PARCEL SIZE	NONRESIDENTIAL BUILDOUT FLOOR AREA (SQ. FT.)	RESIDENTIAL UNITS EXISTING DWELLING UNITS	RESIDENTIAL UNITS BUILDOUT DWELLING UNITS
Single Family	101	291	307.19	1.06	109,600	291	357
Condominium	102	1	0.71	0.71	0	4	4
Mobile Home	103	2	2.27	1.14	0	2	3
Two Family	104	1	61.13	61.13	0	2	32
Three Family	105	2	2.96	1.48	0	6	6
Accessory Land	106	3	2.50	0.83	0	0	3
Multiple Housing on One Parcel	109	10	15.55	1.56	0	20	23
Aparts-4-8 units	111	2	2.00	1.00	0	10	10
Developable Residential Land	130	244	266.42	1.09	0	0	324
Potentially Devel. Residential Land	131	10	46.10	4.61	0	0	53
Undevelopable Residential Land	132	13	8.60	0.66	0	0	0
Total Residential Properties		579	715.43	1.24	109,600	335	815
Commercial Land Uses							
Small Retail & Service (<10,000 sq ft)	325	2	2.92	1.46	25,400	0	1
Eating & Drinking Estab.	326	2	2.73	1.37	41,300	0	0
Auto Sales & Services	330	1	1.27	1.27	19,200	0	0
General Office Bldg	340	1	0.90	0.90	0	0	1
Bank	341	1	1.29	1.29	0	0	1
Developable Commercial Land	390	1	0.52	0.52	7,800	0	0
Potentially Developable Commercial Land	391	2	11.45	5.73	0	0	13
Total Commercial Property		10	21.08	2.11	93,700	0	16
Public Service Land Uses							
Municipalities	903	9	67.97	7.55	0	0	0
Charitable Organizations	905	2	5.26	2.63	0	0	0
Churches, Synagogues and Temples	906	1	0.78	0.78	0	0	0
Total Public Properties		12	74.01	6.17	0	0	0
Open Land Land Uses							
Open Wetlands in Residential Area	202	1	1.20	1.20	0	0	0
Total Open Land Properties		1	1.20	1.20	0	0	0
Multiple-Use Property							
Primarily Residential w/ Commer.	013	4	3.65	0.91	12,100	4	4
Primarily Commercial w/ Resident.	031	1	1.16	1.16	0	1	1
Total Multiple-Use Properties		5	4.81	0.96	12,100	5	5
Totals for Land Use Classes		607	816.53	1.35	215,400	340	836
Totals for Planning Area		607	816.53	1.35	215,400	340	836

WELLFLEET – CBG 12

BUILD-OUT SUMMARY BY CURRENT LAND USE

CURRENT LAND USE	LAND USE CODE	NO. OF PARCELS	TOTAL AREA (ACRES)	AVERAGE PARCEL SIZE	NONRESIDENTIAL BUILDOUT FLOOR AREA (SQ. FT.)	RESIDENTIAL UNITS EXISTING DWELLING UNITS	RESIDENTIAL UNITS BUILDOUT DWELLING UNITS
Single Family	101	417	333.86	0.80	104,900	417	455
Condominium	102	3	4.02	1.34	0	35	35
Mobile Home	103	3	1.00	0.33	0	3	3
Two Family	104	20	19.26	0.96	9,100	40	42
Three Family	105	3	1.74	0.58	7,600	9	9
Accessory Land	106	4	3.55	0.89	0	0	4
Multiple Housing on One Parcel	109	25	30.66	1.23	33,900	50	55
Aparts-4-8 units	111	9	5.26	0.58	3,500	45	45
Developable Residential Land	130	229	171.49	0.75	0	0	238
Potentially Devel. Residential Land	131	17	35.64	2.10	0	0	33
Undevelopable Residential Land	132	23	23.94	1.04	0	0	0
Total Residential Properties		753	630.42	0.84	159,000	599	919
Commercial Land Uses							
Inns, Resorts	302	3	6.77	2.26	0	0	7
Piers, Wharves, Docks	315	1	1.02	1.02	0	0	1
Small Retail & Service (<10,000 sq ft)	325	5	1.06	0.21	12,200	0	0
Eating & Drinking Estab.	326	3	11.33	3.78	17,100	0	1
Auto Repair	332	1	0.52	0.52	0	0	1
General Office Bldg	340	3	1.50	0.50	11,300	0	1
Postal Service	350	1	0.25	0.25	3,200	0	0
Golf Courses	380	1	105.39	105.39	0	0	92
Developable Commercial Land	390	1	1.58	1.58	0	0	1
Total Commercial Property		19	129.42	6.81	43,800	0	104
Public Service Land Uses							
Municipalities	903	9	29.26	3.25	0	0	0
Charitable Organizations	905	3	4.16	1.39	0	0	0
Churches, Synagogues and Temples	906	5	3.93	0.79	0	0	0
Total Public Properties		17	37.35	2.20	0	0	0
Open Land Land Uses							
Open Land in Residential Area	201	3	20.28	6.76	0	0	0
Open Wetlands in Residential Area	202	2	2.81	1.41	0	0	0
Total Open Land Properties		5	23.09	4.62	0	0	0
Multiple-Use Property							
Primarily Residential w/ Commer.	013	12	13.15	1.10	29,000	12	15
Primarily Commercial w/ Resident.	031	7	2.52	0.36	19,200	7	7
Total Multiple-Use Properties		19	15.67	0.82	48,200	19	22
Totals for Land Use Classes		813	835.95	1.03	251,000	618	1,045
Totals for Planning Area		813	835.95	1.03	251,000	618	1,045

WELLFLEET – CBG 13

BUILD-OUT SUMMARY BY CURRENT LAND USE

CURRENT LAND USE	LAND USE CODE	NO. OF PARCELS	TOTAL AREA (ACRES)	AVERAGE PARCEL SIZE	NONRESIDENTIAL BUILDOUT FLOOR AREA (SQ. FT.)	RESIDENTIAL UNITS EXISTING DWELLING UNITS	RESIDENTIAL UNITS BUILDOUT DWELLING UNITS
Single Family	101	174	99.80	0.57	166,100	174	182
Condominium	102	3	17.33	5.78	0	42	42
Mobile Home	103	1	6.03	6.03	0	80	80
Two Family	104	25	15.51	0.62	37,800	50	53
Three Family	105	5	3.71	0.74	6,600	15	15
Accessory Land	106	4	1.34	0.34	6,000	0	3
Multiple Housing on One Parcel	109	13	6.87	0.53	4,700	26	26
Aparts-4-8 units	111	10	3.97	0.40	24,600	50	50
Developable Residential Land	130	33	14.92	0.45	0	0	32
Potentially Devel. Residential Land	131	4	1.11	0.28	0	0	4
Undevelopable Residential Land	132	13	5.49	0.42	0	0	0
Total Residential Properties		285	176.08	0.62	245,800	437	487
Commercial Land Uses							
Motels	301	1	3.19	3.19	41,600	0	0
Inns, Resorts	302	7	12.64	1.81	53,300	0	9
Tanks holding fuel	310	1	1.04	1.04	13,500	0	0
Lumber Yard	313	2	2.60	1.30	33,900	0	0
Storage, Warehouses	316	1	0.60	0.60	9,000	0	0
Small Retail & Service (<10,000 sq ft)	325	5	2.26	0.45	0	0	3
Eating & Drinking Estab.	326	7	4.03	0.58	10,900	0	4
Gasoline Service Stations	334	2	0.77	0.39	6,200	0	1
General Office Bldg	340	2	0.87	0.44	5,900	0	1
Bank	341	1	0.21	0.21	2,700	0	0
Art Galleries	361	2	1.05	0.53	13,700	0	0
Developable Commercial Land	390	2	0.59	0.30	7,600	0	0
Potentially Developable Commercial Land	391	2	3.03	1.52	24,200	0	0
Undevelopable Commercial Land	392	2	0.30	0.15	0	0	0
Total Commercial Property		37	33.18	0.90	222,500	0	18
Public Service Land Uses							
Municipalities	903	18	33.99	1.89	0	0	0
Charitable Organizations	905	2	0.55	0.28	0	0	0
Churches, Synagogues and Temples	906	2	0.92	0.46	0	0	0
Total Public Properties		22	35.46	1.61	0	0	0
Open Land Land Uses							
Open Land in Residential Area	201	2	6.82	3.41	0	0	2
Open Wetlands in Residential Area	202	2	3.39	1.70	0	0	0
Total Open Land Properties		4	10.21	2.55	0	0	2
Multiple-Use Property							
Primarily Residential w/ Commer.	013	12	9.23	0.77	53,500	12	12
Primarily Commercial w/ Resident.	031	10	9.91	0.99	30,000	10	10
Total Multiple-Use Properties		22	19.14	0.87	83,500	22	22
Totals for Land Use Classes		370	274.07	0.74	551,800	459	529
Unclassified		2	0.54		0	0	0
Totals for Planning Area		372	274.61	0.74	551,800	459	529

WELLFLEET – CBG 14

BUILD-OUT SUMMARY BY CURRENT LAND USE

CURRENT LAND USE	LAND USE CODE	NO. OF PARCELS	TOTAL AREA (ACRES)	AVERAGE PARCEL SIZE	NONRESIDENTIAL BUILDOUT FLOOR AREA (SQ. FT.)	RESIDENTIAL UNITS EXISTING DWELLING UNITS	RESIDENTIAL UNITS BUILDOUT DWELLING UNITS
Single Family	101	758	602.96	0.80	130,100	759	925
Condominium	102	6	14.65	2.44	0	51	51
Mobile Home	103	5	2.30	0.46	0	5	5
Two Family	104	14	20.60	1.47	0	28	29
Three Family	105	2	4.88	2.44	0	6	6
Accessory Land	106	4	5.21	1.30	0	0	7
Multiple Housing on One Parcel	109	56	88.20	1.58	6,900	112	136
Aparts-4-8 units	111	3	10.10	3.37	0	15	20
Developable Residential Land	130	312	322.26	1.03	0	0	371
Potentially Devel. Residential Land	131	36	117.95	3.28	0	0	127
Undevelopable Residential Land	132	30	33.40	1.11	0	0	0
Total Residential Properties		1,226	1,222.51	1.00	137,000	976	1,677
Commercial Land Uses							
Motels	301	1	2.34	2.34	0	0	2
Inns, Resorts	302	4	8.60	2.15	0	0	8
Commercial Greenhouses	318	1	1.15	1.15	0	0	1
Supermarkets (>10,000 sq ft)	324	2	6.39	3.20	0	0	7
Small Retail & Service (<10,000 sq ft)	325	2	1.38	0.69	20,800	0	0
Gasoline Service Stations	334	1	1.02	1.02	15,400	0	0
General Office Bldg	340	1	0.96	0.96	14,500	0	0
Medical Office Bldg	342	1	0.80	0.80	0	0	1
Art Galleries	361	1	0.73	0.73	0	0	1
Tennis Clubs	375	1	2.18	2.18	0	0	2
Marinas	384	1	0.48	0.48	0	0	1
Camping Facilities	386	1	8.84	8.84	0	0	10
Developable Commercial Land	390	5	3.60	0.72	37,900	0	2
Undevelopable Commercial Land	392	3	0.39	0.13	0	0	0
Total Commercial Property		25	38.86	1.55	88,600	0	35
Public Service Land Uses							
Commonwealth of Mass	901	1	0.23	0.23	0	0	0
Municipalities	903	36	32.97	0.92	0	0	0
Charitable Organizations	905	10	24.14	2.41	0	0	0
Churches, Synagogues and Temples	906	1	2.01	2.01	0	0	0
Total Public Properties		48	59.35	1.24	0	0	0
Open Land Land Uses							
Open Land in Residential Area	201	1	0.16	0.16	0	0	1
Open Wetlands in Residential Area	202	6	80.56	13.43	0	0	0
Total Open Land Properties		7	80.72	11.53	0	0	1
Multiple-Use Property							
Primarily Residential w/ Commer.	013	4	4.75	1.19	0	4	5
Primarily Commercial w/ Resident.	031	2	1.95	0.98	22,700	2	2
Total Multiple-Use Properties		6	6.70	1.12	22,700	6	7
Totals for Land Use Classes		1,312	1,408.13	1.07	248,300	982	1,720
Totals for Planning Area		1,312	1,408.13	1.07	248,300	982	1,720

WELLFLEET – CBG 15

BUILD-OUT SUMMARY BY CURRENT LAND USE

CURRENT LAND USE	LAND USE CODE	NO. OF PARCELS	TOTAL AREA (ACRES)	AVERAGE PARCEL SIZE	NONRESIDENTIAL BUILDOUT FLOOR AREA (SQ. FT.)	RESIDENTIAL UNITS EXISTING DWELLING UNITS	RESIDENTIAL UNITS BUILDOUT DWELLING UNITS
Single Family	101	427	321.91	0.75	0	427	479
Condominium	102	2	2.76	1.38	0	14	14
Mobile Home	103	2	16.98	8.49	0	146	146
Two Family	104	6	5.58	0.93	0	12	14
Three Family	105	1	8.07	8.07	0	3	3
Accessory Land	106	2	0.59	0.30	0	0	1
Multiple Housing on One Parcel	109	15	79.56	5.30	0	32	78
Developable Residential Land	130	344	265.56	0.77	0	0	375
Potentially Devel. Residential Land	131	35	36.45	1.04	0	0	49
Undevelopable Residential Land	132	46	173.87	3.78	0	0	0
Total Residential Properties		880	911.33	1.04	0	634	1,159
Commercial Land Uses							
Motels	301	5	22.25	4.45	0	0	20
Inns, Resorts	302	3	24.48	8.16	0	0	22
Small Retail & Service (<10,000 sq ft)	325	1	0.70	0.70	0	0	1
Eating & Drinking Estab.	326	5	4.85	0.97	0	0	5
Gasoline Service Stations	334	1	0.80	0.80	0	0	1
General Office Bldg	340	1	0.50	0.50	0	0	1
Motion Picture Theatres	362	1	24.55	24.55	371,900	0	0
Camping Facilities	386	1	1.38	1.38	0	0	1
Developable Commercial Land	390	4	6.15	1.54	79,100	0	1
Undevelopable Commercial Land	392	3	3.24	1.08	0	0	0
Total Commercial Property		25	88.90	3.56	451,000	0	52
Public Service Land Uses							
Municipalities	903	42	24.63	0.59	0	0	0
Charitable Organizations	905	23	688.02	29.91	0	0	0
Churches, Synagogues and Temples	906	1	2.00	2.00	0	0	0
Total Public Properties		66	714.65	10.83	0	0	0
Open Land Land Uses							
Open Land in Residential Area	201	7	13.85	1.98	0	0	9
Open Wetlands in Residential Area	202	17	27.50	1.62	0	0	0
Total Open Land Properties		24	41.35	1.72	0	0	9
Multiple-Use Property							
Primarily Residential w/ Commer.	013	1	5.52	5.52	0	1	4
Primarily Commercial w/ Resident.	031	4	5.35	1.34	0	4	5
Total Multiple-Use Properties		5	10.87	2.17	0	5	9
Totals for Land Use Classes		1,000	1,767.10	1.77	451,000	639	1,229
Totals for Planning Area		1,000	1,767.10	1.77	451,000	639	1,229

WELLFLEET BUILD-OUT ANALYSIS

BUILD-OUT SUMMARY BY CURRENT LAND USE

CURRENT LAND USE	LAND USE CODE	NO. OF PARCELS	TOTAL AREA (ACRES)	AVERAGE PARCEL SIZE	NONRESIDENTIAL BUILDOUT FLOOR AREA (SQ. FT.)	RESIDENTIAL UNITS EXISTING DWELLING UNITS	RESIDENTIAL UNITS BUILDOUT DWELLING UNITS
Single Family	101	2,077	1,683.17	0.81	510,700	2,078	2,415
Condominium	102	15	39.47	2.63	0	146	146
Mobile Home	103	13	28.58	2.20	0	236	237
Two Family	104	66	122.08	1.85	46,900	132	170
Three Family	105	13	21.36	1.64	14,200	39	39
Accessory Land	106	17	13.19	0.78	6,000	0	18
Multiple Housing on One Parcel	109	119	220.84	1.86	45,500	240	318
Aparts-4-8 units	111	24	21.33	0.89	28,100	120	125
Developable Residential Land	130	1,183	1,071.42	0.91	0	0	1,367
Potentially Devel. Residential Land	131	102	237.25	2.33	0	0	266
Undevelopable Residential Land	132	144	282.27	1.96	0	0	0
Total Residential Properties		3,773	3,740.96	0.99	651,400	2,991	5,101
Commercial Land Uses							
Motels	301	7	27.78	3.97	41,600	0	22
Inns, Resorts	302	17	52.49	3.09	53,300	0	46
Tanks holding fuel	310	1	1.04	1.04	13,500	0	0
Lumber Yard	313	2	2.60	1.30	33,900	0	0
Piers, Wharves, Docks	315	1	1.02	1.02	0	0	1
Storage, Warehouses	316	1	0.60	0.60	9,000	0	0
Commercial Greenhouses	318	1	1.15	1.15	0	0	1
Supermarkets (>10,000 sq ft)	324	2	6.39	3.20	0	0	7
Small Retail & Service (<10,000 sq ft)	325	15	8.32	0.55	58,400	0	5
Eating & Drinking Estab.	326	17	22.94	1.35	69,300	0	10
Auto Sales & Services	330	1	1.27	1.27	19,200	0	0
Auto Repair	332	1	0.52	0.52	0	0	1
Gasoline Service Stations	334	4	2.59	0.65	21,600	0	2
General Office Bldg	340	8	4.73	0.59	31,700	0	4
Bank	341	2	1.50	0.75	2,700	0	1
Medical Office Bldg	342	1	0.80	0.80	0	0	1
Postal Service	350	1	0.25	0.25	3,200	0	0
Art Galleries	361	3	1.78	0.59	13,700	0	1
Motion Picture Theatres	362	1	24.55	24.55	371,900	0	0
Tennis Clubs	375	1	2.18	2.18	0	0	2
Golf Courses	380	1	105.39	105.39	0	0	92
Marinas	384	1	0.48	0.48	0	0	1
Camping Facilities	386	2	10.22	5.11	0	0	11
Developable Commercial Land	390	14	17.18	1.23	204,200	0	4
Potentially Developable Commercial Land	391	4	14.48	3.62	24,200	0	13
Undevelopable Commercial Land	392	8	3.93	0.49	0	0	0
Total Commercial Property		117	316.18	2.70	971,400	0	225

WELLFLEET BUILD-OUT ANALYSIS

BUILD-OUT SUMMARY BY CURRENT LAND USE

CURRENT LAND USE	LAND USE CODE	NO. OF PARCELS	TOTAL AREA (ACRES)	AVERAGE PARCEL SIZE	NONRESIDENTIAL BUILDOUT FLOOR AREA (SQ. FT.)	RESIDENTIAL UNITS EXISTING DWELLING UNITS	RESIDENTIAL UNITS BUILDOUT DWELLING UNITS
Public Service Land Uses							
Commonwealth of Mass	901	1	0.23	0.23	0	0	0
Municipalities	903	123	226.27	1.84	0	0	0
Charitable Organizations	905	41	728.32	17.76	0	0	0
Churches, Synagogues and Temples	906	10	9.64	0.96	0	0	0
Total Public Properties		175	964.46	5.51	0	0	0
Open Land Land Uses							
Open Land in Residential Area	201	13	41.11	3.16	0	0	12
Open Wetlands in Residential Area	202	28	115.46	4.12	0	0	0
Total Open Land Properties		41	156.57	3.82	0	0	12
Multiple-Use Property							
Primarily Residential w/ Commer.	013	33	36.30	1.10	94,600	33	40
Primarily Commercial w/ Resident.	031	24	20.89	0.87	71,900	24	25
Total Multiple-Use Properties		57	57.19	1.00	166,500	57	65
Totals for Land Use Classes		4,163	5,235.35	1.26	1,789,300	3,048	5,403
Unclassified		5	2.30		0	0	2
Totals for Planning Area		4,168	5,237.65	1.26	1,789,300	3,048	5,405

CBG 16

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	1	0.10	1	0	0	0	0
>0.25	<=0.5	113	54.10	113	36	77	80	16
>0.5	<=0.75	46	28.60	46	15	31	32	6
>0.75	<=1	4	3.60	4	1	3	3	1
>1	<=2	3	4.50	5	1	3	3	1
>2	<=3	0	0.00	0	0	0	0	0
>3	<=4	1	3.90	4	1	2	2	0
>4	<=5	2	9.10	8	3	6	6	1
>5	<=6	0	0.00	0	0	0	0	0
>6	<=7	1	6.70	6	2	4	4	1
>7	<=8	0	0.00	0	0	0	0	0
>8	<=9	0	0.00	0	0	0	0	0
>9	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0
Total		176	110.60	186	59	126	131	26

Large Single-Family Lots

>5	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		8	18.30	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		6	8.40	0	0	0	0	0

Total – CBG 16

		190	137.30	186	59	126	131	26

CBG 17

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	1	0.10	1	0	0	0	0
>0.25	<=0.5	74	34.50	74	24	50	52	10
>0.5	<=0.75	55	34.90	55	18	37	39	8
>0.75	<=1	16	13.40	16	5	11	11	2
>1	<=2	1	1.10	1	0	1	1	0
>2	<=3	2	5.30	5	2	4	4	1
>3	<=4	0	0.00	0	0	0	0	0
>4	<=5	0	0.00	0	0	0	0	0
>5	<=6	0	0.00	0	0	0	0	0
>6	<=7	0	0.00	0	0	0	0	0
>7	<=8	0	0.00	0	0	0	0	0
>8	<=9	0	0.00	0	0	0	0	0
>9	<=10	0	0.00	0	0	0	0	0
>10		2	77.10	69	22	47	49	10
Total		152	166.40	221	71	150	156	31

Large Single-Family Lots

>5	<=10	1	5.70	2	1	1	1	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		0	0.00	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		1	11.60	0	0	0	0	0
Multiple Use		3	1.20	0	0	0	0	0

Total – CBG 17

		157	184.90	223	71	152	157	31

CBG 18

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	4	0.7	2	1	1	1	0
>0.25	<=0.5	74	34.4	74	24	50	52	10
>0.5	<=0.75	17	10.7	17	5	12	12	2
>0.75	<=1	2	1.8	2	1	1	1	0
>1	<=2	0	0	0	0	0	0	0
>2	<=3	0	0	0	0	0	0	0
>3	<=4	0	0	0	0	0	0	0
>4	<=5	0	0	0	0	0	0	0
>5	<=6	0	0	0	0	0	0	0
>6	<=7	0	0	0	0	0	0	0
>7	<=8	0	0	0	0	0	0	0
>8	<=9	0	0	0	0	0	0	0
>9	<=10	0	0	0	0	0	0	0
>10		0	0	0	0	0	0	0
Total		98	47.6	95	30	65	67	13

Large Single-Family Lots

>5	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		0	0.00	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		0	0.00	0	0	0	0	0

Total – CBG 18

		98	47.60	95	30	65	67	13

CBG 19

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	6	1.2	3	1	2	2	0
>0.25	<=0.5	108	51.4	108	35	73	76	15
>0.5	<=0.75	32	20.4	32	10	22	23	5
>0.75	<=1	16	14.3	16	5	11	11	2
>1	<=2	1	1.3	1	0	1	1	0
>2	<=3	1	2.4	2	1	2	2	0
>3	<=4	2	7	6	2	4	4	1
>4	<=5	0	0	0	0	0	0	0
>5	<=6	0	0	0	0	0	0	0
>6	<=7	0	0	0	0	0	0	0
>7	<=8	0	0	0	0	0	0	0
>8	<=9	0	0	0	0	0	0	0
>9	<=10	0	0	0	0	0	0	0
>10		0	0	0	0	0	0	0
Total		169	98	169	54	115	119	24

Large Single-Family Lots

>5	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		1	1.00	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		2	1.00	0	0	0	0	0

Total – CBG 19

		172	100.00	169	54	115	119	24

CBG 20

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	1	0.2	1	0	0	0	0
>0.25	<=0.5	91	42.2	91	29	62	64	13
>0.5	<=0.75	39	24.6	39	12	27	27	5
>0.75	<=1	11	9.7	11	4	7	8	2
>1	<=2	4	4.9	5	2	3	3	1
>2	<=3	0	0	0	0	0	0	0
>3	<=4	0	0	0	0	0	0	0
>4	<=5	0	0	0	0	0	0	0
>5	<=6	0	0	0	0	0	0	0
>6	<=7	0	0	0	0	0	0	0
>7	<=8	1	7.9	7	2	5	5	1
>8	<=9	0	0	0	0	0	0	0
>9	<=10	0	0	0	0	0	0	0
>10		0	0	0	0	0	0	0
Total		148	89.5	154	49	104	108	22

U

Large Single-Family Lots

SPLIT

>5	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		0	0.00	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		1	0.50	0	0	0	0	0

Total – CBG 20

		149	90.00	154	49	104	108	22

CBG 21

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	5	0.5	3	1	2	2	0
>0.25	<=0.5	58	27.2	58	19	39	41	8
>0.5	<=0.75	49	31.5	49	16	33	34	7
>0.75	<=1	35	29.9	35	11	24	25	5
>1	<=2	9	11.9	12	4	8	8	2
>2	<=3	1	2.1	2	1	1	1	0
>3	<=4	0	0	0	0	0	0	0
>4	<=5	1	4.7	4	1	3	3	1
>5	<=6	0	0	0	0	0	0	0
>6	<=7	1	6.9	6	2	4	4	1
>7	<=8	1	7.5	7	2	5	5	1
>8	<=9	1	9	8	3	6	6	1
>9	<=10	0	0	0	0	0	0	0
>10		0	0	0	0	0	0	0
Total		167	131.2	184	59	125	129	26

Large Single-Family Lots

>5	<=10	3	19.60	6	2	4	4	1
>10		2	37.60	34	11	23	24	5

Other Large Residential Parcels

>10	0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial	0	0.00	0	0	0	0	0
Industrial	0	0.00	0	0	0	0	0
Agricultural	0	0.00	0	0	0	0	0
Multiple Use	3	2.00	0	0	0	0	0

Total – CBG 21

	175	190.40	224	72	152	157	31

CBG 22

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	1	0.1	1	0	0	0	0
>0.25	<=0.5	122	57.6	122	39	83	86	17
>0.5	<=0.75	71	45.2	71	23	48	50	10
>0.75	<=1	41	36	41	13	28	29	6
>1	<=2	37	53	53	17	36	37	7
>2	<=3	6	15.8	16	5	11	11	2
>3	<=4	1	3.2	3	1	2	2	0
>4	<=5	2	9	8	3	6	6	1
>5	<=6	4	22.8	21	7	14	14	3
>6	<=7	2	13	12	4	8	8	2
>7	<=8	1	8	7	2	5	5	1
>8	<=9	1	8.1	7	2	5	5	1
>9	<=10	0	0	0	0	0	0	0
>10		1	11.1	10	3	7	7	1
Total		295	282.9	371	119	252	261	52

Large Single-Family Lots

>5	<=10	3	20.80	6	2	4	4	1
>10		4	90.00	81	26	55	57	11

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial		3	0.80	0	0	0	0	0
Industrial		0	0.00	0	0	0	0	0
Agricultural		0	0.00	0	0	0	0	0
Multiple Use		2	0.50	0	0	0	0	0

Total – CBG 22

		307	395.00	458	147	311	322	64

CBG 23

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	3	0.5	2	0	1	1	0
>0.25	<=0.5	124	57.5	124	40	84	87	17
>0.5	<=0.75	74	46.6	74	24	50	52	10
>0.75	<=1	21	18.1	21	7	14	15	3
>1	<=2	8	9.8	10	3	7	7	1
>2	<=3	0	0	0	0	0	0	0
>3	<=4	0	0	0	0	0	0	0
>4	<=5	1	4.5	4	1	3	3	1
>5	<=6	2	11.8	11	3	7	7	1
>6	<=7	1	6.5	6	2	4	4	1
>7	<=8	0	0	0	0	0	0	0
>8	<=9	0	0	0	0	0	0	0
>9	<=10	0	0	0	0	0	0	0
>10		0	0	0	0	0	0	0
Total		240	155.3	251	80	171	177	35

Large Single-Family Lots

>5	<=10	5	29.50	10	3	7	7	1
>10		1	12.90	12	4	8	8	2

Other Large Residential Parcels

>10	0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial	0	0.00	0	0	0	0	0
Industrial	0	0.00	0	0	0	0	0
Agricultural	0	0.00	0	0	0	0	0
Multiple Use	0	0.00	0	0	0	0	0

Total – CBG 23

	246	197.70	272	87	185	192	38

NO CBG

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	0	0.00	0	0	0	0	0
>0.25	<=0.5	0	0.00	0	0	0	0	0
>0.5	<=0.75	0	0.00	0	0	0	0	0
>0.75	<=1	0	0.00	0	0	0	0	0
>1	<=2	0	0.00	0	0	0	0	0
>2	<=3	0	0.00	0	0	0	0	0
>3	<=4	0	0.00	0	0	0	0	0
>4	<=5	0	0.00	0	0	0	0	0
>5	<=6	0	0.00	0	0	0	0	0
>6	<=7	0	0.00	0	0	0	0	0
>7	<=8	0	0.00	0	0	0	0	0
>8	<=9	0	0.00	0	0	0	0	0
>9	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0
Total		0	0.00	0	0	0	0	0

Large Single-Family Lots

>5	<=10	0	0.00	0	0	0	0	0
>10		0	0.00	0	0	0	0	0

Other Large Residential Parcels

>10	0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial	0	0.00	0	0	0	0	0
Industrial	0	0.00	0	0	0	0	0
Agricultural	0	0.00	0	0	0	0	0
Multiple Use	0	0.00	0	0	0	0	0

Total – NO CBG

	0	0.00	0	0	0	0	0

TOTAL

Vacant Developable and Potentially Developable Land

Parcel Size		No. of Parcels	Acreage	Buildable Lots	Add'd YR Units	Add'd Sum Units	Added YR Pop	Add'd Child'n
>0	<=0.25	22	3	11	4	7	8	2
>0.25	<=0.5	691	325	691	221	470	486	97
>0.5	<=0.75	402	242	402	129	273	283	57
>0.75	<=1	185	148	185	59	126	130	26
>1	<=2	78	99	99	32	67	70	14
>2	<=3	9	21	21	7	15	15	3
>3	<=4	6	19	17	6	12	12	2
>4	<=5	6	27	25	8	17	17	3
>5	<=6	6	35	31	10	21	22	4
>6	<=7	5	33	30	10	20	21	4
>7	<=8	3	23	21	7	14	15	3
>8	<=9	2	17	15	5	10	11	2
>9	<=10	0	0	0	0	0	0	0
>10		1	11	10	3	7	7	1
Total		1,295	992	1,559	499	1,060	1,097	219

Large Single-Family Lots

>5	<=10	12	75.60	24	8	16	17	3
>10		7	140.50	126	40	86	89	18

Other Large Residential Parcels

>10		0	0.00	0	0	0	0	0

Other Potentially Developable Land

Commercial	12	20	0	0	0	0	0
Industrial	0	0	0	0	0	0	0
Agricultural	1	12	0	0	0	0	0
Multiple Use	17	14	0	0	0	0	0

Total – Town

	1,344	1,253.60	1,709	547	1,162	1,203	241

Outer Cape Capacity Study

Transportation Analysis

Prepared for the Outer Cape Capacity Study Steering Committee

Prepared by

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Cape Cod Commission Geographic Information Systems Staff:
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Benjamin Smith

EXECUTIVE SUMMARY

From "Defining the Project - A Project Startup Memo" the following are a list of traffic questions addressed in this study.

Question	Response
1. Where are the problem areas along Route 6 today in terms of volumes and capacity?	Approximately 15 of the 27 miles from Provincetown to Eastham are considered to be "congested" in the summer. 5.5 miles have "exceeded" capacity. In the winter none of the road is considered congested.
2. How will we define "exceeded capacity" along Route 6 for the future?	The traffic model used in this study includes capacities (in vehicles per hour) for each roadway segment. Capacities were identified based on the roadways' functional classifications and geometric characteristics. When the ratio of traffic volume to capacity reaches 80% this is considered "congested;" at 100% and above the road's theoretical capacity is exceeded and extremely congested.

3. What general problems will Route 6 encounter as growth continues?	Route 6 and other roads included in the study will experience sharp rises in the mileage of automobile travel as well as the amount of time motorists spend on the roads. A 46% increase of housing results in a 66% increase in travel mileage and a 196% increase in traveling time.
4. What general types of road improvements are necessary to provide sufficient capacity for our current land use patterns in the future?	To accommodate projected levels of traffic, a comprehensive improvement program of additional lanes on Route 6 with access management, including signalization of major intersections and medians to restrict turns at other intersections, would be needed. Upgrades and signalization of intersections of local roads which serve as bypasses of Route 6 would also be necessary.
5. How will future traffic affect air quality?	Emissions of volatile organic compounds and oxides of nitrogen increase with increased travel, risking a violation of the Clean Air Act Amendments of 1990.
6. Are there general growth strategies that would minimize the necessity of improving Route 6?	A land use pattern based on a lower overall intensity of use, concentrated rather than dispersed, and focused to village centers rather than the regional highway, would decrease pressures on Route 6.

7. What will be the general costs for expanding Route 6 to accommodate demands?	Adding one lane for one mile would cost about $2 million. However, detailed costs require detailed analysis. Estimate of expansion costs must consider: design; right-of-way appraisal and acquisition; construction; construction management; and environmental cleanup, permits, and mitigation.
8. What types of investigations should be pursued to understand how traffic can be managed if Route 6 is not expanded?	Regardless of eventual expansion, the development of local transit service, regional transit service, land use planning, and access management should be examined.
9. What demand management tools are available?	Provision of seasonal and year round transit services would provide some relief, but would not be cheap. Also to be considered are completions of the region's bike paths and new connection to these paths.

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Introduction

Traffic problems have often been compared to trouble with our plumbing. Merge areas are referred to as "bottlenecks" and the number of cars passing a point is called "flow." Traditional traffic engineering solutions result in bigger and more "pipes" - easing flow and removing bottlenecks. Just as the technology of modern plumbing has made the U.S. the leader in per capita water consumption in the known universe, the infrastructure of roads has resulted in a similar accomplishment in the average American's mileage of automobile travel.

There are many advantages of traveling by automobile. However, there are also many disadvantages to its use. This study looks at the *causes* and *limitations* of automobile travel within the four towns of Cape Cod known as the Outer Cape. To borrow from the Cape's Long Range Transportation Plan, a goal of this study is:

> *To support transportation solutions which preserve and enhance Cape Cod's character by considering the interrelationship between changes in transportation capacity and changes in land use.*

It is often said that "if you build it, they will come." In dealing with traffic, one can imagine the following scenario: a remote, moderate-sized community served by a congested two lane highway is the beneficiary of a new multi-lane freeway. This new accessibility spurs new development resulting in a large-sized community with a congested *multi-lane* freeway. Roads built to relieve congestion became congested themselves.

A related concern is that fixing some traffic problems can worsen others. Adding lanes to a two lane road to reduce congestion (and doing nothing else) worsens congestion for drivers entering from side streets, leading to a need for more traffic signals, leading to a new type of delay for through travelers.

Background

The Outer Cape Capacity Study grew out of a need to coordinate the Local Comprehensive Plans of Provincetown, Truro, Wellfleet and Eastham. The objective of this effort is to evaluate the impacts of growth on a regional basis. The other resource components of the Outer Cape Capacity Study are water resources, fiscal capacity, and natural resources and open space.

The transportation component has had the benefit of coordination with and support of the U.S. Environmental Protection Agency. This cooperative effort is intended to integrate environmental concerns into the transportation planning process.

What is Traffic Capacity?

In the world of traffic engineering, *capacity* refers to the number of vehicles which can pass through an intersection or section of roadway over a certain period of time, usually an hour. This theoretical capacity is estimated based on lane and shoulder widths and characteristics of the traffic (e.g., percentage trucks, variations in flow, etc.). Estimation methods are based on "normal" traffic observed by traffic engineers throughout the country. Massachusetts drivers appear to exceed the norm in their ability to exceed this theoretical capacity, which is reflected in higher than average automobile insurance premiums.

A related concept is the traffic Level of Service (LOS), which is like a report card for roads. LOS A reflects uncongested, free flowing conditions. LOS F represents failure or gridlock. LOS is calculated based on different measures for different situations. For a signalized intersection, an average delay of a minute or more corresponds to LOS F. Calculating LOS at an unsignalized intersection is a little more complicated. For each maneuver (turning left, going straight, turning right) from each street entering the intersection there is a limited number of "gaps" per hour. When the demand exceeds the number of gaps available for *any* maneuver, LOS F has been reached. Sections of highway are treated similarly, with a "service flow" in vehicles per hour estimated for each letter of LOS from A - F and compared to the measured amount of traffic.

For this study two ranges of capacity are used. From eighty to one hundred percent a road segment is considered to be "congested." This approximates LOS D to LOS E. For demand exceeding a hundred percent, a road segment is considered to be "over capacity." This corresponds to LOS E, LOS F, or beyond. Currently, few roads other than Route 6 in the Outer Cape are considered congested and almost no roads are considered "over capacity." Congestion may be bad on some roads in the region today, but it can get a lot worse. For a good example of a roadway reaching its capacity, think of Boston's Central Artery at rush hour, which is at LOS F. Similarly, Route 6 approaching the Sagamore Bridge in Bourne on Sunday afternoons in the summer reaches LOS F.

It is important to note the difference between congestion on the roads and roads actually exceeding their capacity. Many roads in the Outer Cape today are congested; but, that congestion does not always result in significant delays. However, it will probably result in driver irritation, safety hazards, and a general feeling that the trip is taking longer than it should.

The Outer Cape

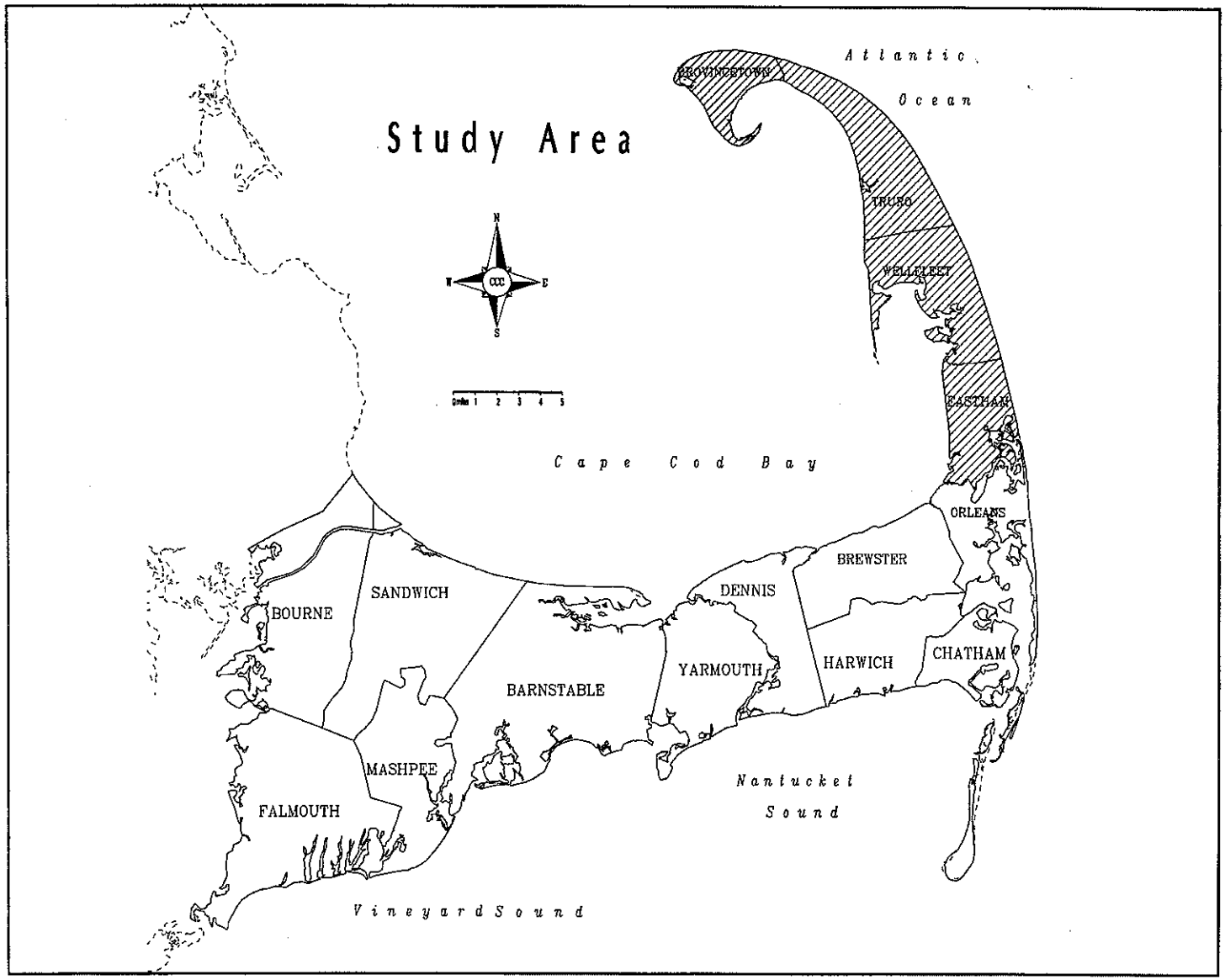
The study area includes the four town region as shown in Figure 1. The distance from Provincetown to the Eastham/Orleans border is about 27 miles. The

peninsula of the Outer Cape averages about two and a half miles in width. This special geography means that travelers in town after town are increasingly more likely to be regional versus local (e.g. drivers on Route 6 in Provincetown are assuredly traveling to, from, or within town - unlike in Eastham where there is a good chance that a driver is simply passing through). It also means that there are few opportunities for drivers to take alternate routes.

Table 1 shows a list of some of the geographical and demographic characteristics of the towns.

Table 1 - Outer Cape Towns' Characteristics

	1990 CENSUS	Low/Moderate Income Households (with income < $24,999)	Total Households
PROVINCETOWN	3,561	1,100	1,951
TRURO	1,573	295	666
WELLFLEET	2,493	605	1,163
EASTHAM	4,462	739	1,930


Study Area
Atlantic
Ocean
PROVINCETOWN
TRURO
WELLFLEET
EASTHAM
ORLEANS
BREWSTER
CHATHAM
HARWICH
DENNIS
YARMOUTH
BARNSTABLE
SANDWICH
BOURNE
MASHPEE
FALMOUTH
Cape Cod Bay
Nantucket
Sound
Vineyard Sound
N
W
E
S
0 Miles 1 2 3 4 5

The "Pressure Gauges" - Route 6 & More

Roads were included in the Outer Cape Capacity Study based on their function to connect areas within the four towns. Federally classified as a Principal Arterial, Route 6 is approximately 28 miles from northern Provincetown to the Eastham/ Orleans town line. Table 2 includes a list of roadways included in this study. Roads were included based on their function to connect areas within the four towns. Each of the roads in the system is a major part of the transportation infrastructure in the area, that is, they are roads that almost everyone taking a trip of more than a couple of miles will use at some point. These roads have high capacities in terms of how many cars they can hold, but they also are used more that the other roads in the region. When these roads start to become congested, it slows down everyone in the region, for two reasons. First, anyone using these roads is slowed by congestion. Second, congestion on these roads implies congestion on smaller roads that people use to access these roads and on alternate routes.

In short, these main roads serve as gauges for the health of the entire roadway system in the Outer Cape. As they become more crowded and approach capacity, the entire roadway system does as well. Just as a pressure gauge will warn you when a hydraulic system is in danger of exploding, so these roads will tell us how healthy the system as a whole is. They will usually become crowded before other roads, and thus can warn us of imminent congestion on smaller roads.

The physical characteristics of Route 6 vary across the Outer Cape. In Provincetown, a landscaped median separates two double lanes, with widely- spaced intersections limited to public roads. This continues to North Truro where the four lanes divided become a two lane highway. This two lane road widens to four lanes at the border of Wellfleet and Eastham. The frequency of curb cuts generally increases as one travels south to Orleans.

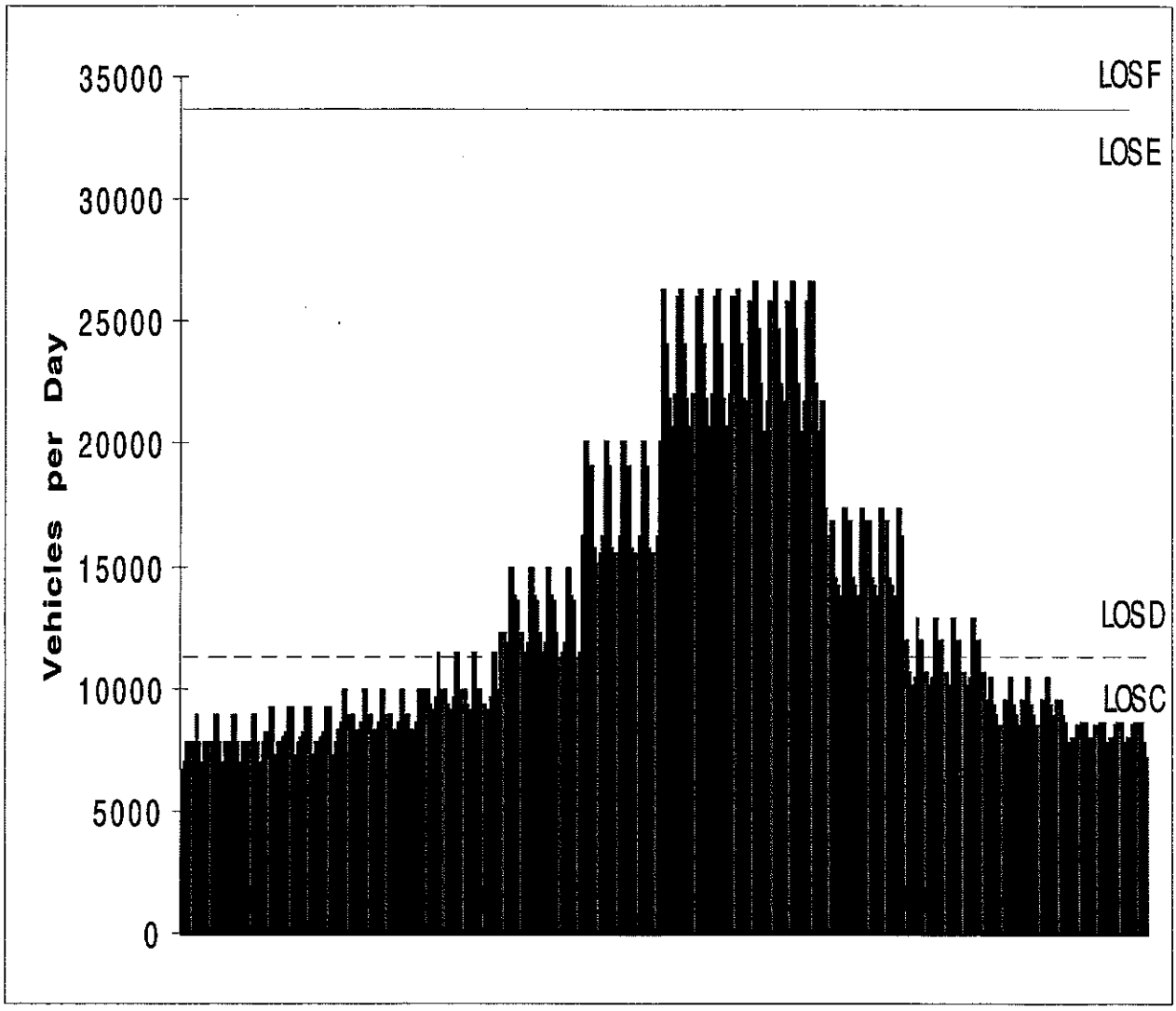
Table 2 - Study Area Roadways

Town	Road	From	To
Provincetown	Route 6	all	
	Route 6A	Rt 6	McMillian Wharf
	Route 6A	Truro T.L.	McMillian Wharf
	Province Land Rd	all	
	Race Point Rd	Rt 6	Province Land Rd
	Conwell St	Rt 6	Rt 6A
	Snail Rd	all	
Truro	Route 6	all	
	Route 6A	all	
	Castle Rd	all	

	Old County Rd	all	
	S. Highland Rd	all	
	Highland Rd	Rt 6	S. Highland Rd
Wellfleet	Route 6	all	
	Old County Rd	all	
	Pole Dyke Rd	all	
	Main St	Rt 6	Pole Dyke Rd
	Gross Hill Rd	all	
	Ocean View Rd	Gross Hill	LeCount Hollow Rd
	LeCount Hollow Rd	Rt 6	Ocean View Rd
	West Rd	all	
Eastham	Route 6	all	
	Massasoit Rd	Wellfleet t.l.	Herring Brook Rd
	Samoset Rd	Rt 6	Herring Brook Rd
	Herring Brook Rd	all	
	Bridge Rd	Orleans t.l.	Samoset Rd

All of these roads experience a variety of traffic conditions. Few people are concerned over the extremely light traffic occurring at three o'clock in the morning. However, the extremely high levels occurring during daylight in the summer have resulted in reports of "time-shifting" trips or "trip postponement." For the purpose of this study, an average congested peak hour is used - 11 am to 12 noon on summer Saturdays.

Figure 2 illustrates the seasonal changes in daily traffic volumes for all 365 days of the year.



Daily Traffic Volumes Estimated for 1995

Figure 2 - Estimated Daily Traffic Volumes - Truro/Wellfleet Town Line

Cars Don't Cause Traffic - People Cause Traffic

This section explains the basic premise of Travel Demand Forecasting and how it is applied in the Outer Cape Capacity Study. Techniques and assumptions used to build a computer model of current traffic are described; also discussed are steps taken in developing assumptions for the future scenarios.

Traffic Modeling

Travel Demand Forecasting, like much of traffic engineering, borrows from another discipline, in this case, Newtonian physics. The core of traffic modeling is a technique called the gravity model. Just as the mass of the apple is attracted to the mass called Earth due to the force of gravity, a similar interaction occurs between the mass of trip *producers* (i.e. houses) and trip *attractors* (i.e. jobs). In both cases the attraction is stronger when the distance is shortened. Since drivers are more concerned about travel time than distance, distance is given a mere 10% weight versus 90% for travel time in the computerized traffic model.

To prepare the traffic model for the Outer Cape Capacity Study, the four towns were broken up into traffic analysis zones (TAZs) identical to Census Block Groups. Using the federal road classification system, Route 6 and other important roads were included. The zones (Figure 3) and the roads (Figure 4) make up the computerized traffic network.

The road network shown in Figure 4 shows numbers by key intersections joined by a skeleton of important roads. Numbers shown on branches from this network are the TAZs. Each section of road has a corresponding capacity. The computer apportions traffic to the network, calculates travel time based on the percentage of capacity used, then continues to apportion traffic with the objective of minimizing people's travel time.

The total demand of traffic is based on the relative travel times between various land uses and the types of trips. Examples of trip types include: home to work, home to shopping or recreation, or errands from work. Traffic between the Outer Cape and the rest of Cape Cod is included. As one would expect, these "Internal to External" trips become more frequent as one moves closer to the boundary of the study area in southern Eastham.

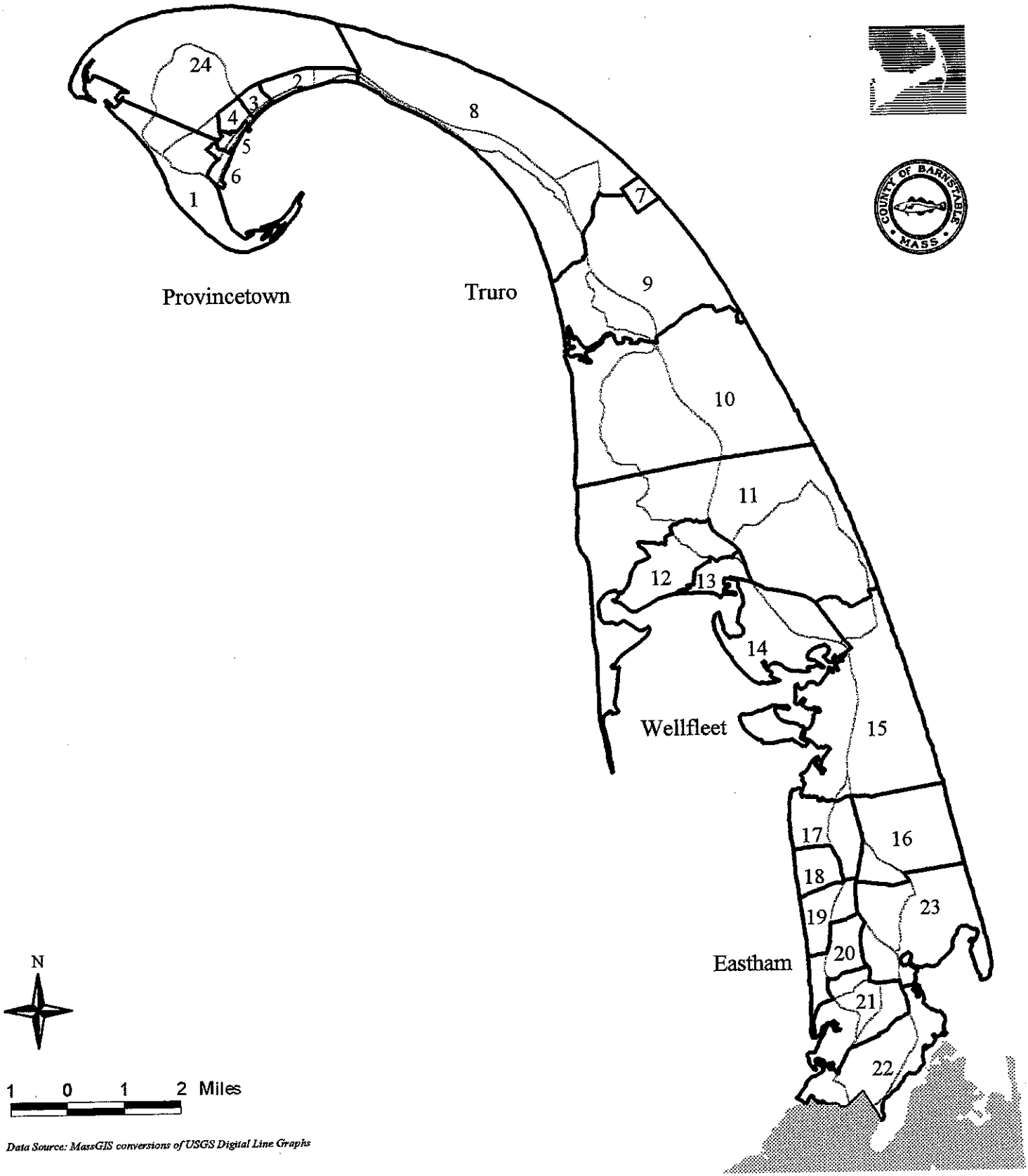


Figure 3 - Census Block Groups/Traffic Analysis Zones

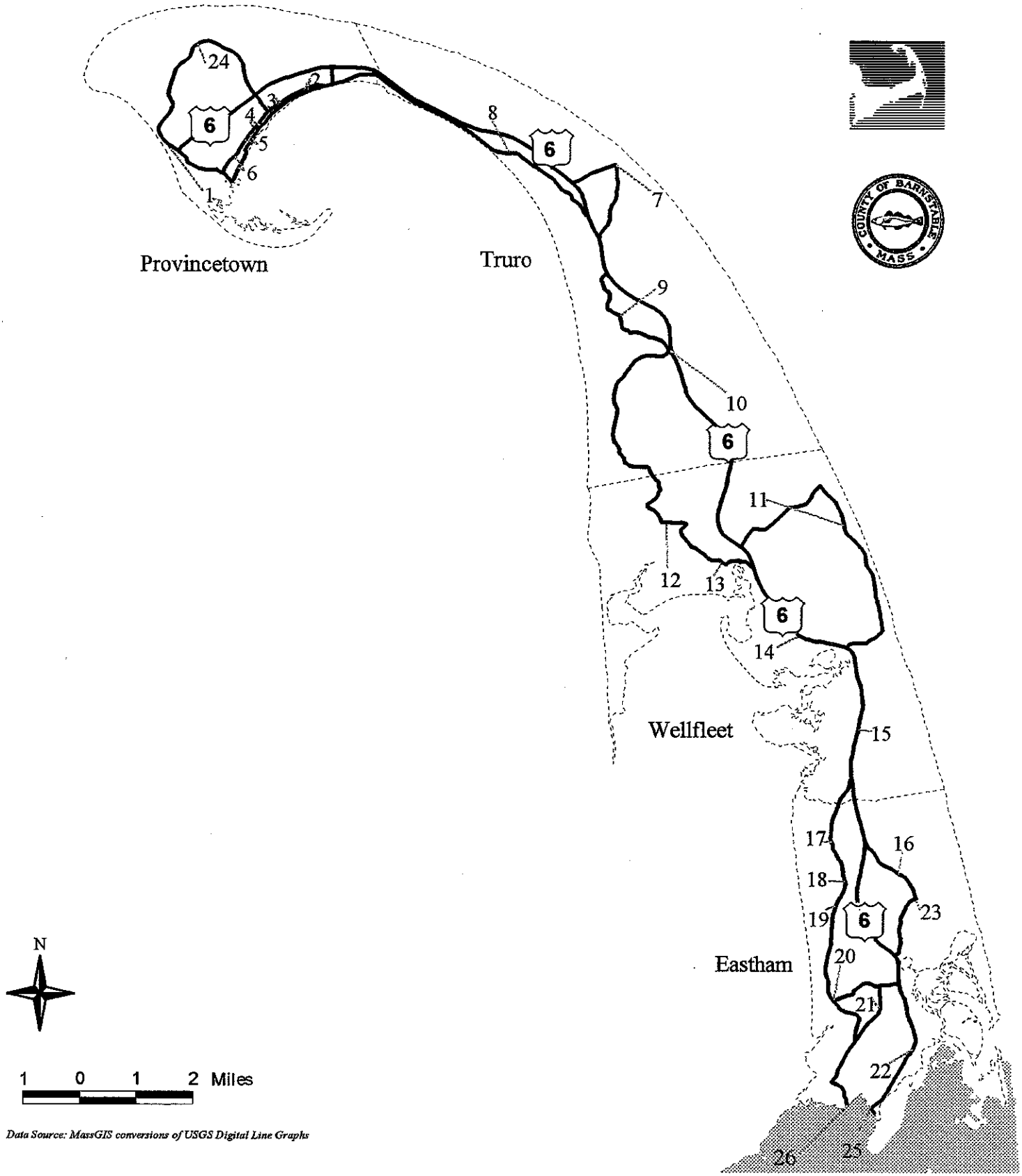


Figure 4 - Traffic Model Network

Existing Land Use

The model uses a standard set of land use categories to analyze traffic generation, including single family dwelling units, multi-family dwelling units, retail employees, and non-retail employees. Two additions were made for the Outer Cape Capacity Study. Because of the high variability of summer versus winter traffic and to attempt to account for the large influx of day trippers, the categories lodging units and parking spaces were added. Lodging units include motel rooms, rooms in bed & breakfasts, camping sites and cottages. Parking spaces are parking spaces at municipal and National Seashore parking lots.

One way to look at how these land uses influence travel patterns is through something called Trip Generation. This is the amount of traffic "caused" by each land use. In the case of houses, traffic is generated by trips to and from work, shopping, and by deliveries and service vehicles, etc. The trip generations of employment includes the employee's trips to and from work, errands, and customers and delivery vehicle trips, and so forth.

A listing of land uses, by traffic zone, is shown in Table 3.

Table 3 - Existing Land Use

Traffic Anaysis Zone	Single Family Dwelling Units	Multi-Family Dwelling Units	Retail Employees	Non-Retail Employees	Lodging Units	Parking Spaces
1	90	82	424	80	164	973
2	510	267	32	42	524	0
3	306	389	18	58	115	110
4	191	450	210	188	331	835
5	344	471	84	18	492	570
6	207	408	19	34	470	220
7	0	0	0	0	0	0
8	843	75	22	4	1,738	900
9	728	29	8	1	293	558
10	466	7	2	1	17	160
11	574	19	56	29	23	365
12	592	46	52	23	75	345
13	417	92	75	16	46	690
14	1,016	17	164	27	275	0
15	783	20	0	0	376	708
16	375	18	43	15	122	425
17	664	20	15	16	41	20
18	502	13	0	0	0	175
19	650	34	10	2	3	20
20	524	4	3	1	0	212
21	522	9	7	112	9	52
22	653	60	6	10	96	100
23	773	42	82	3	339	185
24	45	41	212	40	82	486

Future Land Use Scenarios

Using the build-out assumptions described above, the traffic analysis reviewed projected conditions for the following set of scenarios:

Existing Summer
Existing Winter
2020 Summer
2020 Winter
Build-Out Summer
Build-Out Winter
Build-Out Winter with a 50% shift from seasonal to year-round occupancy

Present conditions were compared against several future scenarios. These include two Build-Out scenarios in which land in the Outer Cape has been entirely developed to the extent permitted by current town zoning. One of these Build-Out scenarios assumes a different mix of seasonal residents. This allows a "worst case" winter scenario in which the rate of year-round occupancy doubles (as more summer homes are converted). A set intermediate scenarios, 2020 summer and winter are also presented.

Reaching (and Exceeding) Capacity

This section is intended to show how well the road system functions at present and how well (or unwell) it can be expected to work under the various scenarios. We look at how the system operates (congestion levels) as well as how it is used (mileage and time spent traveling).

Congestion & More

By looking at the road system in two ways - regional and local - the traffic model shows the severity of summer traffic. Route 6 summer conditions are shown in Figure 5, winter conditions in Figure 6. Local roads' summer conditions are shown in Figure 7, winter conditions in Figure 8. The model results show that under existing summer conditions, 56% of Route 6's mileage is rated "congested" and 21% is considered to be over capacity; of the local roads modeled, 4% fall into the congested category and none exceed the theoretical capacity. For both Route 6 and local roads, all of these percentages are zero for the winter condition.

An interesting phenomenon occurs in Figure 5 where the "congested" portion of Route 6 under the 2020 scenario does not increase in the Build-Out scenarios. The effects of "bottle-necking" result in higher volume/capacity ratios (average summer Route 6 volume/capacity under 2020 scenario is 136%, under Build-Out scenarios it is 145%). Even though the congested mileage does not increase, the severity within the "over capacity" mileage does - resulting in overall worse conditions when comparing these two scenarios.

Figures 9 through 15 show the level of congestion on the roadway system under the various scenarios. The volume/capacity ratio for three ranges (0-80, 80-100, 100+) are shown in percentages by their respective line thicknesses (thin is uncongested, medium is congested, thick is over capacity).

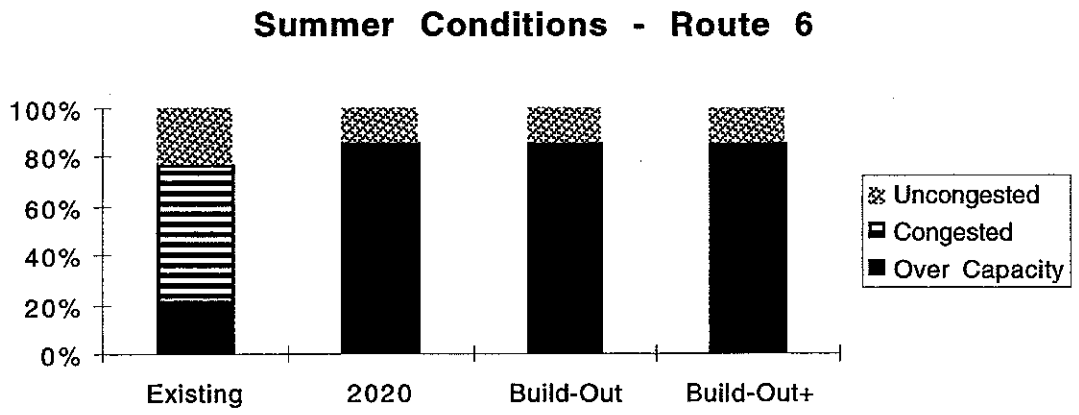


Figure 5 - Summer Conditions: Route 6

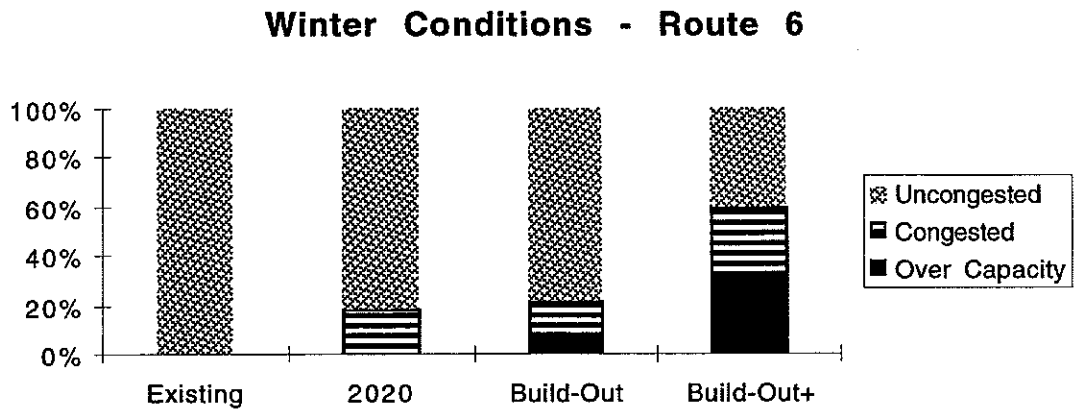


Figure 6 - Winter Conditions: Route 6

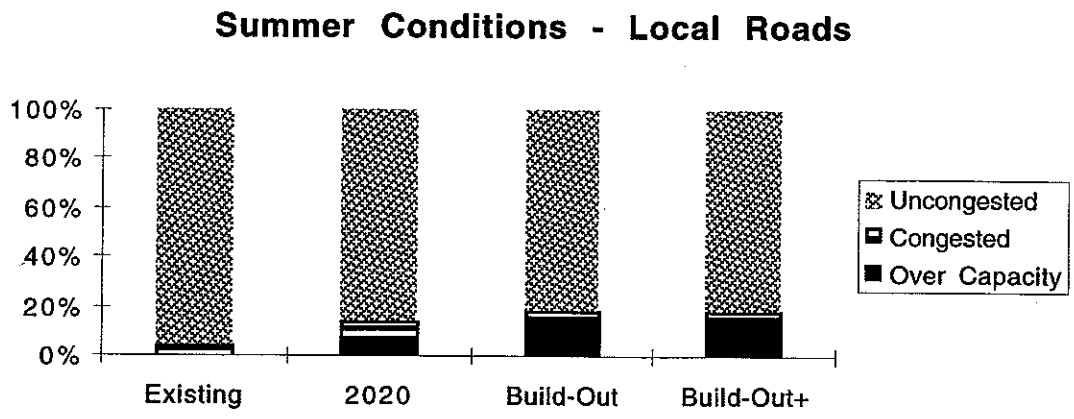


Figure 7 - Summer Conditions: Local Roads

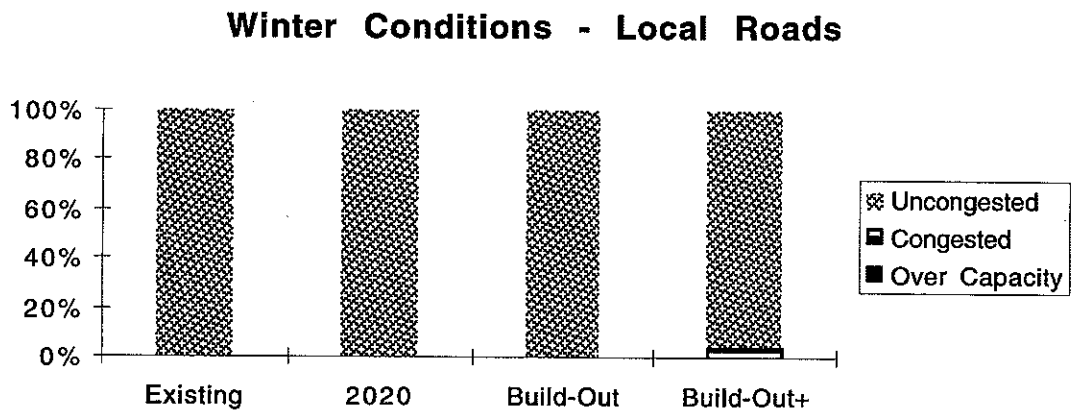
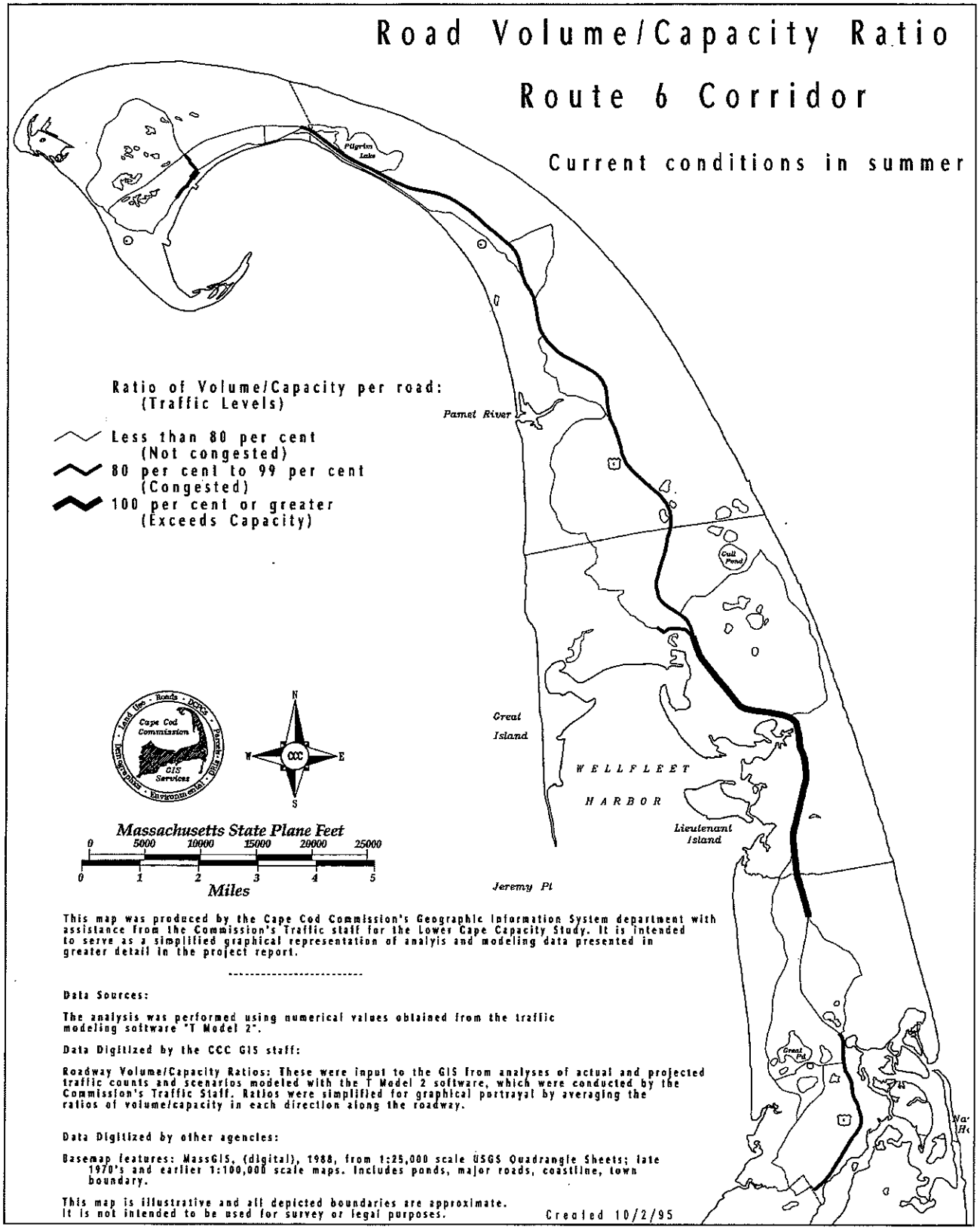


Figure 8 - Winter Conditions: Local Roads

Road Volume/Capacity Ratio

Route 6 Corridor

Current conditions in summer



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Data Sources:

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Data Digitized by the CCC GIS staff:

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Data Digitized by other agencies:

Basemap features: MassGIS, (digital), 1988, from 1:25,000 scale USGS Quadrangle Sheets; late 1970's and earlier 1:100,000 scale maps. Includes ponds, major roads, coastline, town boundary.

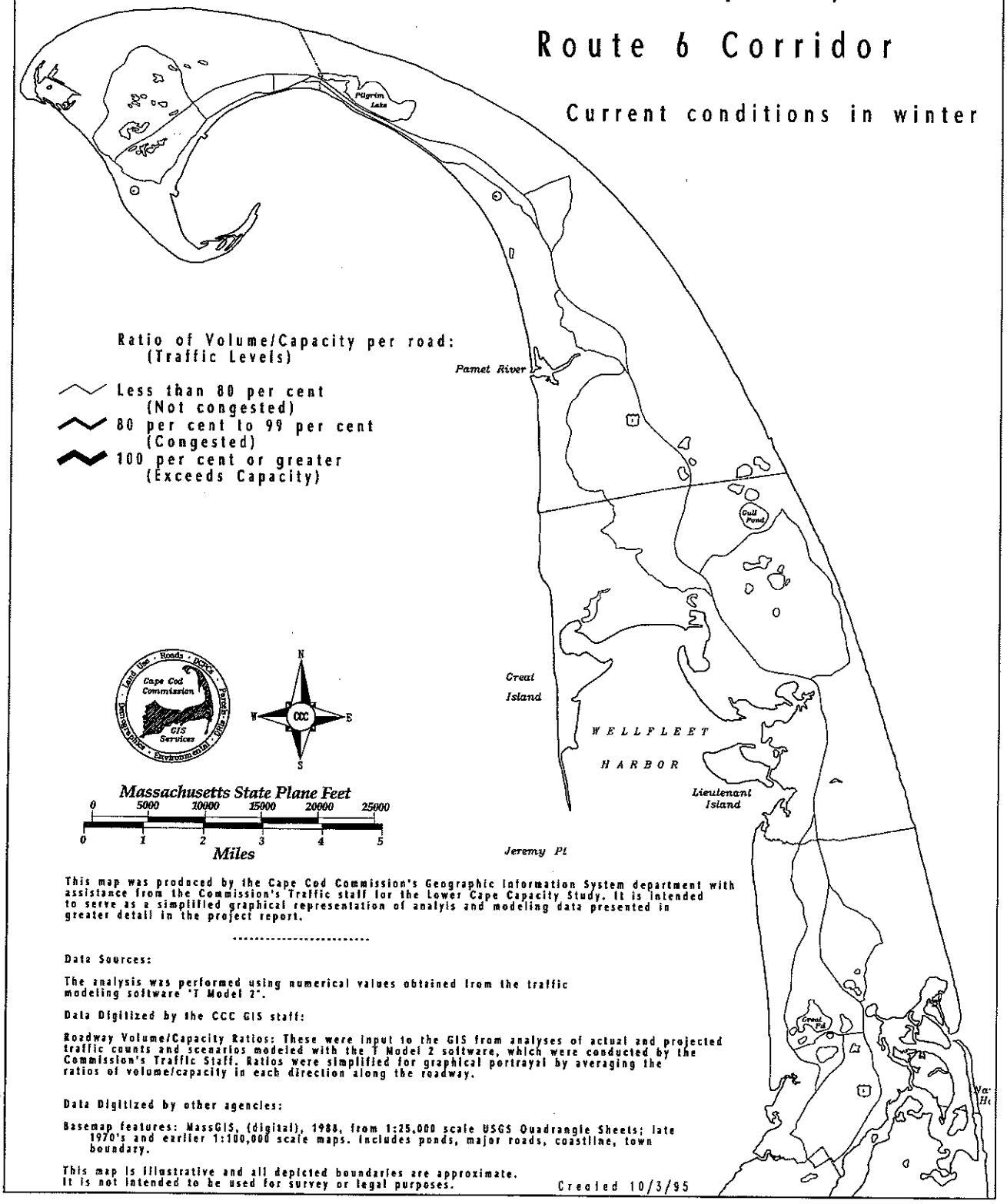
This map is illustrative and all depicted boundaries are approximate. It is not intended to be used for survey or legal purposes.

Created 10/2/95

Road Volume/Capacity Ratio

Route 6 Corridor

Current conditions in winter



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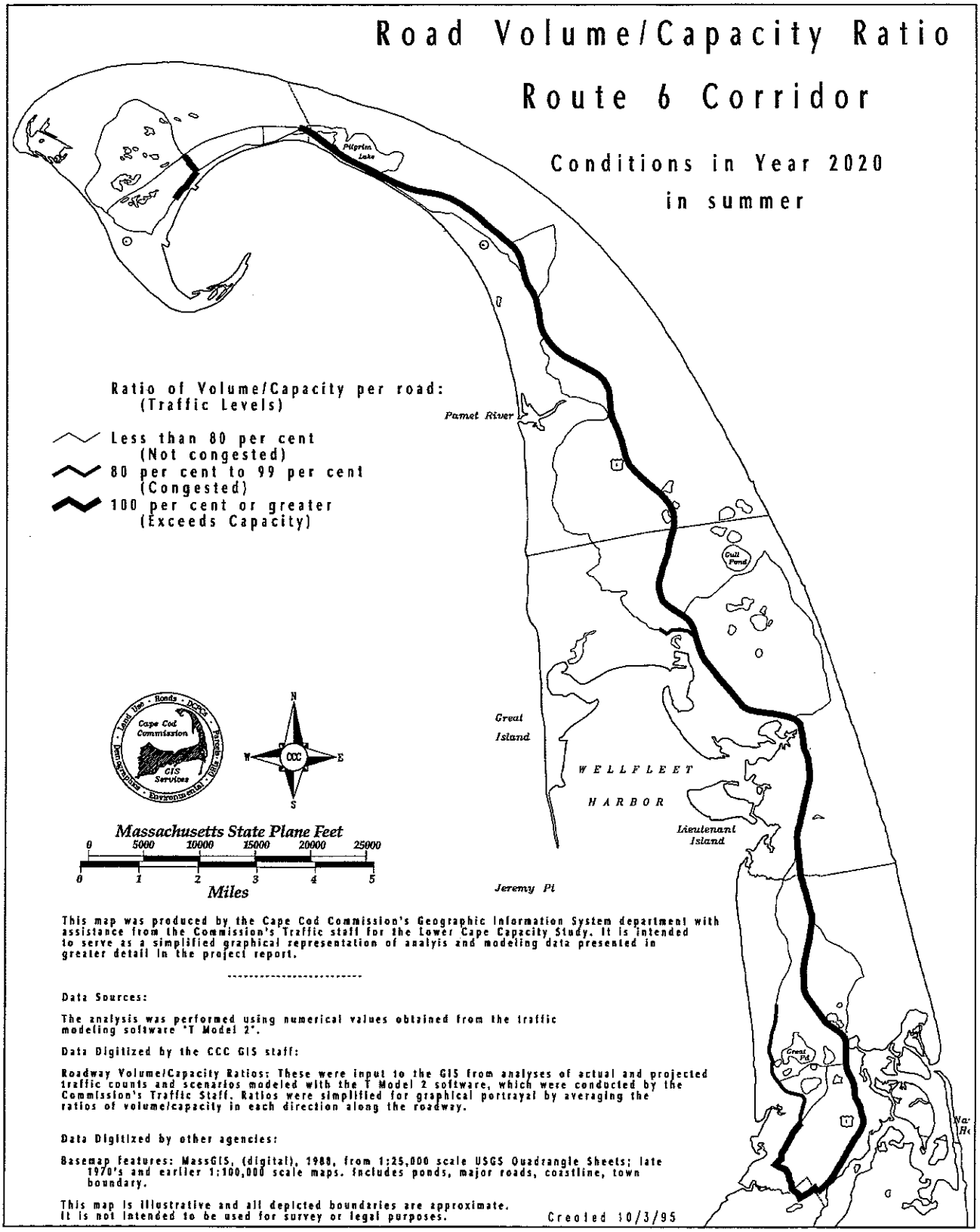
Road Volume/Capacity Ratio

Route 6 Corridor

Conditions in Year 2020

in summer



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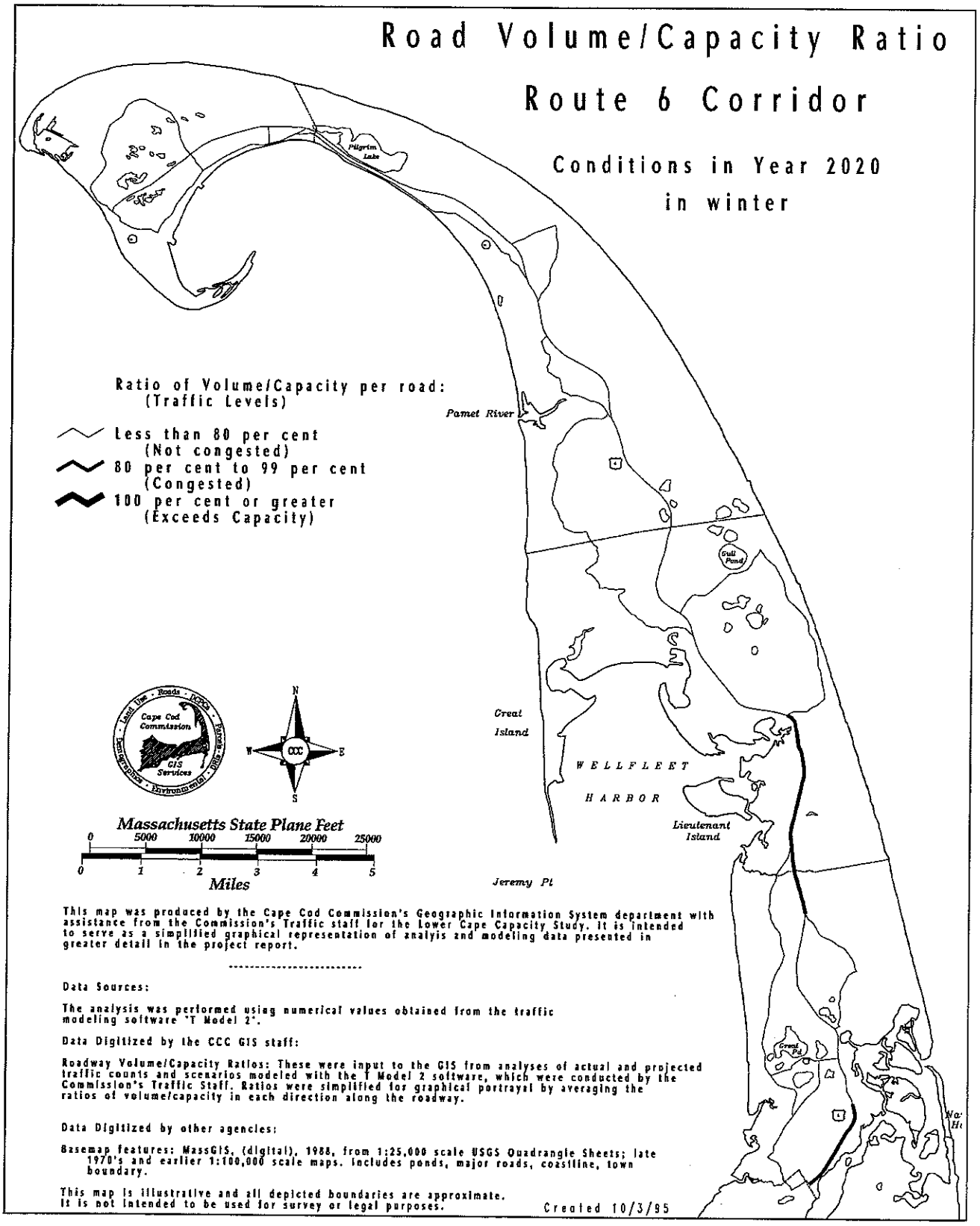
Created 10/3/95

Road Volume/Capacity Ratio

Route 6 Corridor

Conditions in Year 2020 in winter



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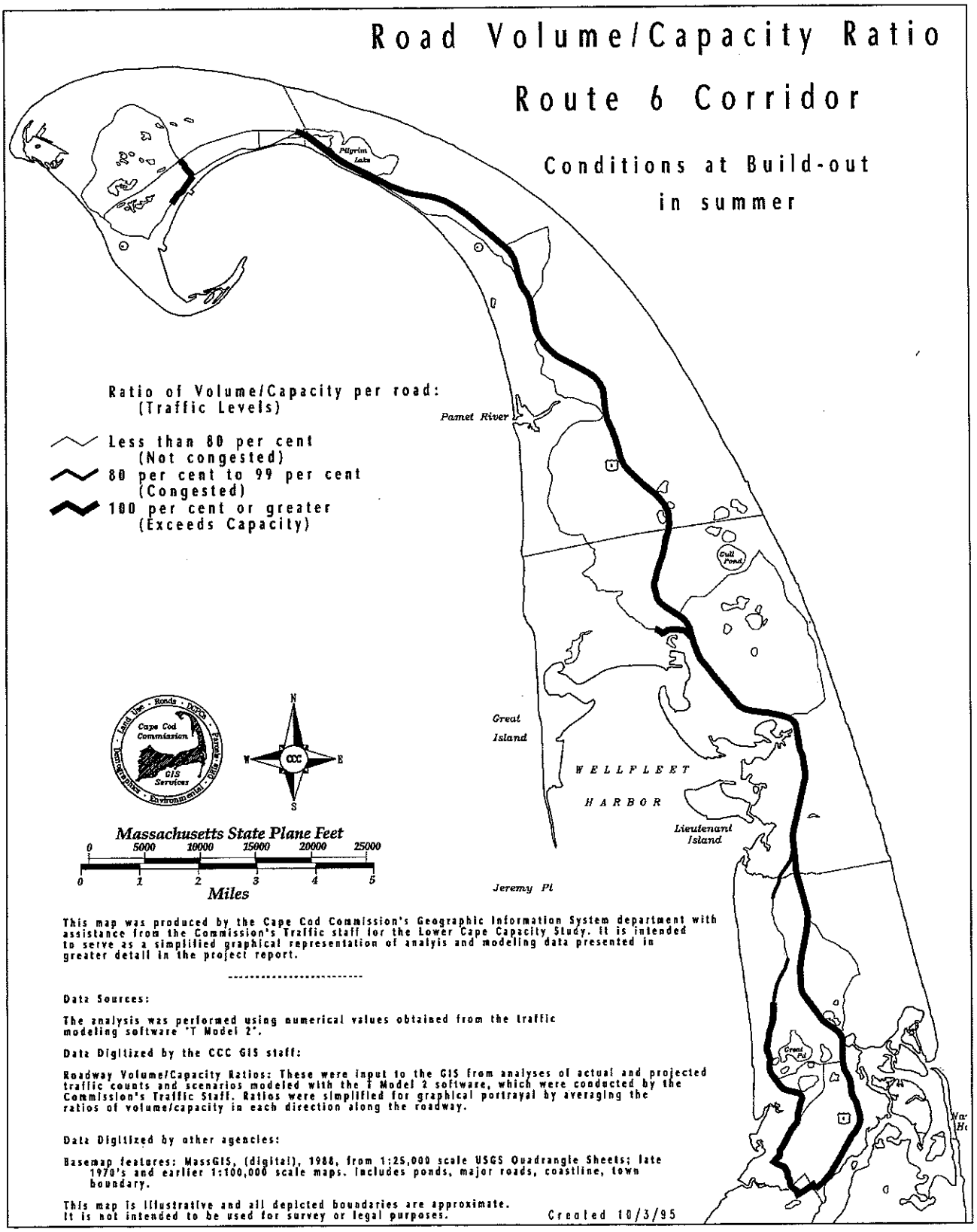
Road Volume/Capacity Ratio

Route 6 Corridor

Conditions at Build-out in summer



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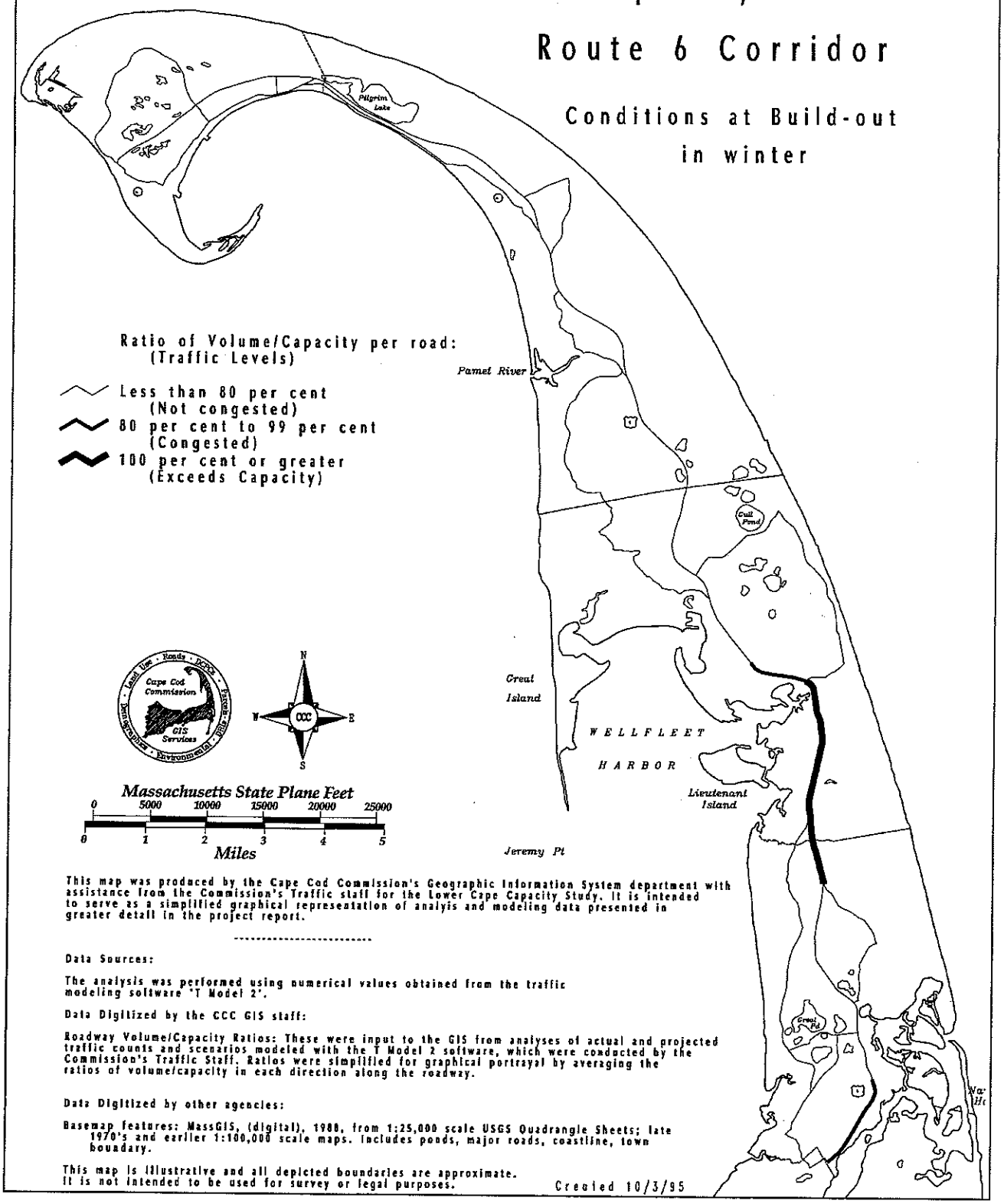
Road Volume/Capacity Ratio

Route 6 Corridor

Conditions at Build-out in winter



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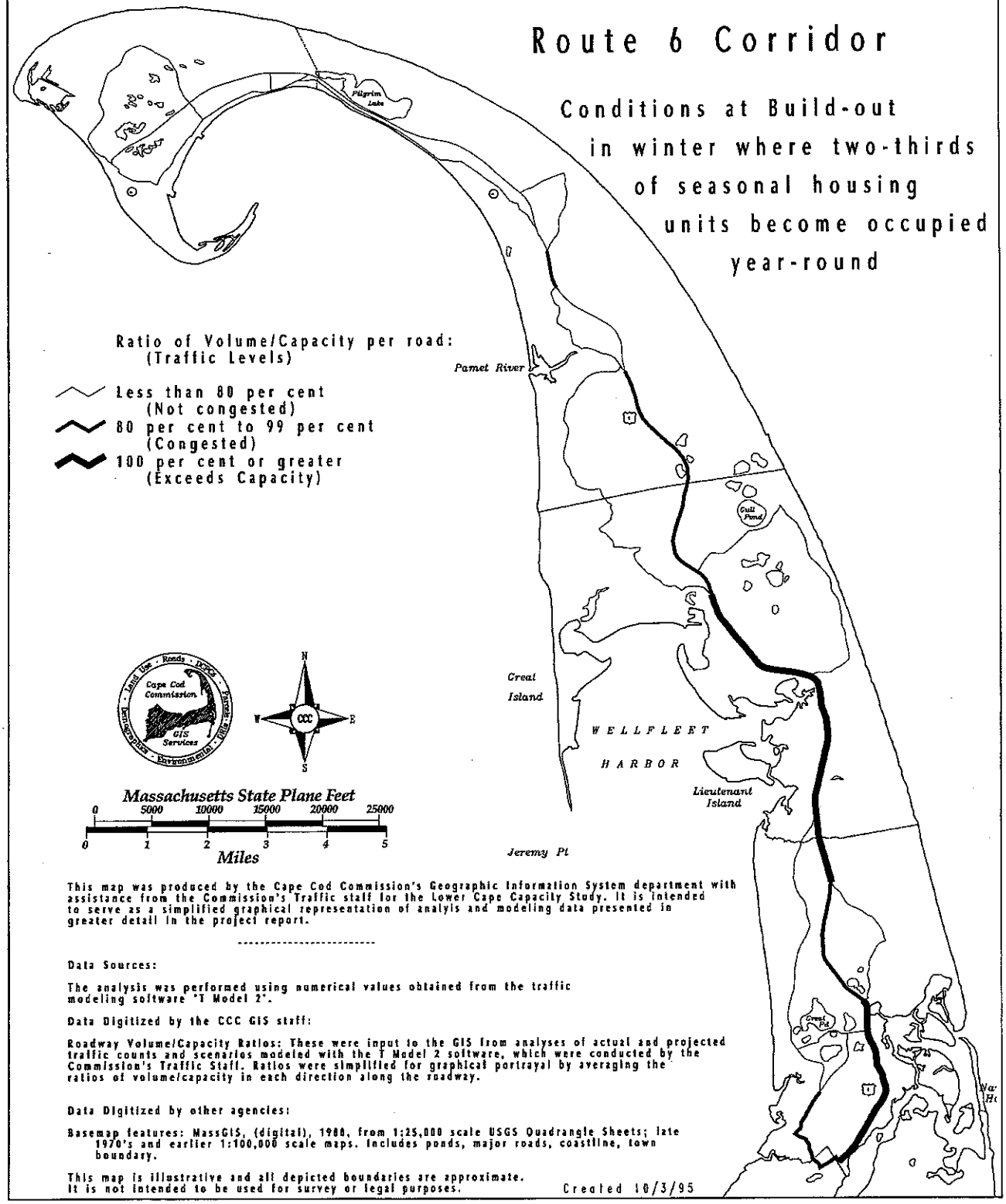
Road Volume/Capacity Ratio

Route 6 Corridor

Conditions at Build-out in winter where two-thirds of seasonal housing units become occupied year-round



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Created 10/3/95

Travel: Miles and Hours

Other ways to look at traffic impacts include Vehicle Miles Traveled (VMT) and the Vehicle Hours Traveled (VHT). VMT represents the total mileage traveled by all the vehicles on the road network during the modeled hour. Likewise, VHT represents the total amount of time that all these vehicles spent on the network. For example, ten vehicles, each driving for 30 minutes each results in a VHT of 10 vehicles x 1/2 hour or 5 VHT. Although the model only quantifies travel during the "peak hour," we can estimate daily travel from those numbers by multiplying them by 10. In other words, about 10% of daily traffic occurs during the peak hour.

The results for the Outer Cape are presented in Table 4 and Figures 16 - 19 for the various scenarios. These figures show that travel distances and time increase in the future more quickly than the number of residents. This means that, in the future, Outer Cape residents and visitors can expect to spend more of their time in their cars, driving farther and taking longer to do so. In part this is due to the dispersed residential pattern of the area projected into the future. In part it is simply due to increased congestion on the roads.

Table 4 - Vehicle Mile Traveled/Vehicle Hours Traveled

		VMT	VHT
Existing			
	Summer	76,735	2,187
	Winter	33,902	829
2020			
	Summer	117,621	5,327
	Winter	48,723	1,245
Build			
	Summer	127,582	6,472
	Winter	52,281	1,358
Build (1/2 rate seasonal)			
	Summer	127,582	6,472
	Winter	73,205	2,179

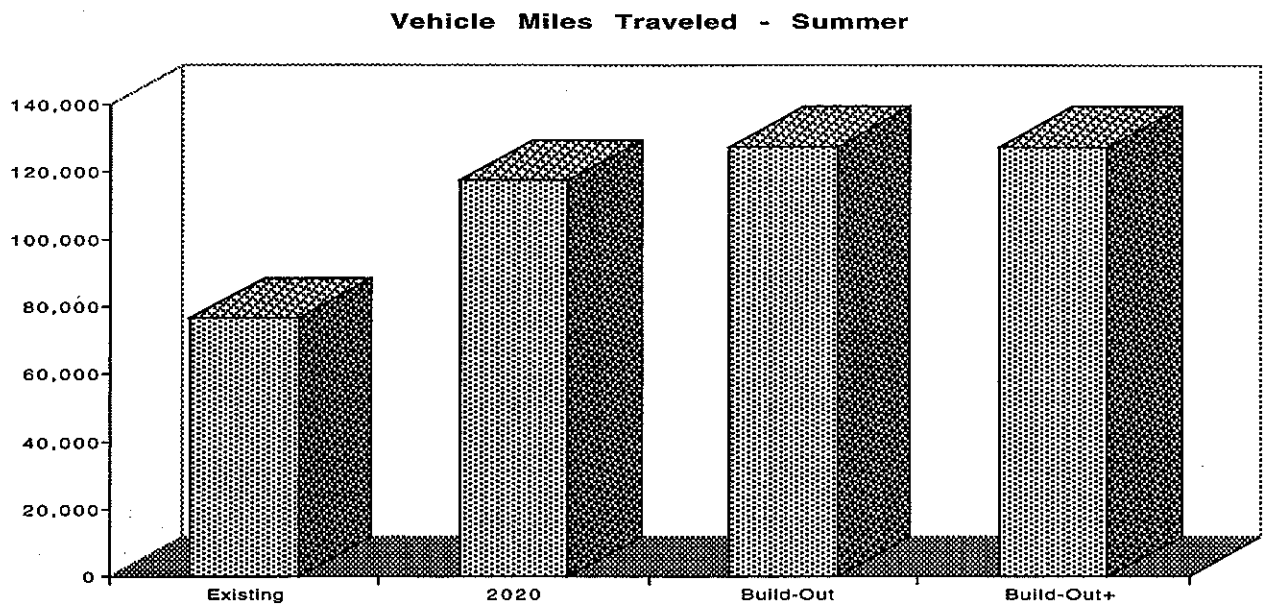


Figure 16 - Vehicle Miles Traveled: Summer

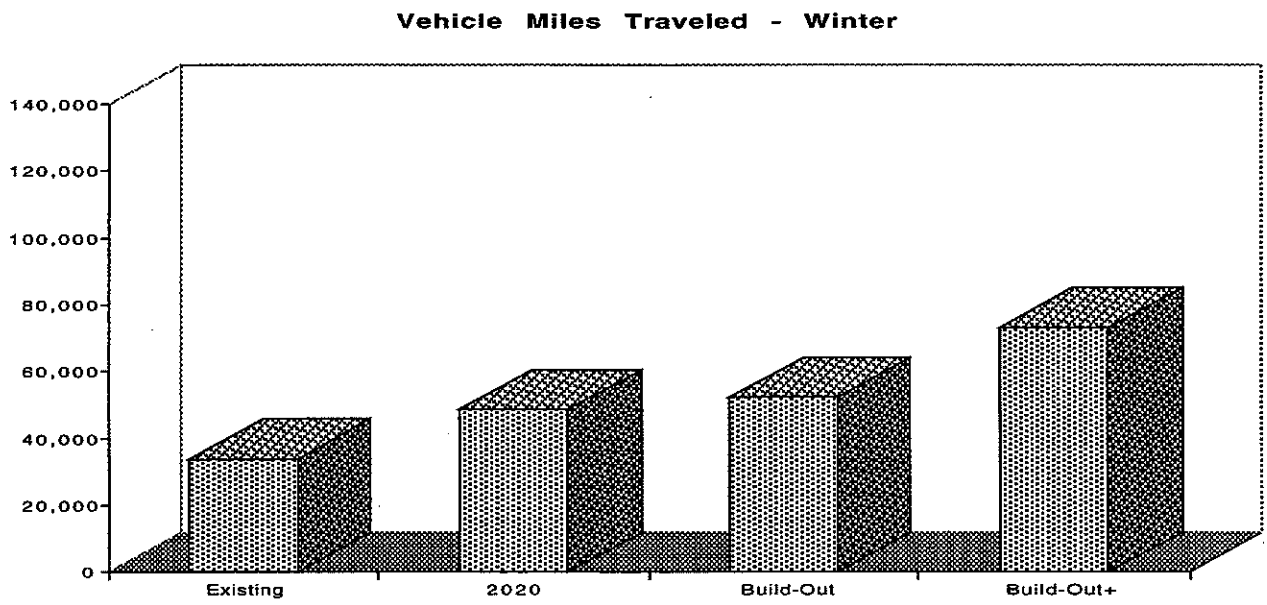


Figure 17 - Vehicle Miles Traveled: Winter

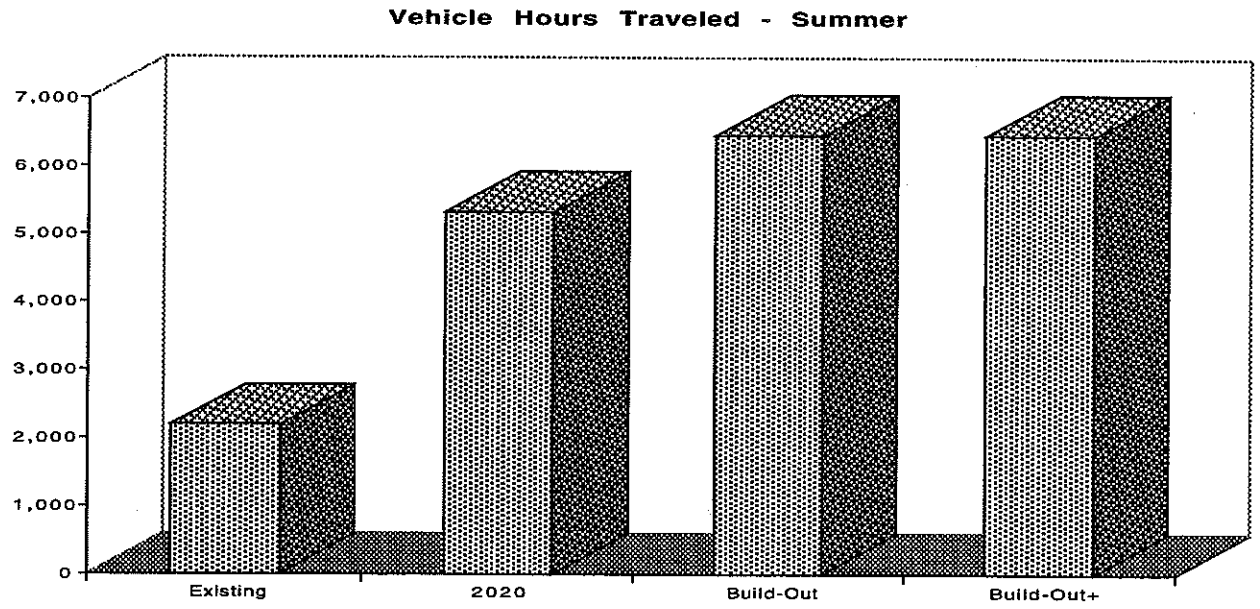


Figure 18 - Vehicle Hours Traveled: Summer

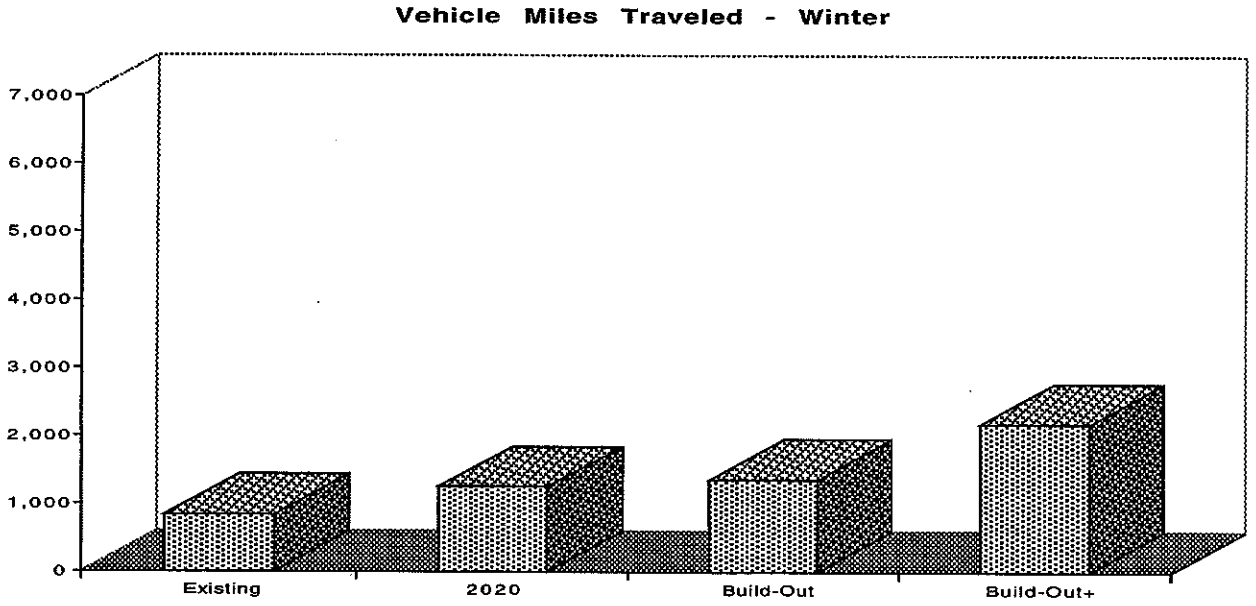


Figure 19 - Vehicle Hours Traveled: Winter

Key Findings

The analysis shows the increasingly higher travel time cost as traffic demand approaches and exceeds capacity due to continued growth in today's sprawling development patterns. A 46% increase in Total Housing (14,389 to 21,021), results in a 66% increase in vehicle miles traveled and a 196% increase in vehicle hours traveled.

It is interesting to note that some of the future winter conditions approach the existing summer conditions. In terms of VMT, the amount of travel in the winter scenario with more year round population is 73,205, over 95% of the existing summer VMT of 76,735. This future winter scenario VHT is 2,179, almost 100% of existing summer VHT of 2,187.

Looking again at the regional versus local perspective, the future scenarios show continued deterioration to Route 6 and new deterioration of the Local Roads. Future winter conditions are similar to existing summer conditions for local roads as well (5% congested mileage under the "more year round housing" scenario versus 4% under the existing summer scenario).

When traffic conditions during some future winter reflect existing summer, what will the future summer be like? The traffic model can estimate travel demand and congestion due to a given land use pattern. The growth in mileage and travel time mentioned above would create stresses on the road network resulting in deleterious consequences.

Another way many drivers will cope with increased congestion will be by using alternative routes. Many drivers have the use of alternative routes down to an art form, knowing which combination of roadways will be most efficient depending on the time of day and other factors.. It is likely that any road projected as "congested" or "over capacity" will affect the level of service on local roads that serve as alternative routes. It is clear that alternative routes will become more popular as the region grows. This popularity will increase pressures on these roads, which may need to be addressed by local government through traffic restrictions, signalization, widening, or other approaches.

Don't Ignore the Environment

Unfortunately for many transportation planning studies, environmental considerations do not receive attention until late in the process - sometimes at the construction phase - and thereby result in both environmental degradation and ad hoc engineering solutions. One of the goals of this study is to bring environmental considerations into the transportation planning process at an earlier stage. Using Geographic Information Systems has made that possible.

Environmental Sensitivity

This study has included development of an easy-to-use planning tool, called the Environmental Sensitivity Index, that summarizes the quantity and proximity of environmental resources to an important transportation facility such as Route 6. The planning tool allows for decision makers, with guidance provided by environmental specialists, to weigh the relative importance of various resources.

Several assumption were made to develop the Index. The "bandwidth" examined is 100 meters to the left and right of the centerline of Route 6. The Index is calculated at points spaced 10 meters along the roadway

Four resources are examined:

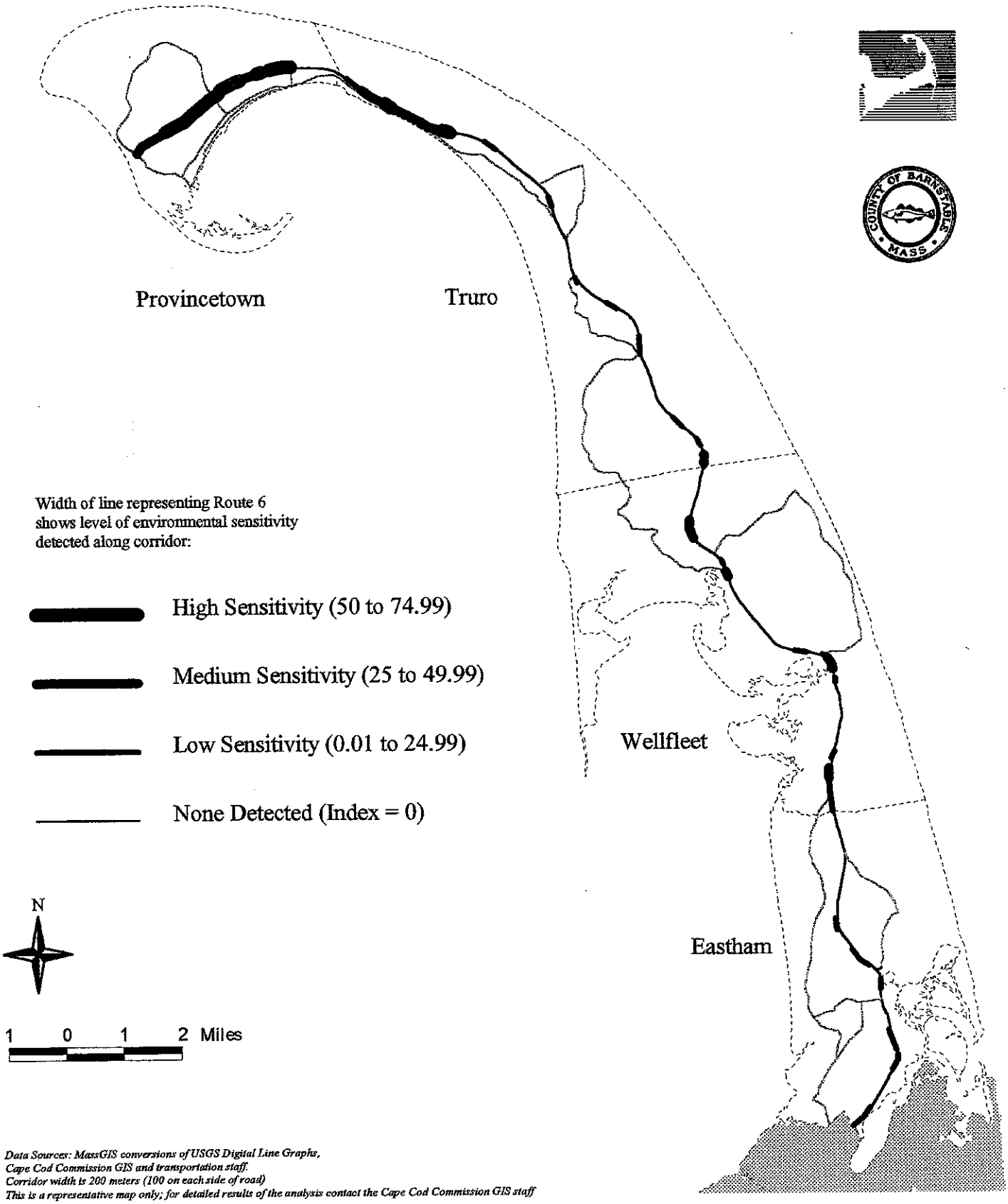
1. Wetlands & Surface Water Bodies
2. Rare Species Habitat
3. Rare Plant Habitat
4. Critical Upland Areas

The Index of each resource may range from 0.0 to 100.0. If the resource is not detected within the bandwidth, it is counted to be 0.0; if the centerline of Route 6 passes through the resource (e.g., a bridge over a wetland), it is counted as 100.0. The index varies linearly within the bandwidth.

The Indices for all of the resources are averaged to produce the Index of each centerline point along Route 6.

Where none of the four resources are detected, the Index is 0.0 and denoted with a thin black line. Wider line widths are used to show changes in the Index as shown on the map.

The result is a map which shows different levels of the Index.



Data Sources: MassGIS conversions of USGS Digital Line Graphs,
Cape Cod Commission GIS and transportation staff.
Corridor width is 200 meters (100 on each side of road)
This is a representative map only; for detailed results of the analysis contact the Cape Cod Commission GIS staff

Figure 20 - Route 6 Environmental Sensitivity Index

Air Quality

Internal combustion vehicles pollute the atmosphere in a number of ways. Two of the most serious pollutants, volatile organic compounds (VOCs) and oxides of nitrogen (NOx), contribute to the formation of low level ozone. Everybody has heard of the importance of ozone in the upper atmosphere, protecting us from dangerous ultra-violet rays. The health effects of exposure to ozone at ground level are also becoming apparent as well as its corrosive weathering effects on painted surfaces, damage to crops, and related impacts.

Automobile emissions of VOCs and NOx are estimated using "external" variables such as the type and model years of vehicles in service, atmospheric characteristics, compliance rates of inspection & maintenance programs, and others. "Internal" variables include the amount of vehicle miles traveled and travel speed. The amount of VOCs that a car emits per mile is very high at low speeds. As speeds increase, engine efficiency increases, reducing the rates of emissions per mile until the effects of wind drag turn the rates up again. NOx behaves in the same way except that the point where the rates change is different. This means that the VOC rate may improve while the NOx rate gets worse for a given change in speed. Table 5 shows the expected emissions of VOCs and NOx under the various scenarios. Note that the emissions drop significantly in the future scenarios despite an increase in VMT. This occurs because of expected improvements in the automobile fleet (e.g., cleaner engines and fuels, enhanced maintenance and inspection, etc.).

Table 5 - Emissions of VOCs and NOx

Scenario	VMT	VOC's	NOx
Existing Summer	76,735	172	183
Existing Winter	33,902	70	86
2020 Summer	117,621	73	122
2020 Winter	48,723	21	53
Build-Out Summer	127,582	84	133
Build-Out Winter	52,281	23	57
Build-Out Winter with shift to year-round occupancy	73,205	35	77

The 1990 Clean Air Act Amendments have many implications for our transportation system, not the least of which will be the manner in which we will deal with land use. One implication is:

Development which increases Vehicle Miles Traveled is inconsistent with the goals of the Clean Air Act

The basis of the above statement is as follows:

1. Emissions increase with Vehicle Miles Traveled (and vary with speed).
2. Emissions of the pollutant, NOx, are restricted to 1990 baseline levels or 1996 levels (based on 1996 Vehicle Miles Traveled & Speeds) whichever is lower, or levels identified in the current State Implementation Plan.
3. Inability to achieve air quality standards will result in sanctions (e.g., suspension of federal funding under Intermodal Surface Transportation Efficiency Act) and/or civil lawsuits.
4. In the absence of externally applied fleet improvements (e.g., cleaner fuels, advanced Inspection/Maintenance, fleet renewal), development which results in an increase in Vehicle Miles Traveled will require a corresponding decrease in Vehicle Miles Traveled elsewhere in the system - a task which is very difficult to implement.

   Examples of development which are more likely <u>not</u> to increase Vehicle Miles Traveled:

   Neighborhood grocery stores
   Convenience stores
   Moderately priced housing within employment centers

   Examples of development which are more likely to increase Vehicle Miles Traveled:

   Remote residential housing
   Large scale retail/wholesale development

Using the Results

Previous sections of this report have dealt with traffic questions such as: What is it like now? What will it be like in the future? What should we consider when looking at solutions? This section includes discussion of some potential solutions.

The results of the output from the travel demand model suggest that the Outer Cape will exceed its transportation capacity far before build out. In fact, under current travel patterns, capacity has already been reached on some sections of the system. Clearly, something will have to change if the area is to avoid gridlock.

There are two ways to approach this problem. One is to increase the capacity of the system through technological innovation, more efficient use of the current infrastructure, or, as a last resort, widening roads; this is the supply-side approach. The second is the demand-side approach; reduce demand by reducing the growth rate of the region. The following sections discuss these approaches.

New Tools: TDM/TSM/ITS

Several acronyms have joined transportation planners' vernacular. These include *Travel Demand Management* (TDM), *Transportation Systems Management* (TSM) and *Intelligent Transportation Systems* (ITS).

> TDM is a combination of strategies or actions whose goal is to encourage travellers to use alternatives to driving alone. These strategies should work toward decreasing demand by providing choices and incentives.
>
> TSM is a combination of low-cost strategies that utilizes total transportation system management. The goal is to shift emphasis from expanding capacity to making better use of transportation systems already built. TSMs work to increase the flow of traffic and encourage the use of more efficient alternative means of transportation. The emphasis, unlike TDM, is on increasing the efficiency of the supply, not reducing the demand.
>
> ITS is a combination of high-technology strategies with goals similar to both TDM and TSM. ITS relies heavily on real-time collection of information and decision making to promote optimal travel route and mode choice.

The Cape Cod Regional Transit Authority estimates that it costs about 35 dollars an hour to operate a bus. In performing ridership projections and auto usage

reductions for the state's Transportation Improvement Program, the CCC staff have estimated a cost of about $400 to reduce a daily mile of vehicle travel (VMT - this covers summer service for 20 years). From the VMT analysis of a previous section, the build-out summer VMT is estimated to be about 127,500, which is about one-tenth of the daily. Supposing that 5% of the auto travel could be persuaded to use transit, twenty years of service may have a one-time cost:

$$5\% \times 127{,}500 \times 400 \times \$ = \$2.5 \text{ Billion}$$

"Fixing" Route 6?

In order to accommodate traffic levels on Route 6 under the projected build-out conditions, major widening of the road would be required. However, there are severe cost and environmental constraints to widening the roads.

To identify costs for major improvements to Route 6, a great deal of information is required. The types of costs aside from actual construction include design, right-of-way acquisition, and environmental mitigation. As an example, the widening of Route 44 from Route 58 to Route 3 (about 7 miles) costs about $28 Million. Improving the 18 mile undivided section of Route 6 would cost approximately $72 Million - *all things being equal.*

Some of the larger unresolved issues include the acceptability of the changes that major widening create. The natural environment would be seriously impacted at many locations as seen on the Environmental Sensitivity Index map. The various natural resources, wetlands and surface water bodies, rare species habitat, rare plant habitat, and critical upland areas all are sensitive to the proximity of a heavily traveled roadway such as Route 6.

More difficult to quantify would be the effects on the communities' character. The transportation experience would be markedly different along a busy multi-lane highway. Widening in some areas would also displace homes, especially in Eastham where the road layout is relatively close to adjacent houses' front doors.

For sake of discussion, if "fixing" Route 6 means widening, how many lanes do we need to build to accommodate certain levels of flow? Table 6 estimates the general costs of road-widening:

Table 6 - Flow & Cost at Level of Service C

Number of Lanes	Service Flow Vehicles/Hour*	Expansion Cost $ per Mile**
2	1,880	$0
4	3,760	$1,850,000
6	5,650	$1,850,000

* Based on Massachusetts Highway Department - Highway Design Manual
** Expansion cost is for adding lanes to an existing roads. Cost does not include Right-of-Way acquisition. Source: Massachusetts Highway Department, District 5.

Dollar-wise, acquiring Right-of-Way for the expansion of four lanes to six is likely to be a much bigger cost than the two lanes to four. While different segments of Route 6 will experience a variety of traffic volumes, adding lanes along some segments and not others could create bottlenecks and confusion to drivers' expectations. The above table was developed based on Level of Service (LOS) C.

Using the LOS C standard as a "desired" quality of flow, Table 7 illustrates the costs of bringing Route 6 up to this level as well as maintaining it into the future. Traffic volumes taken from representative segments were selected for the three general Route 6 sections as follows: for the 4 lane divided highway in Provincetown and North Truro, the Provincetown-Truro town line; For the two-lane section from North Truro to South Wellfleet, the Truro-Wellfleet town line; for the four-lane section from South Wellfleet to Orleans, Route 6 north of Samoset Road.

Table 7 - Route 6 Improvement Costs

Section/Mileage	Traffic Volume (Vehicles/Hour)	# of Lanes Required	Expansion Cost ($Million)
	Provincetown to North Truro/6 Miles		
Existing	1,860	2	0
2020	2,280	4	0
Build-Out	2,470	4	0
		Subtotal:	**$0**
	North Truro to South Wellfleet/12 Miles		
Existing	1,840	2	0
2020	2,990	4	22,200,000
Build-Out	3,110	4	0
		Subtotal:	**$22,200,000**

Table 7 continued

South Wellfleet to Orleans/6 Miles

Existing	3,080	4	0
2020	4,870	6	11,100,000
Build-Out	5,000	6	0
		Subtotal:	**$11,100,000**
		Total:	**$33,300,000**

Fixing Local Roads

In this section, we attempt to quantify the costs to each of the Outer Cape towns of the transportation impacts of growth assumed in the Outer Cape study. It is important to reiterate that these growth numbers are assumed as inputs to the regional model and are not predicted to necessarily occur.

First, we look at the intersections in each town and try to identify how many will need improvement and in what year. Since many of these intersections are not directly in the model, creation of this list involved extrapolating some of the model results to local and secondary feeder roads. Second, we look at the cost of improvements to local roads that will be needed if the present automobile-dominated transportation pattern is to continue. In the final section, we look at the possibility of mitigating some of these costs by the promotion of alternative modes, specifically transit. We then total these costs up to determine how much money each town will need to spend by 2020.

Intersections

The following intersections occur where roads above the functional class of "local" intersect. For this reason, they need to be considered prime candidates for improvement in the future as traffic increases. However, many of them will not need improvements in the next 25 years. In addition, as mentioned below, it is possible that intersections of local roads will also need improvement.

For the intersections for which we expect improvements will be needed, the year of these improvements is listed. Also, for those intersections requiring improvement, the percentage of that cost allocated to the town is listed. These percentages are based on the jurisdiction under which the intersecting roads fall. If both roads fall under town jurisdiction, the intersection is 100% local responsibility. If one is a state road, the intersection is 25% local responsibility. This figure represents local efforts that often go into such improvements in the form of design work and initial planning, although the state is technically responsible for improving these intersections. If both roads are under state or federal jurisdiction (such as those in the National Seashore), the intersection is 0% local responsibility, since the town is not responsible for improvements to those intersections:

Table 8 - Town Shares

Town	Main	Minor	Local Share
Eastham	Route 6	Samoset Rd.	25%
Eastham	Route 6	Nauset Rd. (S)	0%
Eastham	Route 6	Old Orchard Rd.	25%
Eastham	Route 6	Brackett Rd.	25%
Eastham	Route 6	Nauset Rd. (N)	25%
Eastham	Massasoit Rd.	Herring Brook Rd.	100%
Eastham	Samoset Rd.	Herring Brook Rd.	100%
Eastham	Bridge Rd.	Herring Brook Rd.	100%
Wellfleet	Route 6	West Rd.	25%
Wellfleet	Route 6	Lecount Hollow Rd.	25%
Wellfleet	Route 6	Main St.	25%
Wellfleet	Route 6	Briar Ln.	25%
Wellfleet	Route 6	Coles Neck Rd.	25%
Wellfleet	Main St.	Long Pond Rd.	100%
Wellfleet	Main St.	Briar Ln.	100%
Wellfleet	Dyke Rd.	Old Chequesset Neck Rd.	100%
Truro	Route 6	South St.	25%
Truro	Route 6	Castle Rd.	25%
Truro	Route 6	South Highland Rd.	25%
Truro	Route 6	Highland Rd.	25%
Truro	Route 6	Route 6A (town juris.)	25%
Provincetown	Route 6	Bradford St.	25%
Provincetown	Route 6	Conwell Rd.	25%
Provincetown	Bradford St.	Conwell Rd.	100%

Based on figures from the 1997-1999 Cape Cod Transportation Improvement Program, signalization of a typical four-way intersection costs between $100,000 and $225,000. Intersection widening can cost between $35,000 and $210,000. Since we are not recommending specific improvements to these intersections, we are using an average cost of $160,000 for each intersection needing improvement. This total cost is divided between the town and higher levels of government based on the percentage in the table above, which in turn is a factor of whether the intersection is all, part, or none local responsibility.

Table 9 - Town Costs

Town	Intersections (100%/25%/0% local resp.)	Local Cost (1995 $)
Eastham	3/4/1	$640,000
Wellfleet	3/5/0	$680,000
Truro	0/5/0	$200,000
Provincetown	1/2/0	$240,000

Roads of functional class "local" may also need intersection improvements, especially where they intersect with higher-class roads. These intersections are not likely to become signalized due to the effects that would have on the flow of traffic along the higher-class roads. Such delays along major roads might then spiral into the need for more roadway improvements. These local roads are more likely to require additional stop signs, right-turn-only signs, or the addition of turning lanes along the higher-class roads. These improvements have the potential for significant additional costs to the towns. However, since their scope is difficult to calculate, we do not attempt to quantify those costs in this analysis.

Roads

Based on the land use assumptions in this study, many roads in the Outer Cape region will exceed their capacities at summer rush hour peaks in the next 25 years. These roads will need additional lanes or major comparable improvements such as increased transit to reduce the need for wider roads. Either way, expensive improvements will have to be made if development assumptions occur. The good news for the Outer Cape towns is that most of these roads are state highways, for which the state is likely to pay for improvements, and that many alternative improvements are eligible for federal funding.

However, there are still likely to be many miles of roads under local jurisdiction that will need improvements. Based on the miles of roadway under local control in each town and the percentage of roadways in the regional model estimated to be over capacity in the model years, we can estimate how many miles of roads are likely to require some sort of improvement or comparable investment in alternative modes. As a planning assumption we will use a cost of $1 million per mile for improvements to local roadways.

Table 10 - Road Improvement Costs by Town

Town	Miles of Local Roads	Needing Improvements	Miles to Improve	Cost
Eastham	42.39	7%	2.97	$2.97 million
Wellfleet	52.71	7%	3.69	$3.69 million
Truro	38.43	7%	2.69	$2.69 million
Provincetown	16.40	7%	1.15	$1.15 million

Use of Alternate Modes

For the Route 6 corridor, the use of alternate modes has some potential to reduce the need to make roadway improvements. In particular, the careful creation of alternatives to roadway travel along the Route 6 corridor might reduce traffic on those roads to the point where major improvements might be avoided. For this

reason, it is worthwhile to investigate the fiscal impacts of such a policy decision for the towns involved.

At present, the Cape Cod Regional Transit Authority collects funds for transit operation from Cape towns provided with service based on their population. In addition, for para-transit rides, the CCRTA collects a per-rider cost. However, much of the capital cost of CCRTA (buses, offices, etc.) come from federal funding. For the future scenarios, we will assume that operating costs will come entirely from the Outer Cape towns, and that none of capital costs will come from the towns.

For the purposes of this study, we are examining a fairly strong program of transit and concurrent reductions in highway and road improvements. Construction of bikeways along major corridors is also possible, but for the purposes of this study we are not quantifying these costs. A less aggressive program is possible. However, we wanted to highlight the potential fiscal impacts of using alternative modes rather than roads. The highest differences in fiscal impacts occur with the highest level of alternative mode use, so we use that scenario here. Under a strong alternative mode scenario, we predict summer minibus or trolley service on Route 6 along the entire Outer Cape region beginning in the near future.

In order to attract sufficient ridership to reduce the need to improve highways and intersections, frequencies have to be high. Therefore, we need to assume two buses on the route running during summer peak hours (7-9 am. and 4-7 pm. for this analysis), and one bus on the route during the rest of the day from 6 am. to 11 pm. This would mean a total of 17 hours of operation, of which 6 are during peak hours, for a total of 23 bus-hours of operation per day; 11 times one bus plus 6 times 2 buses.

We are using $34 an hour as operating costs, the hourly rate for Cape Cod Regional Transit Authority operations. Using this figure, we can calculate the total cost of providing service in the summer:

$34/hour of bus service times
23 bus-service-hours per summer day times
7 days per week times
14 weeks in the summer season equals
$76,636 to provide transit service for the summer

Ridership is assumed to recover 33% of costs. The cost of this service is therefore:

$76,636 x 67% = $51,346

These are annual costs, as opposed to the one-time costs of the roadway calculations. For the purposes of this study they are allocated to each town served based on population. The shares of total costs work out as follows:

Table 11 - Transit Improvement Costs by Town

Town	Population	% of Total Population	% of Total Transit Costs
Eastham	4,462	36.9%	36.9%
Wellfleet	2,493	20.6%	20.6%
Truro	1,573	13.0%	13.0%
Provincetown	3,561	29.5%	29.5%

With transit provided at this level, how many vehicle trips might be reduced? We assume 2.5 percent of those driving might be convinced to use transit, or a 2.5 percent *mode split*. At present, summer shuttles in Cape Cod towns attract 1 to 1.5 percent of all those making trips, but as congestion increases it is reasonable to assume higher mode shares. In congested regions transit shares are generally 3 to 8 percent. Such levels of ridership would generally reduce the need for roadway improvements.

It is difficult to identify exact improvements that may be delayed or prevented. However, for the purposes of this study we will assumed an overall reduction in roadway-related improvement costs equal to mode share of transit. In other words, we will assume that the cost of roadway improvements in the region is reduced by 2.5 percent due to the transit service provided by the region. Thus the changes in total costs under the aggressive transit strategy work out as follows:

Table 12 - Cost Savings for Transit

Town	Cost of Transit	Cost Saved	Net Change
Eastham	($18,946)	($90,250)	$71,294
Wellfleet	($10,577)	($109,250)	$98,673
Truro	($6,675)	($72,250)	$65,575
Provincetown	($15,147)	($34,750)	$19,603

The use of an aggressive transit strategy appears to decrease the cost of transportation improvements in the Outer Cape region. This calculation assumes that the region receives no operating assistance from the state or federal governments. It is important to note, though, that cost differences between transit and road expansions are minor compared to the total cost of needed improvements in the region. If more than 2.5 percent of those driving in the Outer Cape could be convinced to use transit instead, the effect might potentially be much greater. However, this is unlikely to occur due to the wide variety of origins and destinations for travelers in the region.

From this analysis, increased transit does not appear to have a major effect on the fiscal impact of this study's assumed growth for the region. It is important to note two things at this point, however. First, the use of a transit strategy can have other

positive impacts on the region, such as maintaining community character, providing equity in transportation needs, and providing mobility for those who cannot or choose not to drive. Second, these numbers are preliminary. No individual town should look at these numbers as a precise impact of the effects of transit on the region's financial future. Rather, they should serve as a general guide.

Table 13 - Needed Transportation Improvements by Town: 1996-2020

Town	Cost	Cost with Transit Alternative
Eastham	$3.61 M	$3.54 M
Wellfleet	$4.37 M	$4.27 M
Truro	$2.89 M	$2.82 M
Provincetown	$1.39 M	$1.37 M

Approximate Annual Costs (not including interest)

Town	Cost	Cost with Transit Alternative
Eastham	$150,416	$147,500
Wellfleet	$182,083	$177,917
Truro	$120,416	$117,750
Provincetown	$57,916	$57,083

While these expenses are significant, they are less than the costs of assumed growth in the Monomoy region. For example, the transportation-related costs for Orleans are estimated at $359,210 a year. For Dennis, the estimated cost is over $750,000 a year.

Living with Capacity

We have a sense of where the region needs to head in the future in order to avoid exceeding its transportation capacity. If this is a desirable goal for the region, what actions might the Outer Cape towns take to limit growth? Aside from those listed in the sections above, there are two main approaches: the use of zoning or performance based zoning standards and public acquisition of developable land to be held in trust.

- Changing zoning ordinances to reduce the level of development permitted in the region would reduce traffic pressures. Using "performance based zoning" standards, which allow development not based on the size of a lot but on the development's effects on transportation in the region, is a more sophisticated approach to reducing development. There is a limit to the amount that development potential can be reduced by zoning changes, primarily because of the extent to which land has already been subdivided. However, fine tuning of zoning ordinances is an important element in combination with other approaches to reducing development potential.

- Acquiring land to reduce development potential could also be an important tool to mange traffic. In the short term, land acquisition may be costly for local governments since the value of that land is based on its development potential. However, over the long term, reductions in development can lessen the demand for community services and infrastructure, thus reducing municipal expenses. Using land acquisition to lessen traffic congestion can also serve to achieve other community goals such as protection of open space and water quality.

Conclusion

In this study, an attempt has been made to isolate and analyze the Outer Cape's traffic capacity. As can be imagined, the issue is much more complex than a calculation such as:

Capacity = 3,000,000 feet of road lanes ÷ 20 feet per car = 150,000 CARS

While some readers may find a single, quantifiable result appealing, it is not that simple.

In practical terms, traffic capacity is a sustainable amount of flow, in vehicles per hour, over a road segment. The Outer Cape is of course an entire network of such segments. Recognizing the highly seasonal nature of activity in the four towns, the study has confirmed the obvious: serious congestion and capacity problems in the summer (for Route 6, 56% congested, 21% over capacity) and none of these problems in the winter. The local roads experience similar impacts to a lower degree (summer, 4% congested, 0% over capacity).

The implications of development under existing land use patterns are more dramatic for local roads and future winter conditions than for Route 6 or summer conditions. Under build-out in the winter with more seasonal housing converted to year-round use, impacts to local roads (5% congested, 0% over capacity) exceed existing summer conditions.

What "doing nothing" means is that winter conditions will resemble summer, and the summer will be unlike anything seen before. Strategies for doing something can be divided into three broad categories (1) managing demand through land use controls, (2) providing transportation alternatives, "soft" solutions and minor modification of the existing system, and (3) adding new road capacity. There are economic and social implications of the first two categories, the third category has environmental ones as well.

The steering committee of the Outer Cape Capacity Study has indicated that major widening of Route 6 would be unacceptable. This stance is supportable on two levels. The natural environment is incapable of absorbing the effects of new construction at many locations along Route 6 as indicated on the Environmental Sensitivity Index map. On a second level, if the environment is defined to include attractive elements of infrastructure (such as scenic country roads), protection of community character against unattractive changes (such as multi-lane freeways), or even protection of communities (widening would displace many homes in Eastham), then the decision on what to do becomes narrower.

Focusing away from adding new road capacity, strategies such as better management

of the transportation system and providing alternatives like public transit, bike paths, and pedestrian amenities, can only address a fraction of the demand. A greater effect would result from the reduction of overall travel demand, relocation of existing strip and sprawl patterns, and village centered development patterns which are transit/bicycle/pedestrian friendly.

Outer Cape Capacity Study

Water Resources Analysis

Prepared for the Outer Cape Capacity Study Steering Committee

Prepared by the Lower Cape Water Management Task Force in cooperation with the Cape Cod Commission
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December 1996

Water Resources Element of the Outer Cape Capacity Study

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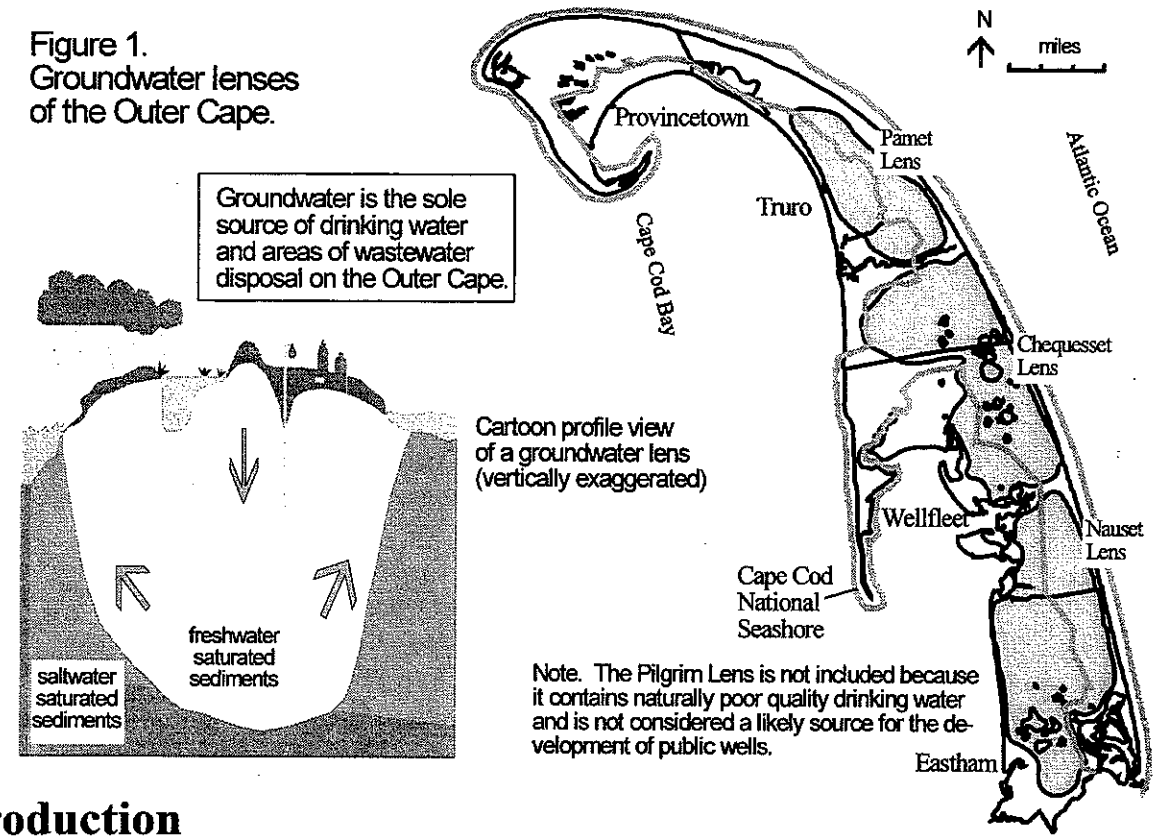
Water Resources Element

Figure 1.
Groundwater lenses
of the Outer Cape.



Introduction

The following report is a condensed version of the Final Report of the Lower Cape Water Management Task Force and is a contribution of the Lower Cape Water Management Task Force to the Outer Cape Capacity Study. It evaluates both water quality and quantity aspects of water resources capacity on the Outer Cape.

The Outer Cape is underlain by sandy sediments saturated with freshwater derived entirely from precipitation. Around half of the forty inches of annual precipitation percolates through the ground and collects in lens-shaped bodies of freshwater which float over sediments saturated with denser saltwater. The bodies of freshwater are called the Nauset, Chequesset, Pamet, and Pilgrim Lenses and are shown in Figure 1. They are the source of drinking water and area of wastewater disposal for everyone on the Outer Cape. In areas of high housing density, private well water quality can become impaired and, as in the case of Provincetown and North Truro, create the need for a public water supply system in order to provide higher quality drinking water. Many look at the protected open space of the Cape Cod National Seashore as the ideal area for locating public wells. Conflicting with this view is the possibility that high-yield groundwater pumping can negatively impact nearby surface waters: a concern embraced in both National Park Service and Massachusetts policy. The need for and possibility of developing public water supply systems has been an ongoing debate throughout the Outer Cape.

Water Quality

What is the status of private well water quality on the Outer Cape, now and in the future?

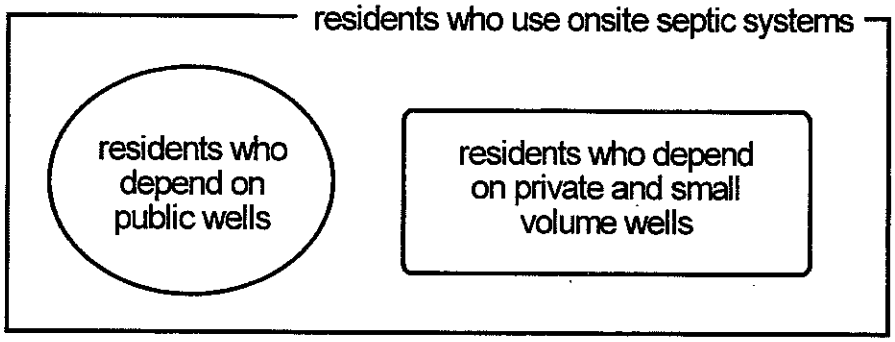


Figure 2.
Ven diagram of the water quality issue considered in this study.

Groundwater is the sole source of drinking water for everyone on the Outer Cape. All of Provincetown and North Truro rely on public wells for their drinking water. The remaining population of Truro, Wellfleet, and Eastham depend on private and small volume wells for their drinking water and reside on lots that are generally less than three quarters of an acre. As shown in Figure 2, all households and businesses on the Outer Cape use onsite septic systems to dispose of their wastewater. This means that effluent from septic systems is being discharged into the water table below the same lots where drinking water is being pumped by private wells. The close spacing of private wells and onsite septic systems has become a concern for the Outer Cape, especially in areas of high housing density and as growth continues in the future.

Present condition

The current status of private well water quality was assessed by compiling a database of over 6,000 private well water quality samples taken between 1985 and 1994 and linking them to the Cape Cod Commission's Geographic Information System (GIS). Nitrate was used as the primary parameter of this analysis because it is both a contaminant in drinking water and a useful indicator for assessing how well effluent from septic systems is being mixed with surrounding groundwater.

Mapping analysis shows that today the majority of private wells in Eastham, Wellfleet, and Truro provide high quality drinking water. For example, during the 10 year period of record, 3 of every 4 wells did not exceed nitrate levels of 2.7 mg/L in Eastham, 2.0 mg/L in Wellfleet, and 1.4 mg/L in Truro. What do these levels mean? When plumes of septic system effluent enter the water table they contain around 35 mg/L of nitrate. The natural groundwater of the Outer Cape generally contains less than 1 mg/L of nitrate. The federal limit for nitrates in drinking water is 10 mg/L and the planning limit on Cape Cod is 5 mg/L (Regional Policy Plan, 1990). This means that the majority of private wells on the Outer Cape provide high quality drinking water.

Notes about nitrate in the groundwater of Cape Cod

Its origin from onsite septic systems

Nitrogen is naturally present in the atmosphere as a gas (N_2) and is a required element for the growth of all living organisms. When organic matter and urea decay in the anaerobic (without oxygen) environment of a septic system, ammonia (NH_3) forms as the predominant nitrogen compound. Biological oxidation reactions transform the ammonia to nitrate (NO_2) and then nitrate (NO_3) as the effluent percolates through the soil and enters the water table. Once entering the generally well-oxygenated groundwater of Cape Cod, nitrogen remains oxidized as nitrate.

Its problem as a contaminant

The gradual accumulation of nitrate in groundwater as it flows towards coastal discharge areas and municipal wells has both environmental and public health implications on Cape Cod. Conditions resembling eutrophication and loss of eelgrass habitat in coastal waters of Cape Cod have been linked to increased nitrate input from discharging groundwater (Eichner et al 1996). Nitrate concentrations exceeding 10 mg/L in drinking water consumed by nursing mothers or used to prepare infant formula is known to deplete oxygen in the bloodstream of infants.

For two thirds of the Cape's population, drinking water is supplied from large gravel-packed or tubular municipal wells which pump between 0.25 and 2 million gallons of water per day from contributing areas which cover several hundreds of acres. The massive size of these contributing areas allows nitrate levels to be sufficiently diluted by mixing before the groundwater reaches the well.

Its use as an indicator

For the third of Cape Cod which relies on private wells for drinking water, plumes from onsite septic systems are not always safely diluted by mixing. The degree of mixing depends on population density, aquifer properties, seasonal shifts in precipitation and wastewater disposal rates, direction of groundwater flow, location and depth of private wells, and other local conditions. Unlike nitrogen compounds, many other contaminants (gasoline, fuel oil, paint thinners, solvents, pesticides, and viruses) may be released to groundwater at irregular intervals. These chemicals present a serious health threat even at minute concentrations yet their irregular occurrence makes them difficult to impossible to monitor in private well environments. Thus, in private well environments nitrate is both a contaminant and indicator for assessing how well effluent from septic systems is being mixed with surrounding groundwater.

Nitrate is a useful indicator for four reasons. First, septic system effluent is the predominant source of nitrate in groundwater across Cape Cod (Eichner et al 1996). Other sources include lawns, agricultural activities, and direct deposition from precipitation. Second, nitrate is always present in septic system effluent. Third, nitrate is generally conserved in the groundwater of Cape Cod. Fourth, and perhaps most importantly, nitrate is routinely tested for in laboratory analyses of private well water quality.

Closer inspection of the maps, however, indicates that cross-contamination (when groundwater contaminated by effluent intercepts a private well) periodically occurs throughout the Outer Cape. A zoomed-in view of these maps is shown in Figure 3: light-coded parcels indicate low nitrate levels and dark-coded parcels indicate high nitrate levels. It is important to notice that wells with high nitrate levels are often found near wells with near background levels and some high density areas contain wells which have remained seemingly unaffected by septic system effluent.

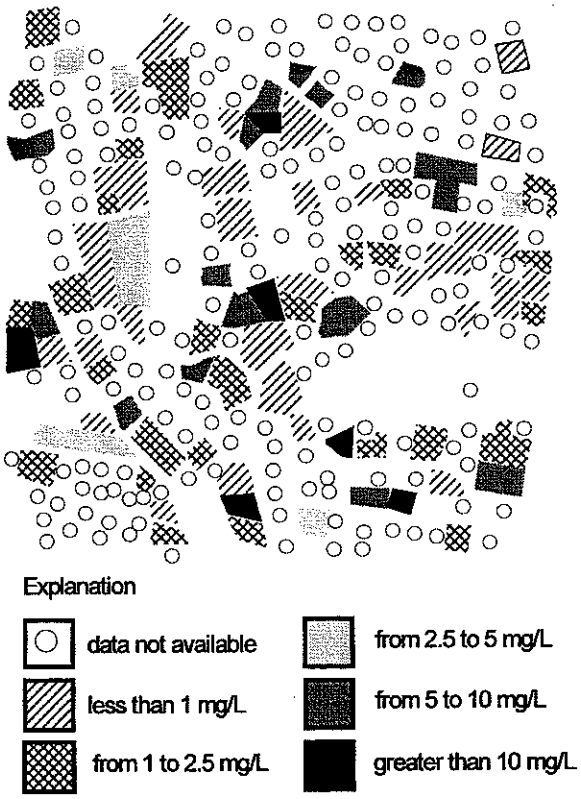


Figure 3.
Random distribution of high nitrate levels sampled in private wells for a subregion of the Outer Cape, 1985 to 1994.

While the vast majority of private wells provide high quality drinking water, analysis also shows that cross-contamination periodically occurs in all areas of the Outer Cape.

The random groupings of high and low nitrate levels is typical of private well environments. Many site-specific factors contribute to this randomness – including well depth, seasonal fluctuations in precipitation and wastewater discharge, distance between a well and nearby septic systems, local flow conditions, and others – but the most notable factor is density. Periodic cross-contamination is an inevitable result of having onsite septic systems and wells on parcels which are generally under three quarters of an acre. Water quality problems may be resolved by moving an affected well to a new location on the property or drilling deeper. These "lot-by-lot" measures are short term solutions at best when lot sizes are less than a half acre and surrounding wells are already impaired.

Wellfleet Center and the Rt 6 corridor in North Eastham are areas which are approaching the point where "lot-by-lot" measures are no longer long-term solutions. In Wellfleet Center the median lot size is around a third of an acre. As shown in Figure 4, 1 of every 3 wells in Wellfleet Center and as many as 1 of every 5 wells along the Rt 6 corridor in Eastham exceeded nitrate levels of 5 mg/L from 1985 to 1994.

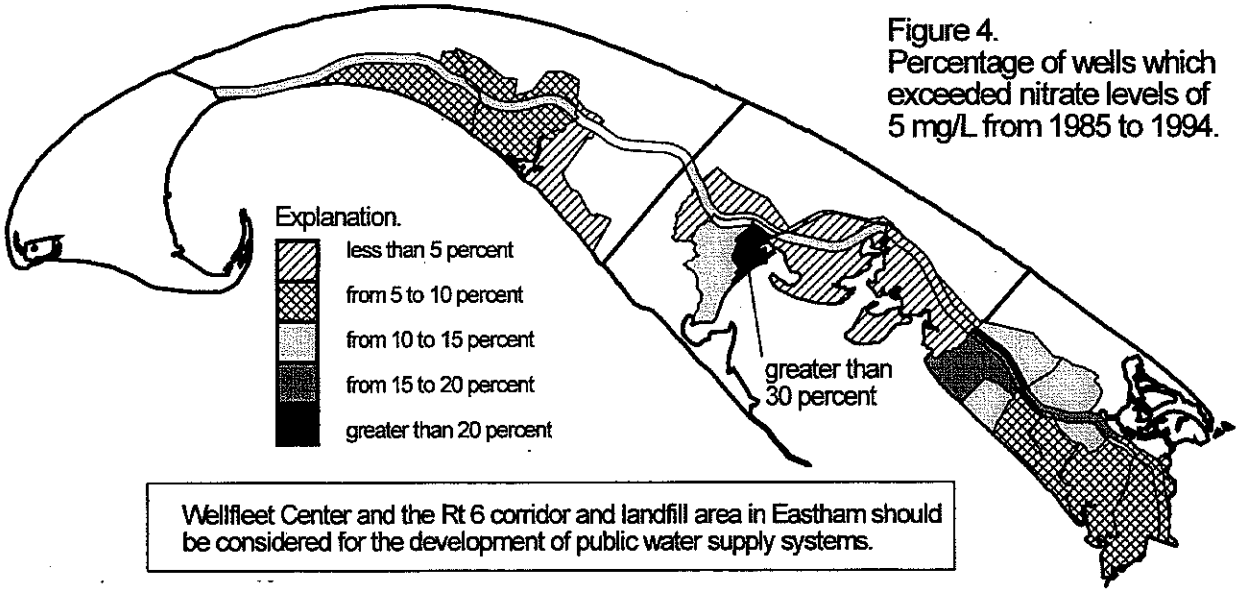


Figure 4.
Percentage of wells which exceeded nitrate levels of 5 mg/L from 1985 to 1994.

Future condition

Projecting private well water quality conditions into the future is understandably a less straight-forward task. For any given well it is impossible to predict what its water quality will be in the next month, year, or decade. There are simply too many variables and too much uncertainty.

However, it is possible to reasonably project water quality for groups of private wells if we only consider a few of the more important and more easily measured parameters. Three such parameters are percent buildout, seasonal occupancy, and median lot size. In order to assess the relation between growth and private well water quality, these three terms were combined into a single term called development density. The 31 subregions of the Outer Cape shown in Figure 4 include 15 which snake along the Rt 6 corridor and 16 which lie away from the Rt 6 corridor and are predominantly residential. These 16 residential subregions are graphed in Figure 5 (as dots) according to development density (along the horizontal axis) and nitrate levels (along the vertical axis). This graph indicates that increases in development density lead to increases in nitrate levels.

The line that runs through the data points in Figure 5 is called a best fit line. Not only does this line indicate that development density is the primary cause of elevated nitrate levels and exceedences in high density areas of the Outer Cape, it also provides a mechanism for predicting water quality into the future. From 1990 to 1994, 1 of every 28 wells in Truro and 1 of every 10 wells in Wellfleet and Eastham exceeded nitrate levels of 5 mg/L. The number of wells that provide high quality drinking water will decrease as growth continues in the future. At 100 percent buildout with existing seasonal occupancy, the best fit line predicts that 1 of every 16 wells in Truro, 1 of every 6 wells in Wellfleet, and 1 of every 4 wells in Eastham will exceed nitrate levels of 5 mg/L. At 100 percent buildout and year-round occupancy increasing by 25 percent, the best fit line predicts that 1 of every 9 wells in Truro, 1 of every 5 wells in Wellfleet, and 1 of every 3 wells in Eastham will exceed nitrate levels of 5 mg/L. (Future predictions do not include Wellfleet Center since it is assumed that drinking water in this area will be provided from public wells.) As shown in Figure 6, the majority of private wells will still provide high quality drinking water into the future but it will be a considerably smaller majority than exists presently on the Outer Cape.

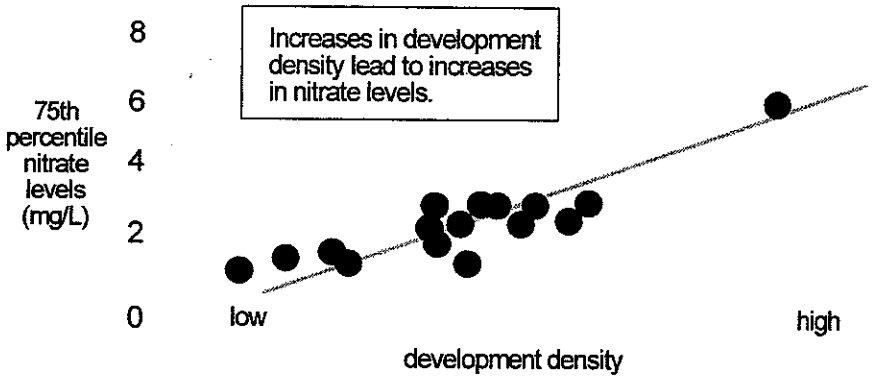


Figure 5.
The relation between development density and nitrate levels.

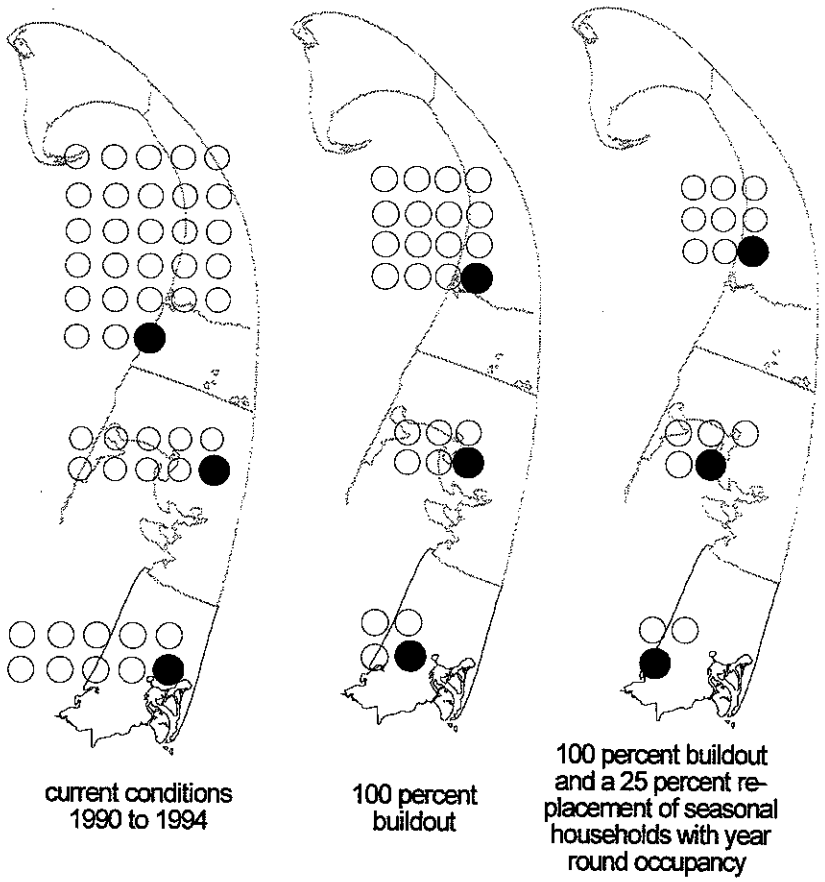


Figure 6.
Projected water quality in private wells for residential areas of Truro, Wellfleet, and Eastham.

Explanation.

● wells will exceed nitrate levels of 5 mg/L

○ wells will not exceed nitrate levels of 5 mg/L

The number of wells that provide high quality drinking water will still be a majority in the future but it will be a smaller majority than in the present.

Water Quantity

How much water is available for high-yield groundwater withdrawal from public wells?

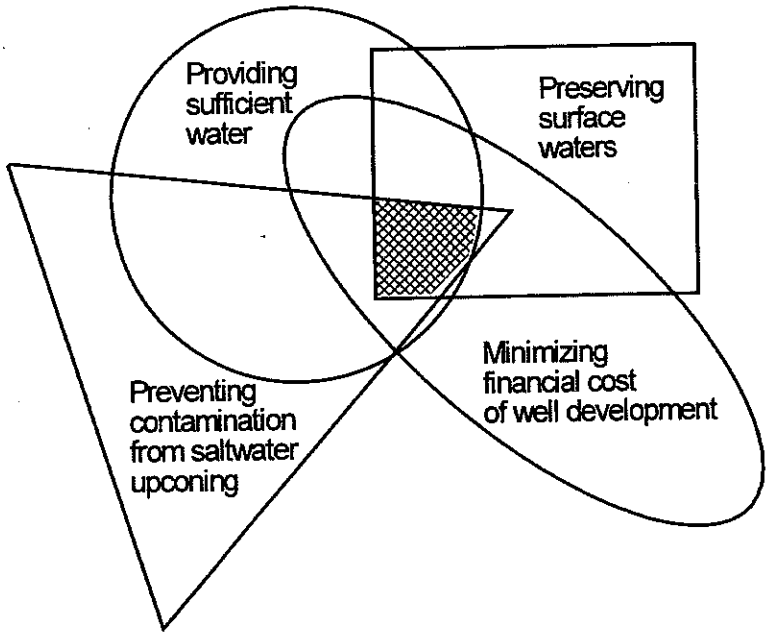


Figure 7.
Ven diagram of the water quantity issue considered in this study.

Identifying suitable locations for public wells is difficult on the Outer Cape because the region's political boundaries do not coincide with its hydrogeologic boundaries and because there are several (and often contradictory) management criteria that have to be simultaneously considered.

The first criterion that must be considered is water demand. How much water is needed for each of the service areas? Water use for existing water supply districts on Cape Cod ranges from 151 to 387 with an average water use of 244 gallons per day per connection. Analysis also suggests that water demand is more reliable to predict in terms of "use per connection" as opposed to "use per capita." This is likely due to large seasonal shifts in population across Cape Cod. Water demand (for potential and existing service areas) is estimated to be 600,000 gallons per day for the Rt 6 corridor and landfill area in Eastham, 300,000 gallons per day for Wellfleet Center, and 1.2 million gallons per day for Provincetown and North Truro in year 2020.

Financial cost is another obvious criterion. It is impossible to plan for a public water supply system without reasonable understanding of the capital expenses, operational expenses, and possibilities for grants and loans. Adding a public well on Cape Cod generally costs from $500,000 to $2.2 million with an average of $1 million. This includes site exploration, land acquisition, regulatory approval from the Department of Environmental Protection (DEP), and final construction of the well and pumping station. Adding water mains costs from $350,000 to $600,000 per mile ($66 to $114 per foot) and is by far the largest capital expense for developing a public water supply system. The cost of running a public water supply system on Cape Cod ranges from $430,000 to $1.3 million per year for a system that provides a million gallons of water per day. Capital expenses are often subsidized by grants and low-interest loans whereas operational costs are generally paid for completely from user fees.

There are also important water quality and environmental criteria that have to be considered on the Outer Cape when developing a public water supply system. Wells have to be strategically located in order to prevent contamination from saltwater upconing such as has historically been a problem at the Knowles Crossing public well on the Pamet Lens. Wells also have to be strategically located away from areas of high housing density. Along these lines, the towns have retained the rights to large parcels adjacent to and within the National Seashore so that the contributing areas for these wells can extend into the undeveloped acreage of the National Seashore and provide high quality drinking water. High-yield groundwater withdrawal also lowers the water table around the well (called a cone of depression) and can potentially degrade the natural ecology of surface waters in situations where wells are located too closely to surface waters or rates of withdrawal are too high. These resources are protected under National Park Service (NPS) and Massachusetts Department of Environmental Management (DEM) policies. It has been hypothesized that these types of environmental impacts could be avoided if well site selection included all areas of the Outer Cape rather than being "pigeon holed" to the subset of locations that are outside park-owned land. However, the Park Service has only very limited authority to allow public wells within its borders.

Building an optimization model

In order to find the well locations and pumping rates which meet all the criteria discussed above, the Task Force developed an optimization model. As illustrated in Figure 7, the goal of optimization is to find the subset of well locations and pumping rates which are best at (1) providing sufficient water to areas of private well impairment, (2) preserving the ecological function of surface waters and streams, (3) preventing contamination from saltwater upconing and other sources, and (4) minimizing the financial cost of well site development. This is achieved by bridging the hydrogeologic and management components of the Outer Cape system into a single framework called an optimization model.

The hydrogeologic component of the optimization model is based on the U.S. Geological Survey's computer models of the Nauset, Chequesset, and Pamet Lenses (Masterson and Barlow 1994). In these models, the contiguous flow system of a groundwater lens is divided into a three-dimensional grid of cells. Each cell is assigned specific geologic and hydrologic properties based on data collected in the field. This concept is illustrated in Figure 8 using a cartoon profile view of a groundwater lens.

The management component of the optimization model is built by "earmarking" critical areas in each lens. There are two types of critical locations. The first include any areas where groundwater may be withdrawn from the lens – such as at potential well sites – or any areas where water may be returned to the lens – such as from septic systems within potential service areas. The second include any areas which are sensitive to groundwater withdrawal such as vernal pools, kettle ponds, streams, and saltwater upconing at well sites. Figure 9 shows the critical locations that are "earmarked" for the Pamet, Chequesset, and Nauset Lenses. Besides just "earmarking" these critical locations, it is also possible to assign management criteria by embedding impact limits (called constraints) at critical areas and ranking possible options (called preferences) according to cost or surface water impacts.

The hydrogeologic component of the model is based on the U.S. Geological survey's computer models of the Outer Cape lenses (Masterson and Barlow, 1994). In these models, the contiguous flow system of a lens is divided into a three-dimensional grid of cells. Each cell is assigned geologic and hydrologic properties based on data collected in the field as shown in Figure 9.

The management component of the model is build by "earmarking" critical areas in the models as shown in Figure 10.

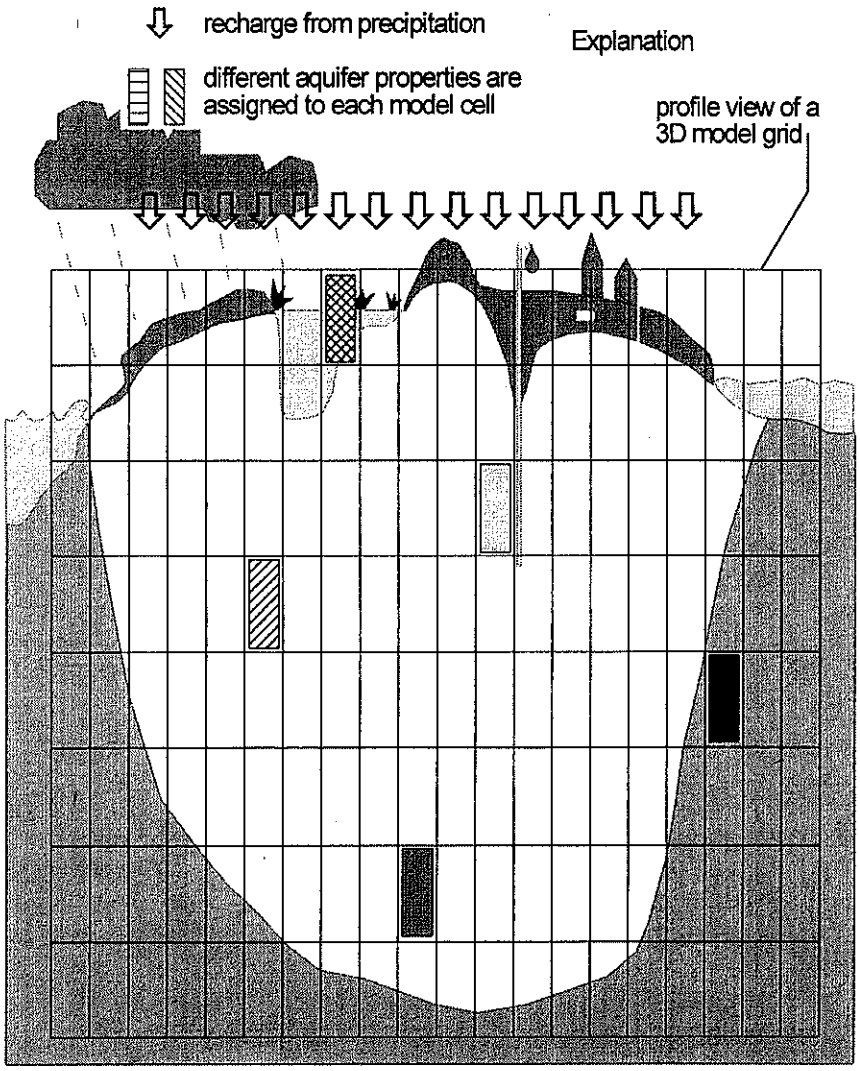


Figure 8. Hydrogeologic component of the optimization model.

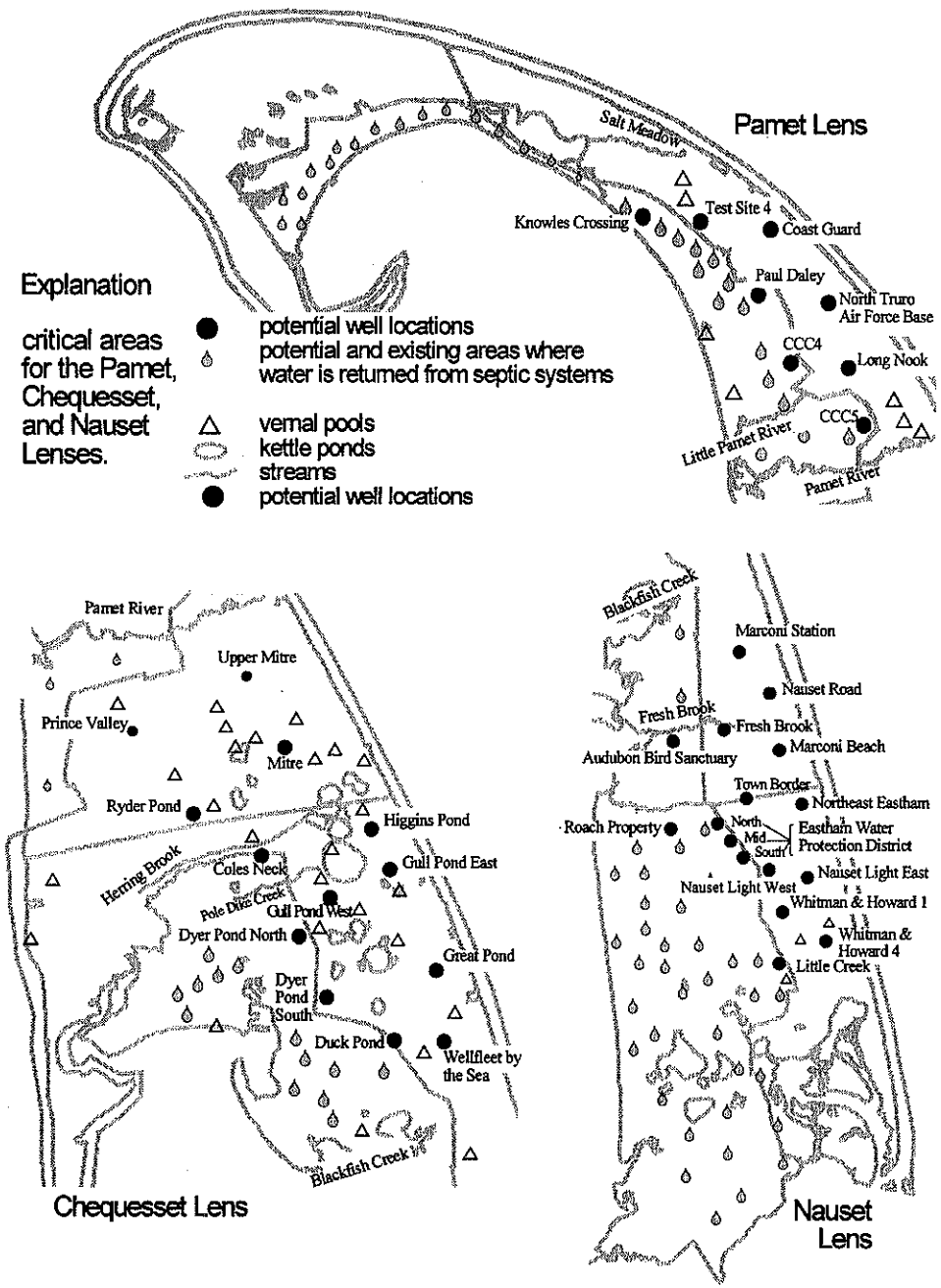


Figure 9. Management component of the optimization model.

Results of the optimization model

Optimizing for potential well sites pumping individually

The first and simplest method of optimization was performed for the 37 potential well locations shown in Figure 9 pumping individually. These potential well locations were placed inside and outside the National Seashore without regard to political boundaries and were chosen to correspond with potential sites identified in past investigations wherever possible.

This method of optimization demonstrates three points. First, potential well locations are hydrologically capable of pumping large amounts of water, often in excess of 1 million gallons per day (Mgal/day), when only saltwater upconing is defined as a limiting factor. This pumping capacity is called upconing yield and is shown in Figure 10 as rings. Second, upconing yields are significantly reduced when impacts to nearby surface waters are also defined as limiting factors. This more reduced pumping capacity is defined safe yield and is shown in Figure 10 as dots. The third point to notice is the relative difference between the upconing and safe yields at each well location. Surface waters are most sensitive to pumping at sites with the largest difference and least sensitive to pumping at sites with the smallest difference.

Optimizing for potential and existing service areas

As one can imagine, there are many different ways the 37 potential well sites shown in Figure 10 can be arranged to provide water to potential and existing service area. For example, the 8 potential well sites identified on the Pamet Lens can be arranged into a total of 255 different combinations of wells. The idea of optimization is to pick the subset of these 255 total combinations which minimize impacts to surface waters, minimize financial cost, provide sufficient water, and also prevent saltwater upconing. In order to do this the pumping rates of individual wells are iteratively adjusted in the optimization model until surface water impacts are minimized, the total demand is still met, and saltwater upconing is prevented. Combinations which contain well sites optimized with pumping rates under 100,000 gallons per day are rejected since sites with such low pumping rates are not considered to be economically worth developing.

Figure 11 shows all the acceptable combinations for providing public water to Provincetown and North Truro from the Pamet Lens. Each dot on the graph represents a different combination of wells. Hollow dots represent well combinations which contain at least one site within the National Seashore and are called resource-based options. Solid dots represent well combinations which do not include any sites within the National Seashore and are called politically-based options. All possible combinations are graphed according to surface water impacts (along the vertical axis) and financial cost of well site development (along the horizontal axis). The win-win options are the combinations which have both low impacts to surface waters and low financial cost. They fall in the bottom left corner of the graphs in Figure 11 and represent the "short list" of preferred options summarized in the adjacent table. Figures 12 and 13 summarize the identical optimization approach for providing water to Wellfleet Center and the Rt 6 corridor and landfill area in Eastham. Major findings are summarized below.

Notes about optimization

The optimization model was built by transferring the data sets contained in the U.S. Geologic Survey's MODFLOW models of the Outer Cape lenses into a model called MODRSP (Maddock and Lacher 1990). MODRSP is used to generate a series of mathematical terms called responses that describe the incremental influence that pumping has at critical areas in the lenses.

There are two types of critical locations. The first include any areas where water may be withdrawn from the lens – such as potential well locations – or areas which are sensitive to groundwater pumping – such as surface waters. It is also possible to assign management criteria called constraints and preferences to these critical areas.

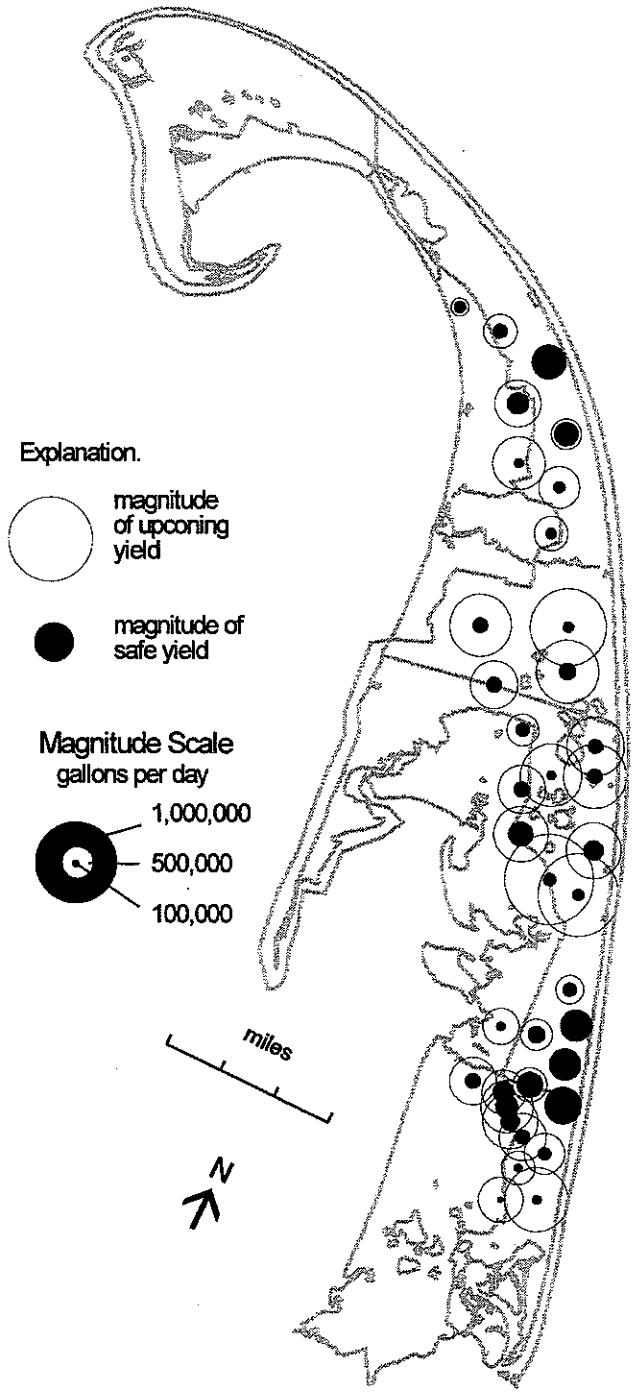
Constraints describe concrete management goals which cannot be violated such as dewatering a vernal pool or causing saltwater upconing at a well site. Our constraint for preventing saltwater upconing is called upconing yield. It is based on an estimate of the maximum drawdown that can occur at a well site without creating conditions favorable to saltwater upconing.

Our constraint for preventing impacts to surface waters is called the surface water constraint (SWC) index. Because it is impossible to know the exact ecological threshold of every surface water body that we have "earmarked" for protection, we combined all surface waters into a single term called the SWC index. If the SWC index is fixed at 0.5, this means that drawdown below all vernal pools and kettle ponds cannot exceed 1/2 feet and flow reduction to streams cannot exceed 5 percent.

Preferences describe flexible management goals defined by a set of prioritized options. Cost is treated as a preference in the optimization model because there may exist many combinations of wells which can provide sufficient water to potential service areas. The most preferred options are the ones that cost the least. For our model cost is based on the distance of water main between the well and service area and well site development.

The premise of the optimization model is similar to the way in which we use the network of lines and symbols on a road map to select the best path to travel between two points (Wang and Anderson 1982). The responses, constraints, and preferences are arranged (using the FORTRAN computer programming language) so that all possible well combinations can be tested simultaneously and then compared to one another to determine which ones best meet the management criteria.

Figure 10. Upconing and safe yields.



Surface waters are most sensitive to pumping at sites with the largest difference between upconing and safe yields and least sensitive to pumping at sites with the smallest difference.

Provincetown Water Department (PWD) should continue using Paul Daley, Knowles Crossing, and North Truro Air Force Station (NTAFS) wells to provide public water to Provincetown and North Truro. Impacts to surface waters can be minimized by increasing yield at NTAFS. South Dyer Pond site is considered the best location for providing public water to Wellfleet Center. Coles Neck, Duck Pond, or Great Pond should be considered as secondary sources. Eastham should consider using either the Northeast Eastham or Eastham Water Protection District (EWPD) site for providing water to the Rt 6 corridor and landfill area. The Roach Property or Town Border sites should be considered as secondary sources.

"Opening" and "closing" the door to the National Seashore (i.e., comparing resource-based and politically-based options) highlights how and why cooperation between the towns and National Seashore is needed to most effectively manage the Outer Cape's water resources. On the Pamet Lens this cooperation centers around the NTAFS well. This well has been used on a seasonal basis by PWD over the past two decades and, following the recent transfer of the site from the Department of Defense (DOD) to the National Park Service (NPS), continues to be used under a special emergency permit granted by the Seashore. Establishing a long-term agreement for this well is beneficial to the Seashore in terms of protecting surface waters and to PWD in terms of financial cost.

Cooperation is also needed on the Chequesset Lens. Coles Neck is currently used to supply water to around twenty connections near the landfill and, if expanded, this site is hydrologically capable of providing water to Wellfleet Center. This could not occur without the threat of reducing freshwater flow to Herring Brook yet the site is legally outside the jurisdiction of the National Seashore. For this reason, impacts to surface waters can be most effectively minimized if pumping primarily occurs at the South Dyer Pond site and Coles Neck is used as a secondary source.

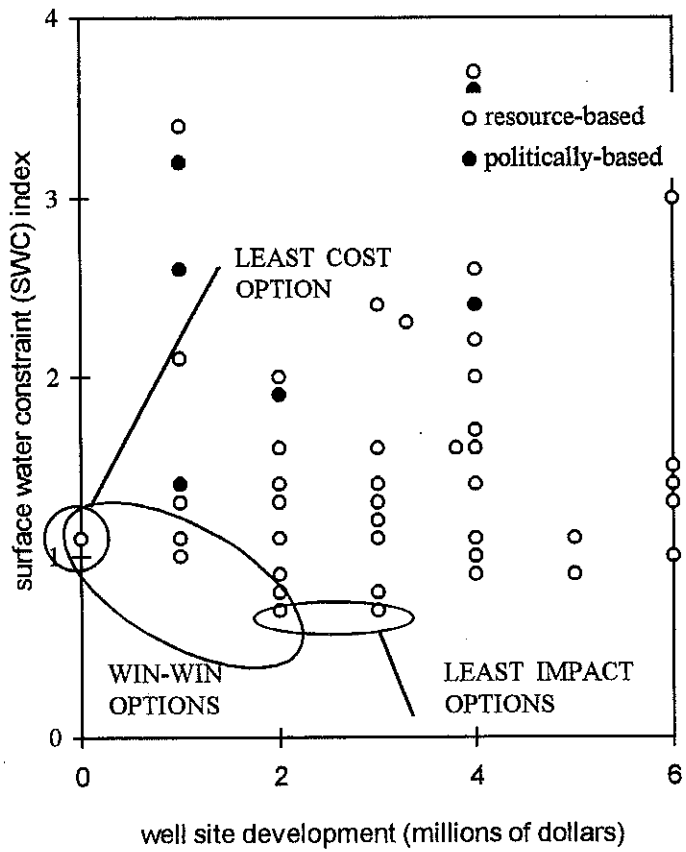
Political boundaries similarly complicate water resources management on the Nauset Lens. Surface waters within the National Seashore are most impacted by pumping from sites on town-owned land (Whitman & Howard 1, Whitman & Howard 4, and Little Creek sites). On the other hand, the sites which cause the least impact to surface waters (Northeast Eastham, Marconi Beach, and Nauset Road sites) are located on park-owned land within the Seashore. Town-owned sites in North Eastham (EWPD and Roach Property) are capable of meeting potential demand in the near future. However, a combination of sites inside and outside the National Seashore should be considered in the future if demand for a public water supply system expands into residential areas of the town.

Optimizing for providing public water to everyone on the Outer Cape

This leads to the third and final method of optimization – is it possible to provide public water to everyone on the Outer Cape? This question was explored to highlight the environmental and financial limits of a worst case, and rather unlikely, scenario.

The question was addressed in two steps. First, total water demand in the year 2020 was projected for each of the lenses. Providing water to everyone would require 2.23 Mgal/day of water from the Pamet Lens, 0.95 Mgal/day from the Chequesset Lens, and 2.09 Mgal/day from the Nauset Lens. Second, the best well locations and pumping rates for withdrawing this total demand were identified. This was done by testing all 1, 2, 3, 4, 5, 6, and 7 well combinations on the Pamet, Chequesset, and Nauset Lenses. It was assumed that water should not be transported "off lens" except in the case of Provincetown and North Truro

Figure 11. Optimized options for providing public water to Provincetown and North Truro, year 2020.

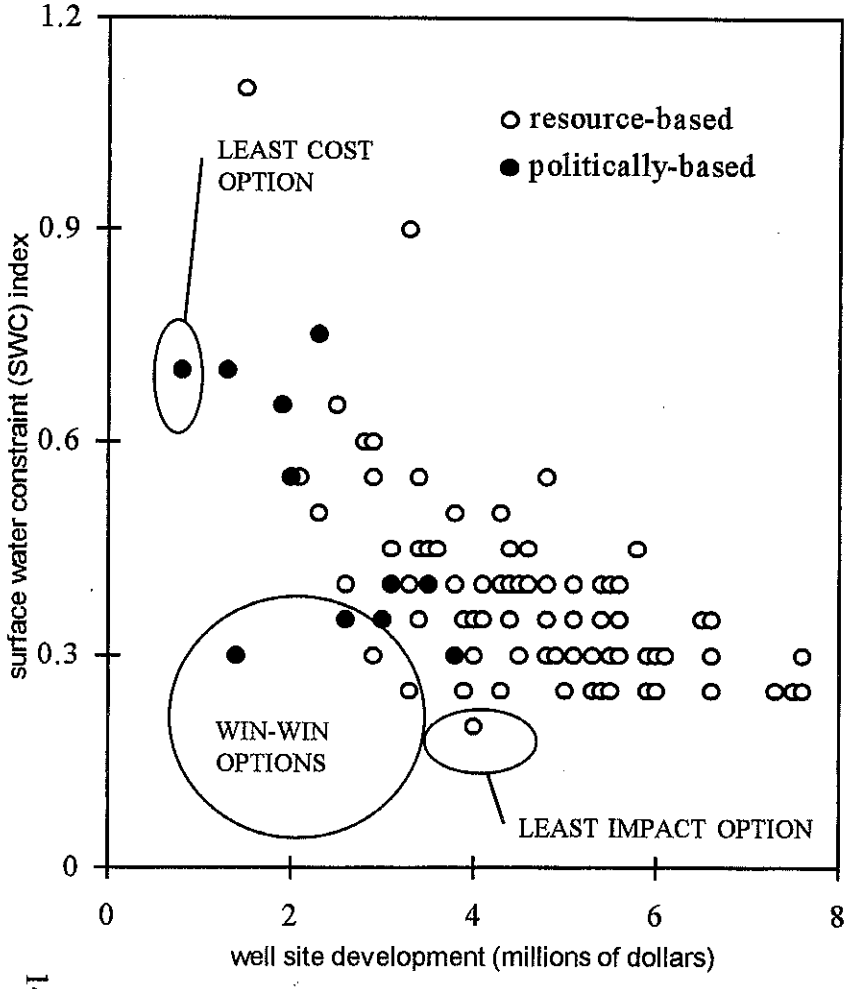


well 1		well 2		well 3		well 4		optimization information		
location	rate (MGD)	location	rate MGD	location	rate (MGD)	location	rate MGD	cost ($1M)	SWC index	well locations
WIN-WIN OPTIONS										
PD	0.45	NTAFB	0.45	KC	0.31	N/A	N/A	0	1.1	resource
PD	0.36	NTAFB	0.36	TS4	0.36	KC	0.15	1	1	resource
NTAF	0.43	TS4	0.43	PD	0.33	N/A	N/A	1	1	resource
CG	0.53	NTAFB	0.46	PD	0.21	N/A	N/A	2	0.9	resource
CG	0.47	NTAFB	0.47	KC	0.26	N/A	N/A	2	0.7	resource
PD	0.48	CG	0.48	KC	0.24	N/A	N/A	2	0.8	resource
OPTIONS WITH LEAST FINANCIAL COST										
PD	0.45	NTAFB	0.45	KC	0.31	N/A	N/A	0	1.1	resource
OPTIONS WITH LEAST IMPACTS TO SURFACE WATERS										
CG	0.47	NTAFB	0.47	KC	0.26	N/A	N/A	2	0.7	resource
CG	0.46	NTAFB	0.46	TS4	0.29	N/A	N/A	3	0.7	resource

CG - Coast Guard, KC - Knowles Crossing, PD - Paul Daley, NT - North Truro Air Force Base, TS4 - Test Site 4, N/A - not applicable

Notes:
Optimization was conducted for all possible well combinations.
Projected 2020 water demand is 1.20 million gallons per day (MGD).
Units of surface water constraint (SWC) index are ft of drawdown for inland surface waters and 1/10 the percentage of flow reduction for streams.

Figure 12. Optimized options for providing public water to Wellfleet Center, year 2020

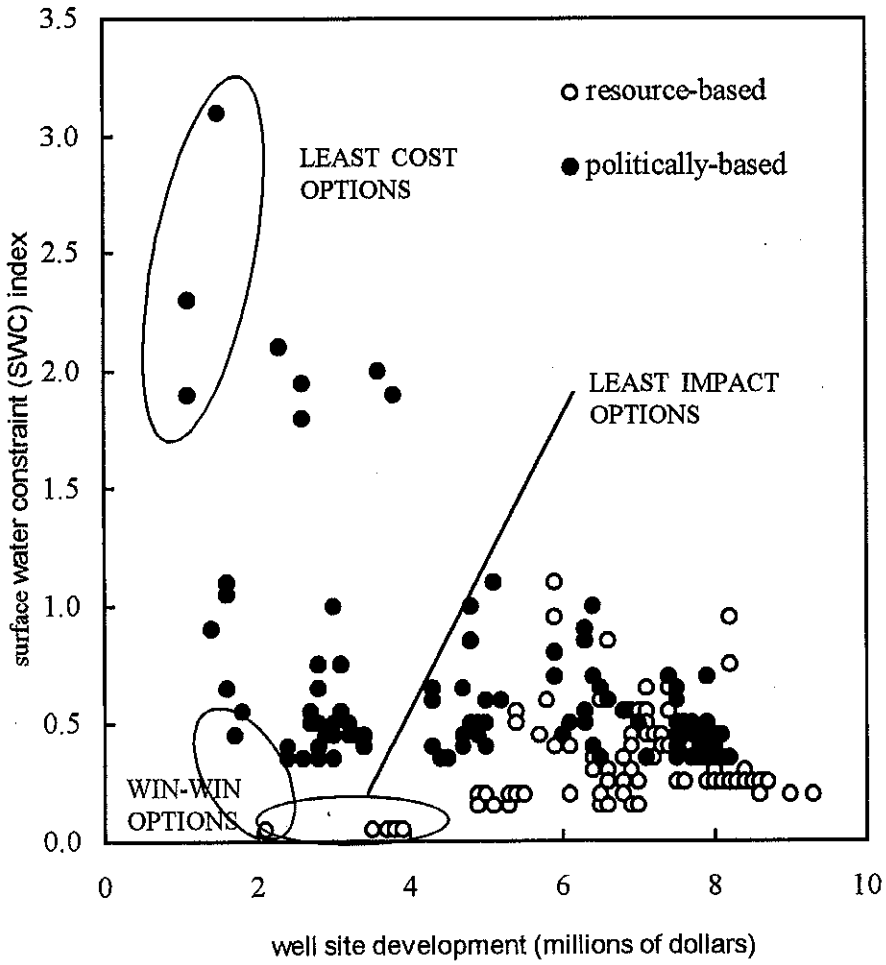


well 1		well 2		optimization information		
location	rate (MGD)	location	rate (MGD)	cost ($1M)	SWC index	well locations
WIN-WIN OPTIONS						
Dyer P. - S	0.30	N/A	N/A	1.3	0.3	political
Coles Neck	0.15	Duck P.	0.15	2.6	0.4	political
Great P.	0.30	N/A	N/A	2.6	0.4	resource
Coles Neck	0.15	Gull P. - E	0.15	2.6	0.4	resource
Coles Neck	0.13	Great P.	0.17	2.9	0.3	resource
OPTIONS WITH LEAST FINANCIAL COST						
Coles Neck	0.30	N/A	N/A	0.8	0.7	political
OPTIONS WITH LEAST IMPACTS TO SURFACE WATERS						
Dyer P. - S	0.19	Mitre	0.11	4	0.2	resource

P. - pond, S - South, E - East, N/A - not applicable

Notes:
Optimization was conducted for all one, two, and three well combinations.
Projected 2020 water demand is 0.30 million gallons per day (MGD).
Units of surface water constraint (SWC) index are ft of drawdown for inland surface waters and 1/10 the percentage of flow reduction for streams.

Figure 13. Optimized options for providing public water to the Rt 6 corridor and landfill area in Eastham, year 2020



well 1		well 2		optimization information		
location	rate (MGD)	location	rate (MGD)	cost ($1M)	SWC index	well loczations
WIN-WIN OPTIONS						
NE Eastham	0.65	N/A	N/A	2.1	0.05	resource
Mid-EWPD	0.65	N/A	N/A	1.7	0.45	political
Town Border	0.44	Roach P.	0.22	2.8	0.35	political
OPTIONS WITH LEAST FINANCIAL COST						
W&H 4	0.65	N/A	N/A	1.1	1.9	political
W&H1	0.65	N/A	N/A	1.1	2.3	political
Little Creek	0.65	N/A	N/A	1.3	3.1	political
OPTIONS WITH LEAST IMPACTS TO SURFACE WATERS						
NE Eastham	0.65	N/A	N/A	1.7	0.45	resource
NE Eastham	0.51	NL-West	0.14	3.5	0.05	resource
NE Eastham	0.53	NL-East	0.12	3.7	0.05	resource
NE Eastham	0.53	EWPD-M	0.13	3.8	0.05	resource
NE Eastham	0.46	EWPD-N	0.19	3.9	0.05	resource

NL - Nauset Light, W&H - Whitman & Howard, N/A - not applicable

Notes:
Optimization was conducted for all one, two, and three well combinations.
Projected 2020 water demand is 0.65 million gallons per day (MGD).
Units of surface water constraint (SWC) index are ft of drawdown for inland surface waters and 1/10 the percentage of flow reduction for streams.

where water is transported from the Pamet Lens.

Analysis shows that it is hydrologically possible to provide public water to everyone on the Outer Cape. It would require at least 4 wells on the Pamet Lens, 1 well on the Chequesset Lens, and 4 wells on the Nauset Lens. Additional sites would be needed as secondary sources. Impacts to surface waters could be more effectively minimized by strategically locating higher yielding wells in areas of low surface water sensitivity as opposed to using many more lower yielding wells in higher sensitivity areas. Regardless of how the wells are arranged, however, it is impossible to provide public water to everyone without impacting some surface waters and accruing significant capital and operational costs. Using "rule of thumb" estimates, capital expenses would be around $43 million for Eastham, $28 million for Wellfleet, and $20 million for Truro in 1995 dollars. Annual operational costs would be around $1.6 million for Eastham, $700,000 for Wellfleet, and $1.8 million for Truro.

Conclusions and Recommendations

Conclusions

Groundwater is the source of drinking water and area of wastewater disposal for everyone on the Outer Cape. Most of its population depends on private and small volume wells for their drinking water and reside on lots that are generally less than three quarters of an acre. Everyone on the Outer Cape uses onsite septic systems to dispose of their wastewater. This means that effluent from septic systems is being discharged into the water table below the same lots where drinking water is being pumped by private wells.

From 1985 to 1994, 3 of every 4 wells did not exceed nitrate levels of 2.7 mg/L in Eastham, 2.0 mg/L in Wellfleet, and 1.4 mg/L in Truro. This means that the vast majority of private wells provide high quality drinking water. Analysis also shows that cross-contamination periodically occurs in all areas of the Outer Cape. This is an inevitable result of having onsite septic systems and private wells on lots which are generally under three quarters of an acre. "Lot-by-lot" efforts to correct these problems (such as relocating the affected well or drilling deeper) are not long-term solutions when lots are less than a half acre and surrounding wells are already impaired.

Wellfleet Center and the Rt 6 corridor and landfill area in Eastham should be considered for the development of public water supply systems. The median lot size in Wellfleet Center is a third of an acre. From 1985 to 1994, 1 of every 3 wells in Wellfleet Center and as many as 1 of every 5 wells along the Rt 6 corridor in Eastham exceeded nitrate levels of 5 mg/L.

The number of wells that provide high quality drinking water is predicted to decrease in the future as growth to buildout occurs and seasonal households are replaced with year-round occupancy. From 1990 to 1994, 1 of every 28 wells in Truro and 1 of every 10 wells in Wellfleet and Eastham exceeded nitrate levels of 5 mg/L. At 100 percent buildout with existing seasonal occupancy, our analysis predicts that 1 of every 16 wells in Truro, 1 of every 6 wells in Wellfleet, and 1 of every 4 wells in Eastham will exceed nitrate levels of 5 mg/L. At 100 percent buildout and year-round occupancy increasing by 25 percent, our analysis predicts that 1 of every 9 wells in Truro, 1 of every 5 wells in Wellfleet, and 1 of every 3 wells in Eastham will exceed nitrate levels of 5 mg/L. (Future predictions do not

include Wellfleet Center since it is assumed that drinking water in this area will be provided from public wells).

An optimization model was developed to find the well locations and pumping rates which best meet the management goals of (1) providing sufficient water to areas of private well impairment, (2) preserving the ecological function of surface waters and streams, (3) preventing contamination from saltwater upconing and other sources, and (4) minimizing the financial cost of well site development.

The first method of optimization indicates that well sites are hydrologically capable of pumping large amounts of water, often in excess of 1 Mgal/day, when only saltwater upconing is defined as a limiting factor. Pumping yields are significantly reduced, however, when impacts to nearby surface waters are also defined as limiting factors. The second method of optimization indicates that Provincetown Water Department (PWD) should continue using Paul Daley, Knowles Crossing, and North Truro Air Force Station (NTAFS) wells to provide public water to Provincetown and North Truro. South Dyer Pond site is considered the best location for providing public water to Wellfleet Center. Eastham should consider using either the Northeast Eastham or Eastham Water Protection District (EWPD) site for providing water to the Rt 6 corridor and landfill area. A third method of optimization indicates that it is hydrologically possible but financially and environmentally unwise to provide public water to everyone on the Outer Cape.

"Opening" and "closing" the door to the National Seashore (i.e., comparing resource-based and politically-based options) highlights how and why cooperation between the towns and National Seashore is needed to most effectively manage the Outer Cape's water resources. Cooperation will be especially important in the future since growth toward buildout conditions and shifts in seasonal occupancy are predicted to significantly impact private well water quality and may require the expansion of public water services into residential areas.

Recommendations

Wellfleet Center and the Rt 6 corridor and landfill area in Eastham should be considered for the development of public water supply systems. Providing public water to Wellfleet Center is estimated to cost from $4 to $6 million in capital expenses and around $250,000 in annual operational expenses. Providing public water to the Rt 6 corridor and landfill area is estimated to cost from $6 to $9 million in capital expenses and around $500,000 in operational expenses. Further cost analysis – including site-specific surveys, financial assistance planning (grants and low-interest loans), and establishing the institutional framework (i.e., what are the fiscal benefits of regionalization in terms of avoiding redundant costs and competing for available grants?) – is the next step of this planning process. An advantage of establishing water supply systems for Wellfleet and Eastham in the near future is that there will be a greater likelihood that future expansion of the system into residential areas could be subsidized by federal and state grants phased in over several years. This is less of a possibility if there is not an existing system.

A private well water quality monitoring program should be established in order to track water quality conditions into the future. Our analysis suggests that future growth and the replacement of seasonal households with year round occupancy may significantly impact drinking water quality of private wells on the Outer Cape, especially in high density areas of Eastham and Wellfleet, and may require the expansion of public water services into

residential areas. It not possible to predict the exact geographic extent or time that problems may occur in the future. The benefit of establishing a monitoring program is that water quality problems can be planned for as they develop rather than reacting to them after they occur.

The potential impacts of groundwater pumping on the hydrology and ecology of vernal pools and kettle ponds should be considered in greater detail. Although the optimization model is instructive for identifying locations which will minimize impacts to surface waters, it offers a rather broad view that cannot be used to infer local-scale hydrologic and ecologic responses. For this reason, the National Seashore has recently initiated indepth investigations regarding the local-scale impacts of groundwater pumping on the hydrology and ecology of vernal pools and kettle ponds (Roman et al 1996).

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Outer Cape Capacity Study

Fiscal Impact Analysis

Prepared for the Outer Cape Capacity Study Steering Committee

Prepared by

Whiteman & Taintor
Planning, Policy and Development Consultants

December 1996

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FISCAL IMPACT ASSESSMENT

INTRODUCTION

This element of the Outer Cape Capacity Study estimates the future municipal revenues and costs that can be expected by each town as growth proceeds. The purpose of this analysis is to isolate the added costs and revenues that additional growth will bring to the Outer Cape communities. To accomplish this, the analysis presents two separate forecasts for each community. The first is a baseline forecast that looks at a hypothetical future with no residential or commercial development beyond what exists today. Under this scenario, operating expenditures are held to their current levels, and only those capital expenditures that will be required regardless of future growth are included. This scenario thus looks only at the costs and revenues that can be expected from the people and development that already exist in each town.

The second forecast is a "growth scenario" that examines the likely fiscal situation for each town if current residential and commercial growth patterns continue for the next 20 years. In this scenario, the tax base is increased according to assumed residential and commercial growth rates and average values of developed parcels, and operating costs are increased based on population growth using multipliers derived from an analysis of small communities in Massachusetts. In addition, capital expenditures that will be required to serve future population growth are included. Comparing the growth scenario with the baseline scenario provides estimates of the incremental impacts caused by growth versus those that are caused by existing development.

Several assumptions within the model are of particular importance in understanding and using these forecasts. These assumptions are explained in the methodology section. It is important to keep these concepts in mind when reviewing the results of the analysis.

It is also important to emphasize that these analyses are intended to estimate the role that continued growth will play in the magnitude and cost

distribution of future budgets in the Outer Cape towns. They are not intended to forecast actual future budgets or costs. Actual future budgets will be greatly influenced by inflation, changing economic conditions, and policy decisions that local residents make as members of Town boards, and as voters at Town Meetings and elections—factors which cannot be simulated in a computer spreadsheet model such as is presented here.

METHOD AND APPROACH

The process of creating this fiscal impact assessment model extended for over a year. The model presented in this report is the result of several iterations, the details of which are presented in *Appendix A—Development of the Model*. These iterations were important to the process for three reasons:

- they compared the Outer Cape towns with other Massachusetts communities (especially other tourism communities) so as to understand the degree to which there may be underlying fiscal growth trends that the Outer Cape communities will also experience as they develop,

- they considered in great deal the best methods to use to approximate reality while keeping the model at a level of detail that will be understandable by the lay public, and

- they explored the sensitivity of the model to varying rates of appreciation, inflation and growth rates.

The approach used for examining the capital costs associated with growth and those not associated with growth was to inventory all existing, planned and likely capital expenditures and make estimates of the degree to which the investment addressed the demands of population growth. The non-growth investments provided the baseline forecast which illustrates the types of capital expenditures needed even if no further growth occurs. The growth related costs were added to that for the growth scenarios. This basic approach was unchanged during the course of developing and refining the model. The operating cost assumptions, however, were tested from a variety of perspectives.

The steps taken in the course of developing the operating cost part of the model were the following:

1. Initially, it was assumed that current costs per capita should be used as the factor to multiply by future population and then estimate future costs. The assumption was that the current cost structure per capita would reflect the policy preferences and variations of different towns and thus provide a valid basis for estimating future costs. In other words, in the first version of the model, operating costs increased as the

population grew by a factor that represented the current costs per person in each town. Inflation was excluded in the first version of the model.

2. Research on 351 Massachusetts communities was then performed by the consultant and this work indicated that there are wide variations in per capita costs within Massachusetts towns and that no clear relationship appears to exist between population growth and operating costs. Multiple regressions failed to define a reliable equation to predict costs. The dependent variable was operating costs. Independent variables used in the regressions were population, population rate of change, percent of older persons, seasonal unit levels and percent of total assessed valuation in the residential category. The purpose of these iterations was to determine whether tourism-based or seasonal communities have stronger per capita cost relationships. No strong predictors were identified.

   The field was narrowed from 351 communities to 61 communities with populations of fewer than 45,000. The only independent variable used against cost was population. Scatter diagrams of this analysis were also produced to more clearly illustrate the degree of variation. Finally, a set of 43 tourism-oriented towns was analyzed and again, no clear relationship was found to exist between population growth and operating costs.

   The conclusion from this research is that in smaller communities there are a variety of factors that influence cost increases and that often the non-population related factors will offset population driven cost increases. For instance, fulfilling contractual salary requirements, meeting rapidly rising health care or pension costs for municipal employees, or making investments to meet new environmental regulations may all place much heavier burdens on small towns than will gradual population growth. The clearest exception to this hypothesis is the school system where there is a much clearer and more dramatic cost relationship with population growth.

3. Because no clear relationship between population and operating costs was determined through cross-sectional analysis of groups of Massachusetts communities, the next iteration of the model incorporated estimates of inflation to project future operating cost increases. It was decided to assume that operating costs would rise at an annual rate of 3 percent and that property values would appreciate at 4 percent per year. No increases in costs on a per person basis were included in this version of the model. Using inflation in the operating cost category required that it be used in the other budget categories as well.

This version of the model downplayed the potential operating cost impacts of population growth and concentrated on the capital facility impacts—both growth and non-growth. In fact, the chosen inflation rates of 3% for costs and 4% for property values guaranteed that growth would stay ahead of operating costs and thus operating costs would have a negligible fiscal impact. After reviewing the results of this iteration, the Committee was concerned that this lack of fiscal impact associated with increased population levels did not appear to make sense, and therefore Step #4 was taken.

4. Research by the consultants indicated that Outer Cape towns have experienced higher inflation rates than the 3% and 4% rates used above. Therefore, in the fourth version of the model a 8% cost inflation rate and a 4% real estate appreciation rate were used. These rates were based on Outer Cape towns' experiences over the last 10 years. When these figures were placed in the model, the resulting average tax rates and tax bills in the year 2015 were too high to appear valid—even though they were based on historic inflation rates. The Committee agreed to move back to a model that excluded inflation, but they requested that the consultants look again at whether some relationship exists between population growth and operating costs.

5. The consultants went back to the data on Massachusetts communities and ran new regression analyses. This time the analyses focused on changes in population and costs over time for a group of 236 communities with populations of less than 15,000 persons. In other words, rather than comparing towns with varying population levels at one point in time and trying to construct a model of how communities will respond as they move along the growth curve, this effort looked at whether there appeared to be a relationship between costs and population within individual towns over time. The independent variable was average annual population change over a ten-year period (1980-1990); the dependent variables were average annual school and non-school cost changes over an eight-year period (1985-93). The analyses suggested that both categories of operating costs increase with increased population, but more slowly than the rate of population growth. Specifically, the results of these analyses indicate that, on average, school expenditures increase 0.72% for every 1.0% increase in population, and non-school costs grow at a rate of 0.61% for every 1.0% in population change. (The stronger relationship for school costs is consistent with the results of previous analyses.)

   In order test whether tourism towns had a similar relationship, the same regression was used to analyze data for the 10 smallest towns of Barnstable County (i.e., the towns from Provincetown to Dennis, plus

Mashpee). The relationship between population and operating expenditures was found to be similar.

6. Finally, in order to make the analyses easier for the layperson to interpret, the model was run again with the data from the 10 small Cape Cod towns but using the average changes in the *absolute* values of the independent and dependent variables (i.e., numeric changes in the numbers of new residents, and inflation-adjusted changes in dollar expenditures for operating costs), rather than percentage rates of increase. The results of the analysis suggested that on average, school expenditures for smaller Cape Cod towns have increased by about $1,133 for every new resident, and that non-school expenditures have increased by about $975 for every new resident (after controlling for inflation). These figures were used as inputs in the fiscal forecast models to increase operating costs as town populations were forecast to grow.

The final version of the model thus incorporates specific relationships between the magnitude of costs that can be expected if no more growth were to occur and the added impacts associated with increased population and commercial growth. Operating costs rise gradually with population increases, but at a slower rate than population. This relationship reflects the economies of scale that Outer Cape towns will have and the fact that total future population growth in these communities will be relatively small. No Outer Cape community is expected to exceed a year-round population of 10,000 persons.

DESCRIPTION OF THE FISCAL IMPACT MODEL

Structure of the Model

The fiscal impact model consists of three linked computer spreadsheets and is designed for ease of use in order to allow communities to use the model as a tool.

1 – Inputs

This one-page form presents the key variables that are used in the analysis: the number of residential units and commercial acres at the start of the analysis, the residential and commercial growth rates, average residential and commercial values, bond interest rates, and ratios of school and non-school expenditure increase to population growth.

2 – Capital Costs

This four-page table lists the major needed capital improvements identified in the facility inventory, and projects their costs out over 25 years using the interest factors in the "Inputs" table.

This table also includes an estimate of "other debt": this figure is determined by subtracting the costs of identified major capital investments from the town's total debt service for 1995, and is held constant into the future. "Other debt" is assumed to be an ongoing level of debt that covers miscellaneous maintenance and smaller capital goods replacement.

3 – Growth Summary

This is an 8-page table presenting two parallel sets of forecasts. The "Baseline Forecasts" (pages 1–4) estimate municipal costs and revenues based solely on existing conditions and planned capital improvements: no new growth is added to the property tax base, and no costs are included for "growth-related" capital expenditures. The "Growth Scenarios" (pages 5–8) adds new growth and related capital expenditures to the baseline forecasts.

The above three sets of spreadsheets are included in Appendix B of this report.

A fourth spreadsheet, "Scenario Summary", presents the key analysis results for the four scenarios and is given in the text that follows. Scenarios are estimated for three future years: 2005, 2010 and 2015. In most of the towns, these scenarios occur before buildout; however, in the case of Eastham, residential buildout is projected for the year 2010, with commercial buildout occurring in 2015.

The "bottom line" of each analysis is the average residential property tax bill necessary to support the projected municipal costs. The easiest way to interpret the results is to compare the estimated property tax bills for the baseline forecast and the growth scenario for a given year. For example, the model suggests that in Eastham, the property tax bill in 2010 will be $1,817, compared to a tax bill of $1,600 that would be expected in the absence of projected growth—thus, the fiscal impact of growth is a tax bill increase of $217 (13.6%).

Unlike the financial planning approaches that might be used by a local Finance Committee, this study does *not* constrain the results of the analysis within the tax levy limits set by Proposition $2^1/_2$: that is, the model assumes that towns will raise revenues to meet anticipated costs, rather than reducing expenditures to meet the Proposition $2^1/_2$ revenue target. An earlier version of the model included estimates of when Proposition $2^1/_2$ overrides might be

required to generate the property tax receipts indicated in the model; however, this portion had to be deleted when inflation was removed from the model.

Assumptions and Simplifications

With the major conceptual issues presented above, a number of other important assumptions must be explained. The following are of particular importance to understand when using these forecasts:

(1) The percentage of *seasonally-occupied units* in each town is derived from the 1990 U.S. Census, which identified the number of units vacant as of April 1 that were being held "for seasonal, recreational, or occasional use." Such units were assumed to represent all of the seasonal units in the town, although it was recognized that some "seasonal" units might also be occupied in the off-season. (Note also that in this context, a "seasonal" housing unit means a unit that is used on a seasonal basis, and does not mean a unit that is physically restricted to summer use—i.e., not winterized). The 1990 percentage of such units within the town's entire housing stock was applied to the 1995 estimated housing stock to derive the starting number of seasonal units.

(2) Scenarios for all three future years assume that future housing growth in each town will have the same *seasonal and year-round occupancy split* as exists in the town today. (To derive the number of seasonal and year-round units in each year, the average growth rate was multiplied by the starting percentage of seasonal or year-round units, and then added to the respective total for the previous year.) In addition, a second scenario for the year 2015 reduces the percentage of seasonally occupied units by 50 percent in order to estimate the impact of a significant shift from seasonal to year-round occupancy.

(3) *Real estate values* are unadjusted for inflation. Therefore, the total residential valuation in any year is computed as the sum of (a) the previous year's residential valuation and (b) the number of new dwelling units multiplied by the 1995 average value of a housing unit.

The 1995 average housing unit value used in projecting tax base growth is based on all units within the town. However, it is likely that new dwelling units will tend to have a higher average value than older units; therefore, the analysis is probably conservative in projecting tax base growth. This will not affect the results of the analysis, since the impacts of growth are measured in terms of average tax *bills*, rather than tax *rates*.

(4) *Municipal operating costs* are also unadjusted for inflation. In the baseline scenarios, therefore, both school and non-school expenditures are held at the level reported for Fiscal Year 1995. In the growth scenarios, operating costs are increased at the rate of $1,133 per new resident for school costs and $975 per new resident for non-school costs.

(5) *Major capital expenditures* are classified according to whether they are required by existing development levels ("non-growth") or will be required if additional growth occurs ("growth-related").

(6) Two categories of capital expenditures were identified from separate elements of the Capacity Study: public water system construction, and local road improvements. Unlike the other capital facility needs, which were identified by local officials and reviewed by the towns' representatives on the project committee, the water and transportation investments were identified by staff of the Cape Cod Commission, who also estimated their costs and scheduling. The specific investment levels were as follows:

	Baseline (Non-Growth)	Growth-Related
Water		
• Eastham	$7,500,000	$16,500,000
• Wellfleet	$5,000,000	$5,500,000
• Truro	$0	$0
• Provincetown	$0	$0
Transportation		
• Eastham	$0	$3,610,000
• Wellfleet	$0	$4,370,000
• Truro	$0	$2,890,000
• Provincetown	$0	$1,390,000

These investments are "wild cards" in the analysis: although they have been determined to be necessary to address looming infrastructure needs attributable to future growth, and represent significant expenditures on the part of local governments, the fact that they were not identified by local officials indicates that they have not yet been incorporated in the towns' fiscal planning. Moreover, some of these investments (such as construction of new public water systems) are likely to be controversial if proposed, and therefore may not appear in municipal budgets until later than indicated in the models (if at all). As a result, the apparent fiscal impacts of growth may be less than predicted by the models because of the deferral of these needed investments.

(7) It is assumed that each community has a certain level of *"background" debt* that covers the costs of major replacements and upgradings and is required whether or not growth occurs. In the model the initial value of this background debt is computed as the total debt service reported in the DOR database, less the debt service attributable to identified major capital expenditures. This initial dollar amount is carried forward in each year to account for unidentified costs and major rehabilitation of infrastructure (ordinary maintenance and replacement is assumed to be covered by departmental operating budgets). This amount is included in a category labeled "Other Debt" that is separate from the "Major Non-Growth Capital Expenditures" and "Major Growth-Related Capital Expenditures." As with all other variables in the model, this debt is reported in current dollars.

It is likely that this assumption will lead to estimates that are more and more conservative (i.e., higher than likely) the further into the future the analysis is carried. This is because it is likely that a portion of the debt service in the starting year represents capital investments that are comparable to the specific expenditures included in the model—for example, a construction project that took place five to ten years ago and is still being paid off, but which was not specifically identified by department heads in interviews or documentation provided to the consultants. Bonds on these investments will be paid off during the period covered by the analysis, but the 1995 bond payment attributable to these investments is carried forward indefinitely in the analysis.

This is an area of the analysis where there are significant differences from town to town, depending on what major expenditures were specifically identified in the inventory phase and therefore separated out as "major non-growth capital expenditures."

(8) It is assumed that major capital expenditures will be *bonded* for terms ranging from 5 to 20 years, depending on the size of the investment, and at an interest rate of 5%, regardless of the term of the bond.

(9) The share of total municipal expenditures paid from property taxes is assumed to remain constant at the level in the most recent year for which data were available.

This is another area of significant variation among the towns. However, there is no way to project accurately what percentage of total revenues will come from property taxes in the future, because of the uncertainty of future state aid and the wide variety of sources of local revenues other than the property tax (including enterprise funds, trust funds, etc.).

(10) New school construction and school addition costs and timing are estimated based on the comprehensive plans and the opinions of school officials in each town. These costs do not factor in inflation.

The model does not include a provision to increase school operating costs when a new school is built or and existing school is expanded. However, such projects are likely to result in some increase in operating expenditures (such as energy, custodial and maintenance costs). Therefore, the true operating costs may be higher than shown in this model. Since no school construction projects were identified that are linked solely to growth, this bias will tend to understate the base-line school operating costs, and thus overstate the relative impacts of growth on school costs.

(11) As noted earlier, the two scenarios for 2015 differ by assuming that at build-out the proportion of seasonal units will be 50% of what it is today. (This does not necessarily mean that existing seasonal units will be converted to year-round occupancy at the same rate; rather, it could mean that a higher proportion of new homes are built for year-round rather than seasonal occupancy.) The model increases total school expenditures in relation to the increased year-round population by using the $1,133 per capita multiplier noted above.

The model assumes that the future year-round households will be demographically similar to the towns' current households, specifically in terms of household size. As a result, the major implication of the hypothetical shift to year-round occupancy of housing units will be an increase in the number of school children. Therefore, in the final scenario, dramatic cost increases are shown for each of the towns as seasonal units shift to year-round use and school costs rise as more families move to the town.

The model's implicit assumption that the current demographic profiles of the towns' year-round populations will persist into the future presents a worst-case scenario. It appears more likely that increased year-round occupancy will be accompanied by a continuing influx of retirees, and will therefore have less of an impact on school operating costs than is indicated in the analyses.

Limitations

Several aspects of the model's approach should be kept in mind when reviewing the results of this revised analysis. To the degree possible, the model has been designed to minimize the number of assumptions that need to be made: for example, by expressing all costs, values and revenues in current dollars, the model avoids the need to make assumptions about

inflation rates (assumptions concerning rates of increases in real estate values and municipal expenditures were required in an earlier version of the model). However, it is nonetheless important to recognize that small variations in some of the inputs to the model could greatly affect its outputs.

For example, consider the following assumptions:

- Tax base growth is estimated assuming that the average value of new homes will be equal to the average value of existing homes, and that 25% of the total value of a developed lot represents the pre-existing value of the undeveloped lot. As a result, total real estate valuation in the town is assumed by the model to grow at 75% of the rate of housing unit and population growth.

- Based on past trends, municipal operating costs are estimated to increase by $2,108 for every new resident ($1,133 per resident in school expenditures and $975 in non-school costs). Thus, a consistent dollar cost per new resident is assumed for all four towns (and for the five towns in the Monomoy study), whereas the increase in valuation per new resident is allowed to vary among towns based on the current average residential valuations in each town.

Taken together, these assumptions imply that municipal operating costs will grow at a faster rate than will residential property valuations, so that the growth scenarios will result in slightly higher average tax bills than the baseline (no-growth) scenarios.

This conclusion may very well be correct, but it is important to recognize the importance of the model's inputs and design in producing this result. For example, if new homes have higher average values than existing homes, the estimated fiscal impacts of growth will be more beneficial than the model predicts. Conversely, if the value of an undeveloped lot represents more than 25% of the value of the same lot after a house is built on it, then the fiscal impacts will be less beneficial than estimated here. Thus, careful consideration of these factors should accompany the interpretation of the fiscal forecasts.

Another aspect of the model that should be remembered is its use of certain current conditions specific to each town as bases for making forecasts. Three factors in particular exhibit wide variations among the towns—school expenditures per capita or per student, percentage of total expenditures supported by local property tax revenues, and the "other debt" category (i.e., total debt service in the starting year, less identified major capital investments). Theoretically, it might be better to use estimated long-term averages for some or all of these factors; however, doing so would make it impossible to compare the resulting forecasts with the current experience of the individual towns.

Furthermore, the analysis has relied on estimates of major capital expenditures supplied by local officials, with additional estimates of two categories of expenditures (water supply systems and local road improvements) provided by staff of the Cape Cod Commission through other elements of this study. Thus, the capital facility forecasts combine planned expenditures that have been reviewed and accepted by town officials or discussed in local comprehensive plans, with other potential investments that have not been subjected to the same level of public discussion and scrutiny.

It is also likely that additional capital investments (both non-growth and growth-related) have been excluded from the analysis. Examples of such investments include open space purchases and nitrogen-loading mitigation projects.

TOWN SUMMARIES

The discussion on the following pages gives the forecast results for the non-growth baseline forecasts and for each of the four growth scenarios used in this study. For each town, a "Scenario Summary" is presented which excerpts items from the detailed fiscal forecast spreadsheets. There are also brief narrative summaries of the key factors affecting the forecasts (including identified growth and non-growth capital needs, and estimated residential and nonresidential growth rates) and tables comparing the percentage changes in key variables under the baseline and growth scenarios.

Note that some towns stop growing before the year 2015 due to the limited amount of developable land available in each town and the pace at which growth is likely to proceed. Nevertheless, all scenarios are presented for each town so that comparisons may be made among towns in this study (and the towns in the parallel Monomoy capacity study).

Eastham

Existing Development Overview

Housing Units

Total existing units (1990 Census)	4,863
Seasonally-occupied units (1990 Census) (53%)	2,555
Total existing units (1995 est.)	5,363
Recent growth rate (new dwelling units per year)	100
Total buildout units	6,644
Remaining residential development potential (est. units)	1,281
Median value, owner-occupied housing units (1990 Census)	$178,600
1994 equalized valuation per capita	$185,027

Population

Population, 1990 (U.S. Census)	4,462
Population, 1994 (U.S. Census est.)	4,639
Persons per year-round unit	1.93
School-age children per year-round unit	0.30

Commercial/Industrial Land Area

Existing	140 acres
Recent growth rate (estimate, based on employment growth)	1 acre/year
Buildout	160 acres
Percent increase to buildout	14%

Capital Investment Inventory

General Government

Town Hall has recently undergone an expansion and rehab project. The majority of the work involved refurbishing the existing structure, although a 560 square foot addition was also planned. The estimated cost is $1.7 million to be paid through short term debt. The Town has prepared a five year capital plan that includes a number of normal operating upgrades and expenditures, but no other major costs.

Police

The police station is in good shape and no major investments will be needed for at least 10 years. The forecast assumes a $500,000 repair/improvement effort in 10 years. Ongoing cruiser replacements will be funded through the operating budget.

Fire

An improved fire station is planned for 1997 at a cost of $1,000,000. It is assumed that this cost will be bonded for a 20 year period. Minor fire department capital improvements (e.g., removing the signal tower and heating work) will be paid for from free cash.

Other Public Safety

No other major public safety improvements are anticipated.

Education

Elementary students attend the Eastham Elementary School. An addition of six classrooms is planned for the future. No cost estimates have been developed. The forecast will assume that the addition will cost $500,000 and that the bond payments will begin in the year 2000.

Eastham participates in the Nauset Regional Middle and High Schools. The Middle School has a capacity for 900 6th-9th graders. It's enrollment is now approximately 800 students. It was refurbished in 1992 and is in excellent condition. No investments appear to be necessary until the capacity is exceeded. The recent formation of a middle school charter school, allowed under the recent Education Reform Act, will serve to give extra life to public school facilities by decreasing short term demand.

The Nauset High School sees the need for an expanded facility by the end of the decade. Eastham's share of the expansion will be $2,187,000 over 20 years according to Eastham's capital plan.

Public Works—Highways

The main future costs for the highway department are ongoing equipment purchases. For the purposes of the model, a refurbished highway garage is assumed to be required by the year 2010 at a cost of $500,000.

Other Public Works

Public water supply: Eastham has no public water supply currently. A municipal water supply study is planned for the next few years. If a municipal supply is needed, it is assumed that the initial investment will be approximately $2,000,000 which will be bonded and that payments will begin in the year 2005.

Sewage facilities: Eastham neither has nor sees the need for municipal sewerage.

Septage disposal: Eastham is one-third co-owner and co-participant in the TriTown Septage Facility. The Town's share of a needed upgrade to that facility will be $15,000 in fiscal year 1997. Ninety percent of the upgrade cost will be paid for by the state Department of Environmental Protection.

Solid waste management facilities:: Landfill capping is a major upcoming capital expense. The town's capital plan estimates annual payments of $125,000 to retire the $1.2 to $1.5 million debt. This will begin in 1997.

Stormwater collection, treatment and discharge areas: No capital investments are seen relative to this issue.

Cemeteries: No capital investments are seen relative to this issue.

Health & Welfare

Health Care Facilities and Services: No Town investment is anticipated to provide health care facilities or services.

Elderly Housing: No Town expenditures are expected relative to elderly housing.

Affordable Housing: Eastham recently spent $185,000 to purchase four units of existing housing as affordable family housing. The Eastham Housing Authority will work with the Orleans Housing Authority to manage the units. No major debt is included for this category in the forecast. It is assumed that such investments will be paid for from the General Fund.

Culture & Recreation

Library: No near term major investments will be needed for the library. Issues identified by a library planning committee included a major automation project, an evaluation of space needs and staff training. The forecast assumes that a new library or expansion will be needed by the year 2010 at an estimated cost of $1 million. This will be bonded over 20 years.

Community/Senior Center: Eastham has a well functioning senior center which will be adequate with ongoing maintenance for at least 20 years. No major facility investments for the center are included in the forecast.

Beach Parking/Facilities: No major investments are included in the forecast for this issue.

Harbor Facilities: Eastham recently dredged their harbor. A cost of $100,000 every ten years for dredging is within the forecast.

Open Space: The Eastham forecast assumes a $500,000 expenditure every 5 years for open space protection. This is bonded for five year terms.

Capital Facility Investment Summary—Eastham

Budget Category	Detail	Total Cost (1995)	Start Year
Major NonGrowth Capital Facility Investments			
General Govt	Town Hall improvements	$1,700,000	1995
Fire	Station improvements	$1,000,000	1997
Solid waste	Landfill capping	$1,450,000	1997
Open space	Land purchases every five years	$500,000	1998
"	"	$500,000	2003
"	"	$500,000	2008
"	"	$500,000	2013
"	"	$500,000	2018
Police	Station improvements	$500,000	2005
DPW	Refurbished highway garage in 2010	$500,000	2010
Water	New system: Rte. 6 corridor and landfill area	$7,500,000	2000
Subtotal for NonGrowth		$15,150,000	
Major Growth Related Capital Investments			
School	Nauset expansion	$2,187,000	1998
School	Future elementary addition	$500,000	2000
School	Future elementary addition	$500,000	2015
Library	New or improved library	$1,000,000	2010
Water	Expand system to residential areas (CCC est.)	$4,125,000	2005
"	"	$6,187,500	2010
"	"	$6,187,500	2015
Traffic	Local road improvement costs (CCC est.)	$722,000	2000
"	"	$722,000	2005
"	"	$722,000	2010
"	"	$722,000	2015
Subtotal for Growth Costs		$23,575,000	

Baseline Scenario

Major Non-Growth Capital Needs: Without any additional growth Eastham will be servicing debt for Town Hall improvements, police station improvements, landfill capping, open space land purchases, fire station improvements and refurbishing the highway garage. A major expansion of public water supply facilities will also be needed in the near future. The

majority of these investments will be completed by the year 2016, after which the only remaining debt for non-growth facilities will be the investments for open space land and water supply.

Property Tax Bill: If the Town's budget continues to be supported at the same proportion by non-real estate tax sources (i.e., state support or local user fees), then Eastham's average residential tax bill will need rise from today's $1,450 to $1,533 by the year 2015 in order to pay for the expected increase in costs resulting from non-growth related capital expenditures.

Total Costs: The total costs faced by the Town to operate will rise from $9.5 million to $10.0 million in 2015. This increase is due primarily to the cost of a new public water system, since Eastham has made or is making most of the other capital investments necessary to handle its current population. (Remember that operating costs only rise with population growth since inflation is not used in this model.)

Property Tax Levy: From now until 2015, if no growth proceeds, the annual property tax levy will increase by $487,000 (6%) to cover non-growth capital investments.

Growth Scenarios

Housing Unit Growth: The number of housing units in Eastham is forecast to rise from 5,363 in 1995 to 6,644 at residential buildout (2010) for an increase of 1,281 units (24%). Today, there are about the same number of seasonally occupied as year-round units in the Town. If the percentage of seasonally-occupied units at buildout drops by 50%, then the number of year-round units will rise to 4,930 and those year round units will comprise 74% of the total housing stock.

Commercial Acreage Growth: It is anticipated that commercial buildout will take longer than residential buildout. The amount of land developed for commercial use will rise from 140 to 160 acres during the 1995 to 2015 time frame.

Real Estate Valuation: The estimated total valuation in the year 2015 under the growth scenario is $942 million, which is $148 million more (18.6%) than the 1995 total valuation. In other words, over the course of the next 20 years, as growth proceeds, new residential and commercial development will provide an additional $148 million of value that can be taxed.

Major Growth-Related Investment Debt: Eastham faces investments in the Nauset school expansion, a future elementary addition, substantial expansion of the public water system, an improved library and perhaps another elementary school addition beyond the year 2015. The annual payments on these investments will rise from around $200,000 per year in the next few

years, to nearly $2 million per year by 2015, with water system investments accounting for between $1 million and $1.5 million per year at the end of the 20-year period.

Operating Costs with a Seasonal Shift in Residents: The shift of 50% of the seasonal units to year-round use from the current mix of residential units would result in a $7.0 million increase in operating costs.

Total Costs: Eastham's total annual costs rise by $4.7 million from its baseline figures to the year 2015, assuming no shift in seasonal to year round residents. If such a shift occurs, then the total costs could rise by an additional $7.0 million (that is, a total increase of $11.7 million over the baseline amount).

Property Tax Levy: Eastham's tax levy is projected to rise from $8.4 million to $13.1 million in the year 2015 with no seasonal shift, and to $19.3 million if that shift occurs.

Property Tax Bill: The average property tax bill will increase from the 1995 figure of $1,450 to $1,825 in 2015 with no seasonal shift and will be $2,690 with the seasonal shift.

Summary

Due primarily to major water system investments needed to support both the existing level of development (non-growth costs) and future growth, Eastham faces significant fiscal impacts over the next 20 years. Expected growth will add 19 percent to the average residential tax bill at buildout (2015). However, if a major shift from seasonal to year-round occupancy occurs, the average tax bill increase attributable to growth would be 75 percent.

The following table summarizes the data presented in the baseline and growth forecasts by indicating the change estimated in each growth scenario as a percentage difference from the baseline scenario.

Changes in Key Variables: Eastham
(Difference from Baseline Forecasts)

	2005 Growth	2010 Growth	2015 Growth – Current Split	2015 Growth – Seasonal Shift
Housing Units	+ 18.6%	+ 23.9%	+ 23.9%	+ 23.9%
Commercial Acreage	+ 7.1%	+ 10.7%	+ 14.3%	+ 14.3%
Real Estate Valuation	+ 14.3%	+ 18.4%	+ 18.6%	+ 18.6%
Total Municipal Expenditures	+ 26.4%	+ 39.9%	+ 46.8%	+ 116.5%
Average Property Tax Bill	+ 7.1%	+ 13.6%	+ 19.0%	+ 75.4%

SCENARIO SUMMARY: EASTHAM

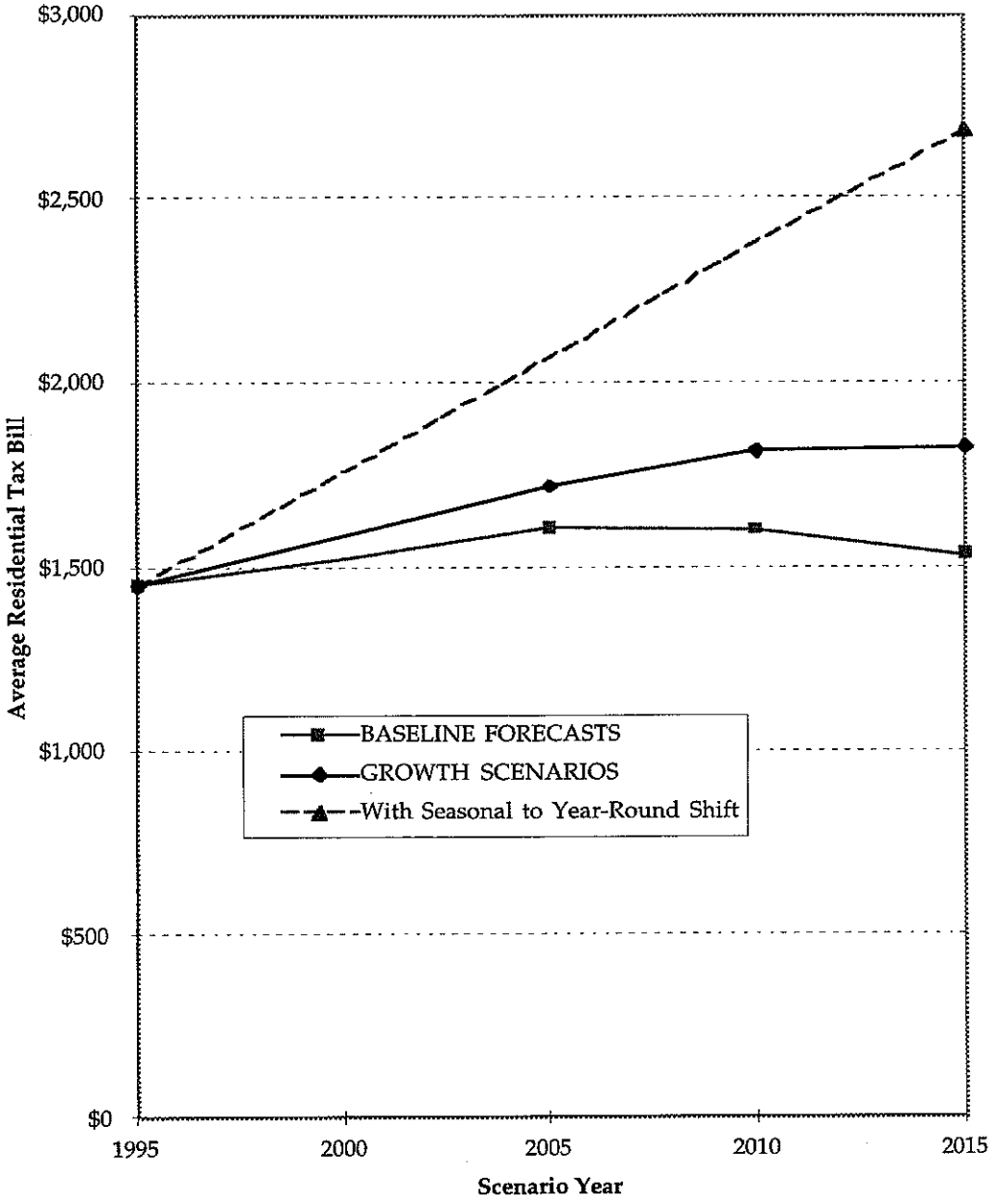
PART 1 — BASELINE FORECASTS

	1995	2005	2010	2015	2015
REAL ESTATE VALUATION					
• Residential	$733,384,100	$733,384,100	$733,384,100	$733,384,100	$733,384,100
• Commercial	$60,446,800	$60,446,800	$60,446,800	$60,446,800	$60,446,800
• Total	$793,830,900	$793,830,900	$793,830,900	$793,830,900	$793,830,900
MUNICIPAL COSTS					
Operating Costs (excluding debt service)	$7,918,835	$7,918,835	$7,918,835	$7,918,835	$7,918,835
Debt Service:					
• Major Non-Growth Investments	$170,000	$1,191,179	$1,152,696	$718,500	$718,500
• Other Debt Service	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
• Total Debt Service	$1,564,332	$2,585,511	$2,547,028	$2,112,832	$2,112,832
Total Costs (Operating + Debt Service)	$9,483,167	$10,504,346	$10,465,863	$10,031,667	$10,031,667
PROPERTY TAX ANALYSIS					
• Property Tax Levy	$8,414,608	$9,320,721	$9,286,575	$8,901,303	$8,901,303
• Average Residential Tax Bill	$1,450	$1,606	$1,600	$1,533	$1,533
Tax Levy as % of Valuation	1.06%	1.17%	1.17%	1.12%	1.12%

PART 2 — GROWTH SCENARIOS

	1995	2005	2010	2015 - Current Mix	2015 - Seasonal Shift
Housing Units					
• Occupied Year Round	2,543	3,013	3,216	3,216	4,930
• Occupied Seasonally	2,820	3,350	3,428	3,428	1,714
• Total	5,363	6,363	6,644	6,644	6,644
Commercial Acreage	140	150	155	160	160
REAL ESTATE VALUATION					
• Residential	$733,384,100	$842,660,624	$873,367,328	$873,367,328	$873,367,328
• Commercial	$60,446,800	$64,336,086	$66,280,729	$68,225,371	$68,225,371
• Total	$793,830,900	$906,996,710	$939,648,056	$941,592,699	$941,592,699
MUNICIPAL COSTS					
Operating Costs (excluding debt service)	$7,918,835	$9,834,333	$10,660,669	$10,660,669	$17,646,581
Debt Service:					
• Major Non-Growth Investments	$170,000	$1,191,179	$1,152,696	$718,500	$718,500
• Major Growth-Related Investments	$0	$853,978	$1,431,328	$1,956,334	$1,956,334
• Other Debt Service	$1,564,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
• Total Debt Service	$1,734,332	$3,439,488	$3,978,356	$4,069,166	$4,069,166
Total Costs (Operating + Debt Service)	$9,653,167	$13,273,821	$14,639,025	$14,729,835	$21,715,747
PROPERTY TAX ANALYSIS					
• Property Tax Levy	$8,414,608	$11,778,133	$12,989,506	$13,070,084	$19,268,826
• Average Residential Tax Bill	$1,450	$1,720	$1,817	$1,825	$2,690
Change from Baseline Tax Bill	- 0.00%	+ 7.11%	+ 13.59%	+ 19.00%	+ 75.43%
Tax Levy as % of Valuation	1.06%	1.30%	1.38%	1.39%	2.05%

Estimated Average Tax Bills: Eastham



Wellfleet

Existing Development Overview

Housing Units

Total existing units (1990 Census) 3,576
Seasonally-occupied units (1990 Census) 2,257 (63%)
Total existing units (1995 est.) 3,801
Recent growth rate (new dwelling units per year) 45
Total buildout units 5,251
Remaining residential development potential (est. units) 1,450
Median value, owner-occupied housing units (1990 Census) $177,900
1994 equalized valuation per capita $254,203

Population

Population, 1990 (U.S. Census) 2,493
Population, 1994 (U.S. Census est.) 2,685
Persons per year-round unit 1.89
School-age children per year-round unit 0.24

Commercial/Industrial Land Area

Existing ..... 281 acres
Recent growth rate (estimate, based on employment growth) ..... 0.8 acre/yr.
Buildout ..... 360 acres
Percent increase to buildout 28%

Capital Investment Inventory

General Government

Town Hall is currently being renovated, including removal of architectural barriers. Other than ongoing normal maintenance, no major capital investments will be needed in this building for at least ten years. All future investments are assumed to be fundable from within the General Fund or the normal maintenance debt load.

Police

The police and fire departments are considering the need for a new facility. It is assumed that a new facility will be built within ten years. A total cost of $2 million will be assumed. No other major police expenditures will be required beyond normal equipment replacement debt.

Fire

The fire/rescue department consists of a full-time chief, three firefighters/paramedics and a volunteer squad. There are two part time staff persons. It is assumed that this configuration will continue through buildout. If the department shifts to an increased full-time staff, it will likely be to an eight person full-time squad (2 full-time persons per eight hour shift plus two rotating day off replacements) and a volunteer backup squad under this scenario, the costs will rise by approximately $200,000 per year (assumption of $30,000 salary per year per staff and $10,000 per staff in employee benefit costs and taxes).

Other Public Safety

No other major public safety investments are expected for the future.

Education

Elementary students attend the newly expanded Wellfleet Elementary School completed in 1992 at a total cost of $7.5 million with a $4 million cost to the Town. Wellfleet's preschool through fifth grade facility has a capacity for 240 students. In 1993, there were 201 students in this system. It is anticipated that a new school at an approximate cost of $5 million will be needed by the year 2005.

Wellfleet participates in the Nauset Regional Middle and High Schools. The Middle School has a capacity for 900 6th-8th graders. Its enrollment is now approximately 800 students. It was refurbished in 1992 and is in excellent condition. About 100 Wellfleet students attend the Middle School.

Nauset High School has a capacity for 800 students, but a current enrollment of 861, including approximately 100 Wellfleet students. Portable classrooms are currently being use to provide needed space, but enrollment is projected to continue growing and will exceed 1000 students (25% above current capacity) by 1998, even if no future growth occurs. Thus, there is a clear need for an expanded facility by the end of the decade. A $10 million building program has been developed and is currently before Town Meeting in the 4 towns. Wellfleet's share of the $16 million expansion ($10 million principal plus $6 million in interest) will be $749,000 over 20 years according to regional school department estimates.

Public Works—Highways

Highways are maintained by the Department of Public Works. A new highway garage at a cost of $1.2 million is in the planning stages. This facility is not growth related but would have to be built under any circumstance. A major road related expense is the replacement of the Lieutenant Island bridge

at a total cost of $400,000, but a state grant will cover 90% of the cost leaving Wellfleet with just $40,000 to pay.

Other Public Works

Public water supply: The only public water supply system is at Coles Neck. The system was recently constructed at a total cost of $835,000. Debt repayments for this existing water quality problem range between $62,000 and $83,000 per year and extend to the year 2000.

Sewage facilities: No municipal expenditures relative to sewerage are expected, although a sewage treatment facility study was prepared in 1991. The study estimated the cost of collection and conveyance systems and a treatment facility for the village to cost approximately $7.5 million. Recent cost reductions in package treatment plants mean that this project could be undertaken for approximately $5.5 million.

Septage disposal: Upcoming improvements in the TriTown Septage Facility in Orleans will increase Wellfleet resident's septage disposal rates. No significant government costs will be involved for the Town as consumers will pay for higher disposal rates. Long term capacity to dispose of septage is a concern for the Town and the region, but the costs would be borne by an Outer Cape regional approach.

Solid waste management facilities: Wellfleet is paying to cap its landfill now at a rate of $50,000 per year for the next 13 years. The transfer station is adequate through buildout. Most towns have contracts with SEMASS that will last through 2012. It is hoped that the existing SEMASS facility will continue to operate well past 2012. The $26/ton tipping fee is one of the lowest in the state.

The County may need to create a regional lined landfill for non-burnable, non-recyclable, non-compostable wastes. These would be very expensive facilities. Dennis and Bourne are moving ahead with lined landfills, but these facilities are not designed to handle the region's waste stream.

Relative to recycling, there are currently no plans for any regional recycling facilities. The town transfer stations will be adequate to handle recyclables through buildout. No capital investments are foreseen for this category.

Finally, composting of leaves and brush will not impose large facility costs on the Town.

Stormwater collection, treatment and discharge areas: There is no underground stormwater collection system in Wellfleet nor is one anticipated for the future.

Health & Welfare

Health Care Facilities and Services: The Outer Cape Health Services office is located in Wellfleet. The nearest hospital is in Hyannis, a 35 mile drive. No Town investment is anticipated to provide other health care facilities or services.

Elderly Housing: The only Town investment is the donation of land for a housing project. It is assumed that this will be handled within the normal maintenance debt budget.

Culture & Recreation

Library: Wellfleet's new library was built at a cost of $1.8 million. The debt repayments will end in the year 1999. No additional library investments are foreseen in the near future. As the population grows, then state library standards may dictate an expansion. Since the current site could not handle an expansion, a satellite or new central facility would be needed. The cost for such a facility is assumed to be between $2 and $3 million.

Community/Senior Center: The Town is considering a combined community and senior center on the old highway garage site at a cost of $500,000. This is not a growth related cost.

Beach Parking/Facilities: The parking lot at White Crest Beach will probably need to be moved and expanded at an unknown cost to the Town. This cost will be caused by tourism demand and by beach erosion, not by residential or commercial growth.

Athletic/Recreation Fields: Wellfleet's fields are in good shape now, but as growth continues, new investments will be needed. It is assumed that these investments will be in the $100,000 to $500,000 range.

Harbor Facilities: Dredging is happening currently at a local cost of approximately $270,000 with an additional state grant of almost $1 million.

Open Space: No open space purchases are currently scheduled and most open space projects are coordinated through the Land Trust. No significant Town costs are estimated.

Capital Facility Investment Summary—Wellfleet

Budget Category	Detail	Total Cost (1995)	Start Year
Major NonGrowth Capital Facility Investments			
Buildings	Town Hall	$349,400	1995

Water supply	Coles Neck Water Supply	$600,000	1995
Solid Waste	Transfer Station	$260,000	1995
DPW	Landfill Closure	$800,000	1995
DPW	28-acre purchase	$860,000	1995
Buildings	Library Renovation	$1,105,760	1995
Buildings	Elementary Expansion	$4,500,000	1995
DPW	Highway Garage - Design	$40,000	1996
DPW	Highway Garage	$800,000	1997
DPW	Bridge Replacement	$40,000	1998
Wastewater	Sewer Central Village	$10,000,000	2010
Water supply	New system: Wellfleet Ctr. & Rte. 6 corridor	$5,000,000	2000
Subtotal for NonGrowth		$24,355,160	
Major Growth Related Capital Investments			
Buildings	Nauset Expansion	$749,000	1997
Buildings	New Elementary School	$5,000,000	2005
Water supply	Expand system to residential areas (CCC est.)	$1,375,000	2005
"	"	$2,062,500	2010
"	"	$2,062,500	2015
Traffic	Local road improvements (CCC est.)	$874,000	2000
"	"	$874,000	2005
"	"	$874,000	2010
"	"	$874,000	2015
Subtotal for Growth Costs		$14,745,000	

Baseline Scenario

Major Non-Growth Capital Needs: Wellfleet faces a long list of non-growth related investments which will have fiscal impacts greater than the growth-related expenditures. These non-growth investments include Town Hall repairs, completing payment on the Cole's Neck water system, landfill closure, library renovation payments, a new elementary school expansion, the new highway garage, bridge replacements and potentially sewering Wellfleet Center. The Cape Cod Commission also identified providing a public water system for the Center and nearby areas of Route 6 as a needed action to address existing conditions. These investments will require annual payments of between $670,000 and $1.1 million for the next 20 years.

Property Tax Bill: If the Town's budget continues to be supported at the same proportion by non-real estate tax sources (i.e., state support or local user fees), then Wellfleet's average residential tax bill will actually decrease from today's

$1,340 to $1,307 by the year 2015 due to a decrease in the tax levy as a percent of valuation.

Total Costs: The total costs faced by the Town to operate will decrease from $6.6 million to $6.4 million in 2015.

Property Tax Levy: From now until 2015, if no growth proceeds, the annual property tax levy will decrease by approximately $138,000 (2.4%).

Growth Scenarios

Housing Unit Growth: The total number of housing units in Wellfleet will rise from 3,801 in 1995 to 4,701 at buildout (2015) for an increase of 900 units (23.7%). If the current mix of year-round and seasonally occupied units (37%:63%) remains the same, Wellfleet will have a total of 1,735 year-round units by buildout. If there is a 50% shift of seasonally-occupied units to year-round use, then the number of year-round units will rise to 3,218 and comprise 68% of the total housing stock.

Commercial Acreage Growth: The acres of commercial development will rise from 281 to 297 by the year 2015.

Real Estate Valuation: The estimated total valuation in the year 2015 under the growth scenario is $796 million, which is $113.5 million more than the 1995 total valuation. In other words, over the course of the next 20 years, as growth proceeds, new development will provide an additional $113.5 million of value that can be taxed.

Major Growth-Related Investment Debt: Wellfleet faces a significant amount of growth related costs in the years ahead. Major expenditures include a new elementary school ($5 million), expansion of the public water supply system to residential areas ($5.5 million), and locally-financed road improvements ($4.4 million over 25 years). Between 2005 and 2015, these investments will represent between $830,000 and $1.1 million in annual expenditures.

Operating Costs with a Seasonal Shift in Residents: Wellfleet's operating costs could create an additional $5.9 million in costs in the year 2015 if the shift from seasonal to year round housing occurs, a difference of 84% compared with continuing the current mix of year-round and seasonal occupancy.

Total Costs: Wellfleet's total annual costs rise from $6.6 million in 1995 to $8.9 million in 2015, assuming no shift in seasonal to year round residents. If such a shift occurs, then the total costs could rise by an additional $5.9 million.

Property Tax Levy: Wellfleet's tax levy is projected to rise from $5.7 million to $7.8 million in the year 2015 with no seasonal shift and to nearly $13 million if that shift occurs.

Property Tax Bill: The average property tax bill will rise by about $167 (12%) between 1995 to 2015 with no seasonal shift, and will increase by $1,166 (87%) with the seasonal shift.

Summary

A large portion of Wellfleet's future investment costs are non-growth related and will be retired within 10 to 15 years. The construction of a new school, new water and sewer systems, and improvements to local roads will create new large debt loads between the years 2005 and 2015, but increased taxable values will allow the Town to repay the debt with moderate tax increases. As in Eastham, if a significant shift of seasonal to year-round units occurs, then school costs will create a very large cost category that will drive tax bills up by over 90% from the baseline year of 1995.

Changes in Key Variables: Wellfleet
(Difference from Baseline Forecasts)

	2005 Growth	2010 Growth	2015 Growth – Current Split	2015 Growth – Seasonal Shift
Housing Units	+ 11.9%	+ 17.8%	+ 23.7%	+ 23.7%
Commercial Acreage	+ 2.8%	+ 4.3%	+ 5.7%	+ 6.0%
Real Estate Valuation	+ 8.3%	+ 12.5%	+ 16.6%	+ 16.7%
Total Municipal Expenditures	+ 24.3%	+ 30.0%	+ 38.4%	+ 130.2%
Average Property Tax Bill	+ 13.9%	+ 13.5%	+ 15.3%	+ 91.7%

SCENARIO SUMMARY: WELLFLEET

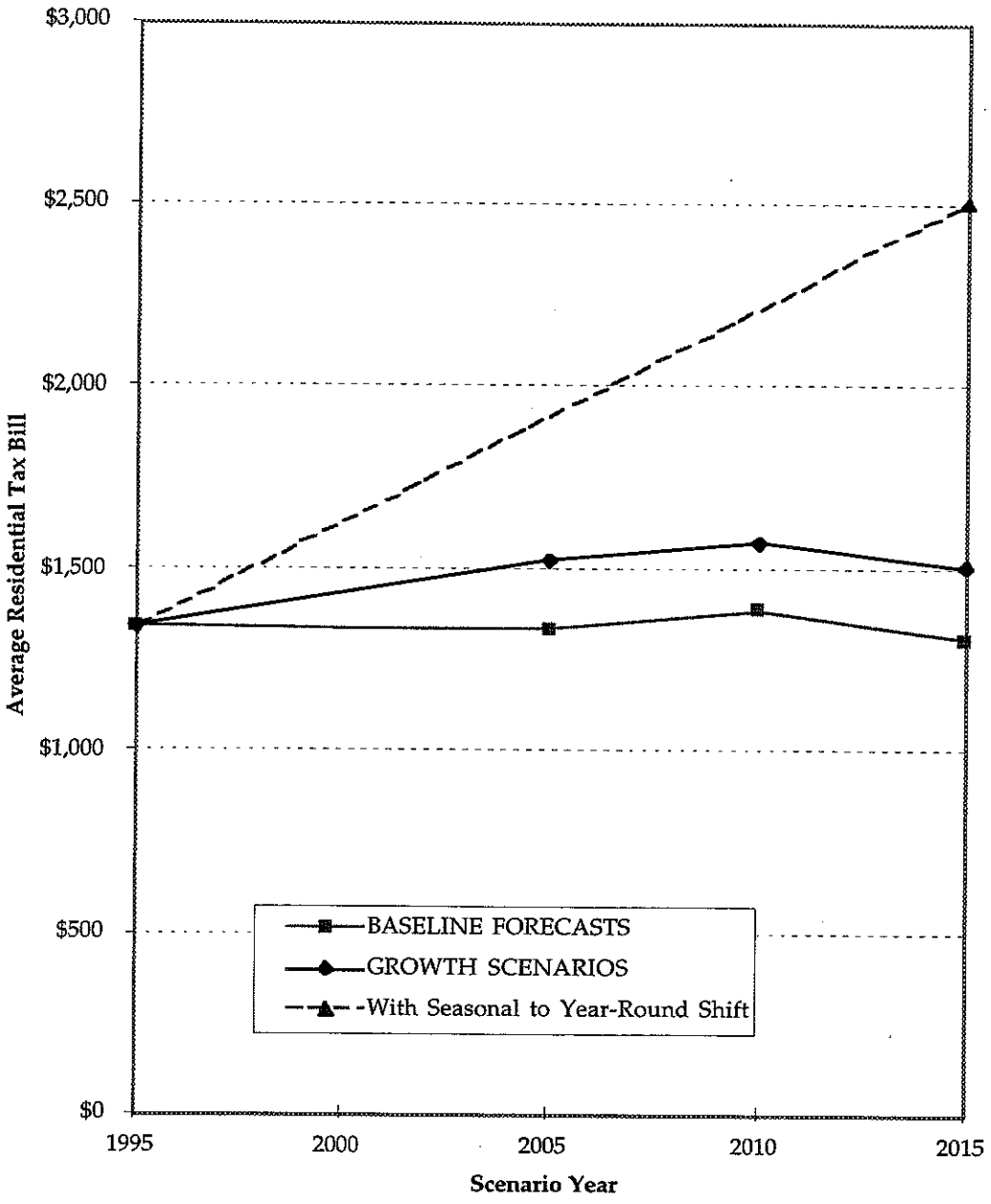
PART 1 — BASELINE FORECASTS

	1995	2005	2010	2015	2015
REAL ESTATE VALUATION					
• Residential	$613,428,216	$613,428,216	$613,428,216	$613,428,216	$613,428,216
• Commercial	$69,200,501	$69,200,501	$69,200,501	$69,200,501	$69,200,501
• Total	$682,628,717	$682,628,717	$682,628,717	$682,628,717	$682,628,717
MUNICIPAL COSTS					
Operating Costs (excluding debt service)	$5,668,087	$5,668,087	$5,668,087	$5,668,087	$5,668,087
Debt Service:					
• Major Non-Growth Investments	$911,323	$908,500	$1,140,500	$750,000	$750,000
• Other Debt Service	$20,978	$20,978	$20,978	$20,978	$20,978
• Total Debt Service	$932,301	$929,478	$1,161,478	$770,978	$770,978
Total Costs (Operating + Debt Service)	$6,600,388	$6,597,565	$6,829,565	$6,439,065	$6,439,065
PROPERTY TAX ANALYSIS					
• Property Tax Levy	$5,665,818	$5,663,395	$5,862,545	$5,527,337	$5,527,337
• Average Residential Tax Bill	$1,340	$1,339	$1,386	$1,307	$1,307
Tax Levy as % of Valuation	0.83%	0.83%	0.86%	0.81%	0.81%

PART 2 — GROWTH SCENARIOS

	1995	2005	2010	2015 - Current Mix	2015 - Seasonal Shift
Housing Units					
• Occupied Year Round	1,402	1,569	1,652	1,735	3,218
• Occupied Seasonally	2,399	2,683	2,824	2,966	1,483
• Total	3,801	4,252	4,476	4,701	4,701
Commercial Acreage	281	289	293	297	298
REAL ESTATE VALUATION					
• Residential	$613,428,216	$668,868,824	$696,404,735	$724,063,575	$724,063,575
• Commercial	$69,200,501	$70,646,053	$71,368,828	$72,091,604	$72,236,159
• Total	$682,628,717	$739,514,876	$767,773,564	$796,155,179	$796,299,734
MUNICIPAL COSTS					
Operating Costs (excluding debt service)	$5,668,087	$6,334,477	$6,663,325	$6,994,281	$12,903,005
Debt Service:					
• Major Non-Growth Investments	$911,323	$908,500	$1,140,500	$750,000	$750,000
• Major Growth-Related Investments	$0	$937,770	$1,054,970	$1,146,389	$1,146,389
• Other Debt Service	$20,978	$20,978	$20,978	$20,978	$20,978
• Total Debt Service	$932,301	$1,867,248	$2,216,448	$1,917,367	$1,917,367
Total Costs (Operating + Debt Service)	$6,600,388	$8,201,725	$8,879,773	$8,911,648	$14,820,372
PROPERTY TAX ANALYSIS					
• Property Tax Levy	$5,665,818	$7,168,618	$7,761,258	$7,789,118	$12,953,566
• Average Residential Tax Bill	$1,340	$1,525	$1,573	$1,507	$2,506
Change from Baseline Tax Bill	+ 0.00%	+ 13.89%	+ 13.48%	+ 15.31%	+ 91.74%
Tax Levy as % of Valuation	0.83%	0.97%	1.01%	0.98%	1.63%

Estimated Average Tax Bills: Wellfleet



Truro

Existing Development Overview

Housing Units

Total existing units (1990 Census) 2,175
Seasonally-occupied units (1990 Census) 1,376 (63%)
Total existing units (1995 est.) 2,375
Recent growth rate (new dwelling units per year) 40
Total buildout units 3,978
Remaining residential development potential (est. units) 1,603
Median value, owner-occupied housing units (1990 Census) $212,200
1994 equalized valuation per capita $349,460

Population

Population, 1990 (U.S. Census) 1,573
Population, 1994 (U.S. Census est.) 1,671
Persons per year-round unit 1.97
School-age children per year-round unit 0.20

Commercial/Industrial Land Area

Existing ..... 264 acres
Recent growth rate (estimate, based on employment growth) ..... 0.25 acre/yr.
Buildout ..... 271 acres
Percent increase to buildout 3%

Capital Investment Inventory

General Government

Town Hall is in need of extensive maintenance. This will include an addition to the Town Hall to provide more space and to redo the interior to provide for handicapped access, improved bathrooms, and general structural improvements. Improvements will be bonded and made in the latter part of this decade. The estimated cost in today's dollars is $1,000,000 which will be funded through a 20 year bond. These payments will begin in 1998.

Police

The police department moved into the new $1.7 million public safety facility on Route 6. The facility is sized to accommodate expected growth in Truro. No significant investments will be required for this facility for 20 years and then only periodic maintenance investments will be required (e.g. roofs, etc.). The Safety Complex is being paid for by a 20 year bond.

Fire

The fire/rescue department was previously located in two buildings—Truro Center and North Truro—and has moved into the new joint public safety building. The department is volunteer with a paid part time chief. No new facilities will be required due to growth. It is assumed that the volunteer squad will continue through buildout. If the department shifts to a full-time contingent, it will likely be to a three person full-time squad (1 full-time person per eight hour shift with the chief rotating through day off periods) and a volunteer backup squad.
The costs will rise by approximately $120,000 per year (assumption of $30,000 salary per year per staff and $10,000 per staff in employee benefit costs and taxes.)

The rescue squad is assumed to continue with its combination of volunteer and paid ambulance service staffing. If a full time fire department were created, these staff would also support the rescue squad.

The old existing stations are available for limited use. The North Truro station has limited parking available and is structurally weak. The Truro Center station may provide space for meetings or storage. All investments relative to these facilities are assumed to be covered within the General Fund operating budget.

Other Public Safety

No other major public safety investments are expected for the future

Education

Elementary students attend the new Truro Elementary School completed in 1991 at a total cost of $4 million with a $2.5 million cost to the Town. Truro is paying off that debt at a declining rate of approximately $200,000 per year for 20 years. Truro's preschool through sixth grade facility has a capacity for 225 students. In 1993, there were 143 students in this system. Nauset High school had eleven Truro high school students and three middle school students. The Provincetown school system had 45 Truro students in 7-12. It is anticipated that a future expansion of the Truro facility will cost between $500,000 to $1.5 million. For the purposes of the facility forecast, this investment is anticipated to occur in the year 2010. It is assumed that short term classrooms will suffice until the need is more clearly determined and the existing expansion is paid down further.

Public Works—Highways

Highways are maintained by the Department of Public Works. No major capital expenditures are anticipated into the future beyond annual road

maintenance and equipment replacement. New trucks and equipment at an average cost of $75,000 are assumed once every three years. The only exception to this situation might be the potential construction of a new highway garage at a new site if the Town Hall Hill area is designated for another use. A new highway garage is anticipated to cost $1 million and the repayments will begin in the year 2005.

Other Public Works

Public water supply: The primary potential long range water improvements may be the extension of the existing system to areas with salt water intrusion in private wells and/or the potential need to consider a regional water supply well. Cooperative protection of public water supply wellfields will also be important. No growth of the system is necessary unless well contamination occurs or unless growth causes contamination in adjoining towns and those towns seek water in Truro. Expansion of the current system to include all the coastal areas on the Bay side is unknown, but a figure of $1 million is included in the facility forecast to indicate the potential of a major expenditure. Purchasing a new well field would be a regional cost and the facility forecast assumes Truro's share will be paid for from the General Fund. If a more elaborate water supply system is put in place, a water district will likely be created and the operational costs will be largely borne by those served.

Sewage facilities: No municipal expenditures relative to sewerage are expected. If Provincetown builds a system, Beach Point may be hooked in, but the resulting sewer district tax would not place a burden on the Town of Truro. The Town might participate in construction of the facility, however, and therefore an expenditure of $500,000 incurred in the year 2005 is included in the forecast.

Septage disposal: Upcoming improvements in the TriTown Septage Facility in Orleans will increase Truro's septage disposal rates. No significant government costs will be involved for the Town of Truro since consumers will pay for higher disposal rates. Long term capacity to dispose of septage is a concern for the Town and the region, but the costs would be borne by an Outer Cape regional approach and no likely problem is envisioned prior to the year 2010.

Solid waste management facilities: Truro's solid waste transfer station and closed landfill is located off Route 6 in the southern portion of the town. Landfill capping will be necessary at a cost of $550,000 beginning in 1999. A new transfer station facility is planned for the year 2000 at a cost of $200,000 to be paid by a five year note. The abandoned landfill on South Highland Road is being monitored to determine if a plume is developing and migrating. There is no evidence of one at this time. All solid waste materials with the exception of brush, some construction/demolition debris and certain

recyclables are transported to a trash-to-energy facility in Rochester, MA (SEMASS). The loss of SEMASS as a shipping site will pose local and regional problems on the Cape.

Stormwater collection, treatment and discharge areas: There is no underground stormwater collection system in Truro nor is one anticipated for the future.

Cemeteries: With the opening of the Town's new South Cemetery, adding approximately 4500 graves to the Town's inventory, no shortage of burial plots is anticipated in the foreseeable future.

Health & Welfare

Health Care Facilities and Services: No Town investment is anticipated to provide health care facilities or services.

Elderly Housing: The establishment of a Housing Authority in Truro in 1993 has provided the Town with a body that can actively seek infrastructure improvements in this area of growing concern regarding the gentrification of the Town's population. No Town investment for elderly housing is anticipated in the forecast.

Culture & Recreation

Library: Truro has two libraries, both of which suffer from inadequate shelf space and parking. Pilgrim Memorial Library (circa: 1960) is located in North Truro and Cobb Memorial Library (circa: 1912) is located in Truro Center. The Library Trustees recently completed a facility study and identified the construction of a new centralized facility as an important goal over the next eight to ten years. Reuse or expansion of the existing libraries is limited by small lots, adjacent wetlands and accessibility problems. The anticipated cost of the new library will be $500,000 financed through a 20 bond starting in the year 2005.

Community/Senior Center: Although support for this type of facility has not coalesced at this time, it may become an actively sought facility as the Town's population and demographics change. The Truro Central School presently serves these needs. The cost for a new senior center will be approximately $500,000 and will financed through a 20 year bond starting in the year 2005.

Snows Field: This athletic field located on Town Hall Hill serves a number of the Town's Recreation Commission's activities as well as being available for the general use of the citizens. Periodic maintenance and investments will be required for this facility at a level of $5000 per every five years.

Golf Course: The golf course will continue to be leased by the Town and will continue to be a largely self supporting entity.

Harbor Facilities: Dredging is scheduled for Truro Harbor at a cost of $110,000. Dredging will be required every ten years and is included in the budget forecast at that frequency.

Open Space: No open space purchases are currently scheduled although the Town may decide to buy more open space in the future. An average of $30,000 per acre will be used as the open space purchase figure if such purchases are tested in the model.

Capital Facility Investment Summary—Truro

Budget Category	Detail	Total Cost (1995)	Start Year
Major NonGrowth Capital Facility Investments			
Schools	Former Elementary Addition	$2,500,000	1995
Public Safety	Safety Complex	$1,700,000	1995
Harbor	Current dredging	$110,000	1995
Library	New facility	$450,000	1997
Buildings	Town Hall improvements	$1,000,000	1998
DPW	Landfill capping	$550,000	1999
DPW	New transfer station	$200,000	2000
DPW	New highway garage	$1,000,000	2005
Harbor	Dredging in 2005	$100,000	2005
DPW	Partial sewerage system	$500,000	2005
General Govt	Build senior center	$500,000	2005
DPW	Partial public water system	$1,000,000	2010
Harbor	Dredging in 2015	$100,000	2015
Subtotal for NonGrowth		$9,710,000	
Major Growth Related Capital Investments			
Schools	Future Elementary Expansion	$1,000,000	2010
Traffic	Local road improvements (CCC est.)	$578,000	2000
"	"	$578,000	2005
"	"	$578,000	2010
"	"	$578,000	2015
Subtotal for Growth Costs		$3,312,000	

Baseline Scenario

Major Non-Growth Capital Needs: Truro has a number of non-growth related investments to pay down, but few growth related investments. Non-growth investments identified by Town officials include the elementary school, the public safety complex, harbor dredging, a new library, Town Hall improvements, landfill capping and a number of other projects. Today, these investments cost the Town approximately $340,000 per year. By the year 2020, many of these debts will be fully retired and payments will drop to $195,000 per year.

Property Tax Bill: Without further growth, and assuming that the Town's budget will continue to be supported at the same proportion by non-real estate tax sources (i.e., state support or local user fees), Truro's average residential tax bill would decrease slightly from the present $1,449 to $1,405 in 2015. This will be due to the decrease in large capital investments needed as they are being paid for today.

Total Costs: In the absence of further residential and commercial development, the total costs faced by the town to operate would decrease from $4.9 million to $4.7 million in 2015.

Property Tax Levy: From now until 2015, if no growth proceeds, the annual property tax levy will decrease by $116,000 (3.0%).

Growth Scenarios

Housing Unit Growth: The number of housing units in Truro will rise from 2,375 to 3,175 in the year 2015 for an increase of 800 units (25%). If the year-round to seasonal proportion stays the same into the future, Truro could see a total of 1,169 year-round units by 2015. If there is a 50% shift of seasonal units to year-round use, then the number of year-round units could rise to 2,172 and comprise 68% of the total housing stock.

Commercial Acreage Growth: The acres of commercial development will rise from 264 to 269 by the year 2015.

Real Estate Valuation: With the new growth from the above housing and commercial development, real estate values will rise from $567 million to $693 million by the year 2015. This means there will be an additional $126 million of value to be taxed at the end of the 20-year period.

Major Growth-Related Investment Debt: The only major growth related investments programmed into the model are a $1 million addition or new elementary facility for early in the next century, and a series of local road improvements totalling $2.9 million over a 25-year period. All of Truro's other costs are non-growth related.

Operating Costs with a Seasonal Shift in Residents: Truro's operating costs will rise if there is a seasonal to year-round shift. An additional $4.2 million could be added to the 2015 projected Truro budget by a 50% shift from seasonal to year-round use. This assumes the mix of households with children and retiree households remains the same as today.

Total Costs: Truro's total annual municipal costs will rise from $4.9 million in 1995 to $6.2 million in the year 2015. This is a 27% increase in cost without a seasonal shift in residential units. If the shift occurs, the total operating costs will escalate to $10.3 million, a 113% increase over the 1995 figure.

Property Tax Levy: The total tax levy required to cover the costs rises from $3.8 million in 1995 to $4.9 million in 2015. A seasonal shift in residents by 2015 would require a tax levy of $10.3 million.

Property Tax Bill: The average property tax bill will decrease by $22 in the year 2015 without a seasonal shift. However, if the seasonal shift does occur, the average property tax bill will increase by about $900 (62% more than the current average tax bill).

Summary

As with other Outer Cape towns, the combination of making large capital facility investments in the recent past and recent future will mean that the Town will be able to manage future growth. The large real estate values that will accompany that growth will, in fact, allow the tax bill to drop as the programmed non-growth investments are paid off over time. As with the other towns, if a seasonal to year-round housing shift occurs, then school costs will rise significantly, and property owners will experience substantial increases in their property tax bills.

Changes in Key Variables: Truro
(Difference from Baseline Forecasts)

	2005 Growth	2010 Growth	2015 Growth – Current Split	2015 Growth – Seasonal Shift
Housing Units	+ 16.8%	+ 25.3%	+ 33.7%	+ 33.7%
Commercial Acreage	+ 0.9%	+ 1.4%	+ 1.9%	+ 2.0%
Real Estate Valuation	+ 11.1%	+ 16.7%	+ 22.3%	+ 22.3%
Total Municipal Expenditures	+ 15.1%	+ 23.8%	+ 31.3%	+ 119.7%
Average Property Tax Bill	- 0.4%	+ 0.3%	+ 0.1%	+ 67.5%

SCENARIO SUMMARY: TRURO

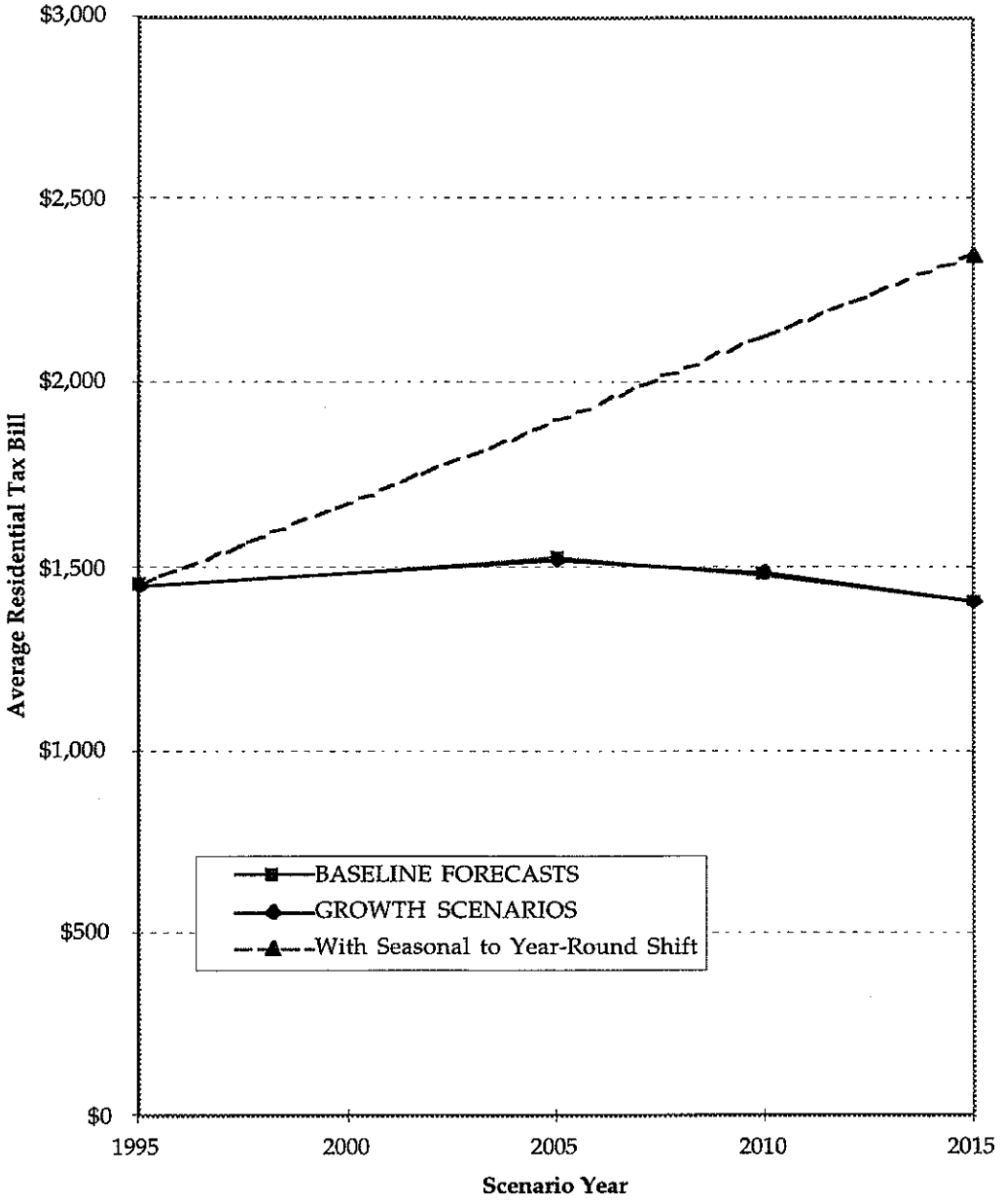
PART 1 — BASELINE FORECASTS

	1995	2005	2010	2015	2015
REAL ESTATE VALUATION					
• Residential	$508,990,100	$508,990,100	$508,990,100	$508,990,100	$508,990,100
• Commercial	$57,559,205	$57,559,205	$57,559,205	$57,559,205	$57,559,205
• Total	$566,549,305	$566,549,305	$566,549,305	$566,549,305	$566,549,305
MUNICIPAL COSTS					
Operating Costs (excluding debt service)	$4,345,044	$4,345,044	$4,345,044	$4,345,044	$4,345,044
Debt Service:					
• Major Non-Growth Investments	$341,500	$593,250	$447,250	$194,750	$194,750
• Other Debt Service	$168,260	$168,260	$168,260	$168,260	$168,260
• Total Debt Service	$509,760	$761,510	$615,510	$363,010	$363,010
Total Costs (Operating + Debt Service)	$4,854,804	$5,106,554	$4,960,554	$4,708,054	$4,708,054
PROPERTY TAX ANALYSIS					
• Property Tax Levy	$3,829,873	$4,028,475	$3,913,298	$3,714,105	$3,714,105
• Average Residential Tax Bill	$1,449	$1,524	$1,480	$1,405	$1,405
Tax Levy as % of Valuation	0.68%	0.71%	0.69%	0.66%	0.66%

PART 2 — GROWTH SCENARIOS

	1995	2005	2010	2015 - Current Mix	2015 - Seasonal Shift
Housing Units					
• Occupied Year Round	873	1,021	1,095	1,169	2,172
• Occupied Seasonally	1,502	1,754	1,880	2,006	1,003
• Total	2,375	2,775	2,975	3,175	3,175
Commercial Acreage	264	267	268	269	269
REAL ESTATE VALUATION					
• Residential	$508,990,100	$571,663,826	$603,000,689	$634,337,553	$634,337,553
• Commercial	$57,559,205	$57,968,296	$58,172,841	$58,377,387	$58,418,296
• Total	$566,549,305	$629,632,122	$661,173,531	$692,714,939	$692,755,849
MUNICIPAL COSTS					
Operating Costs (excluding debt service)	$4,345,044	$4,959,137	$5,266,905	$5,572,565	$9,735,865
Debt Service:					
• Major Non-Growth Investments	$341,500	$593,250	$447,250	$194,750	$194,750
• Major Growth-Related Investments	$0	$158,950	$258,950	$246,450	$246,450
• Other Debt Service	$168,260	$168,260	$168,260	$168,260	$168,260
• Total Debt Service	$509,760	$920,460	$874,460	$609,460	$609,460
Total Costs (Operating + Debt Service)	$4,854,804	$5,879,597	$6,141,365	$6,182,025	$10,345,325
PROPERTY TAX ANALYSIS					
• Property Tax Levy	$3,829,873	$4,638,315	$4,844,820	$4,876,896	$8,161,253
• Average Residential Tax Bill	$1,449	$1,518	$1,485	$1,407	$2,354
Change from Baseline Tax Bill	- 0.00%	- 0.41%	+ 0.33%	+ 0.12%	+ 67.53%
Tax Levy as % of Valuation	0.68%	0.74%	0.73%	0.70%	1.18%

Estimated Average Tax Bills: Truro



Provincetown

Existing Development Overview

Housing Units

Total existing units (1990 Census).....3,802
Seasonally-occupied units (1990 Census).....1,416 (37%)
Total existing units (1995 est.).....3,942
Recent growth rate (new dwelling units per year).....28
Total buildout units.....5,148
Remaining residential development potential (est. units).....1,206
Median value, owner-occupied housing units (1990 Census) $148,100
1994 equalized valuation per capita.....$160,922

Population

Population, 1990 (U.S. Census).....3,561
Population, 1994 (U.S. Census est.).....3,587
Persons per year-round unit.....1.49
School-age children per year-round unit.....0.14

Commercial/Industrial Land Area

Existing.....151 acres
Recent growth rate (estimate, based on employment growth).....0.01 acre/yr.
Buildout.....152
Percent increase to buildout.....<1%

Capital Investment Inventory

General Government

Other than ongoing normal maintenance, no major capital investments are expected to be required in Town Hall in the foreseeable future. All future investments are assumed to be fundable from within the General Fund or the normal maintenance debt load.

Police

The Police Department is housed in a modern facility on Shankpainter Road. No needs for expansion or other major capital expenditures are anticipated.

No other major police expenditures will be required beyond normal equipment replacement debt.

Fire

The new Fire Station on Shankpainter Road, built at a cost of $1.2 million, opened in October 1993. No additional building investments are expected to be needed in the foreseeable future.

Other Public Safety

No other major public safety investments are expected for the future

Education

School enrollment is below the capacity of the physical plant, and current demographic projections do not suggest that enrollments will grow to the point where facility expansions will be required. Some growth in enrollment could be fiscally beneficial, because existing facilities could be used more efficiently and the capital and operating costs could be spread over a broader base, lowering the per-pupil costs.

School athletic fields are adequate and sufficient to meet current and anticipated needs.

Public Works—Highways

The Highway Department is in the midst of a three-year, $350,000 program to replace all sidewalks in the Town. Other than ongoing maintenance and repairs (funded in part through the State's Chapter 90 program) no other major road improvement projects are anticipated.

The Town has been considering the transfer of Route 6 in Provincetown from State to Town jurisdiction, and this issue has been taken on by the Local Planning Committee as part of the Local Comprehensive Plan. If this transfer is carried out, the addition of 8 miles of road would increase operating costs to the department.

Other Public Works

Public water supply: The entire Town is served by the municipal water system, and no expansion of the system is anticipated. Currently, the Town is preparing to undertake a corrosion control program for compliance with DEP's lead and copper requirements. The estimated cost of constructing corrosion control facilities and the Town's two pumping facilities is estimated to be $500,000, which will come from the Town's Water Enterprise Fund (i.e., no impact on the general fund or tax rate).

Sewage facilities: The Town has no sewer facilities, but is currently beginning to address the need for an overall strategy for wastewater collection, treatment and disposal. The use of septic systems for wastewater disposal is made

difficult by the density of development in the downtown area, and this has been exacerbated by the impact of recent changes to Title 5, the State Sanitary Code. A Citizens Advisory Committee is about to issue a Request for Proposals for a consultant to develop an overall strategy for the Town. It is expected that it will be 3 to 5 years before the Town is ready to implement any major sewerage program, and there are no estimates of the costs of such a program. This is an existing problem: growth is limited by existing conditions, but a strategy and solution must be developed to support the Town's current land use patterns, regardless of whether future growth occurs. For the purposes of this forecast, it is assumed that a facility will cost $6 million and that expenditure will begin to be repaid in the 2005.

Septage disposal: Until August 1991 Provincetown maintained septage lagoons at the Sanitary Landfill. In July 1991 the Town entered into a contract with the Tri-Town Septage Treatment Facility in Orleans; the current contract expires in 2013. Capacity at the Tri-Town facility is said to be adequate, although anticipated improvements in the facility will increase the costs of disposal. However, no significant government costs will be involved, as consumers will pay for higher disposal rates.

Long term capacity to dispose of septage is a concern for the Town and the region, but the costs would be borne by an Outer Cape regional approach.

Solid waste management facilities: Following extensive negotiations with the National Park Service, the Town was able to secure the use of "Site 9" for use as a transfer station and recycling site. The transfer station has adequate capacity through buildout. The Town's contract with SEMASS runs through 2013.

The County may need to create a regional lined landfill for non-burnable, non-recyclable, non-compostable wastes. These would be very expensive facilities. Dennis and Bourne are moving ahead with lined landfills, but these facilities are not designed to handle the region's waste stream.

The Town has a curbside recycling program. There are currently no plans for any regional recycling facilities. The town transfer stations will be adequate to handle recyclables through buildout. No capital investments are foreseen for this category.

Finally, composting of leaves and brush will not impose large facility costs on the Town.

Stormwater collection, treatment and discharge areas: There is no underground stormwater collection system in Provincetown. The Citizen's Advisory Committee for the wastewater study will consider a drainage system as part of its study, but this is not expected to be a major issue for the Town.

Harbor and Marina Facilities: The U.S. Army Corps of Engineers is currently dredging the harbor, with no local cost. No future dredging costs are anticipated. The Town may need to expand parking and upgrade the pier. It is assumed that such costs will be paid from the General Fund. No extraordinary costs are included in this forecast.

Health & Welfare

Health Care Facilities and Services: Outer Cape Health Services has a facility in Provincetown. No Town investment is anticipated to provide other health care facilities or services.

Public Elderly/Family Housing: The Provincetown Housing Authority operates 24 elderly housing units and 8 family units, and is developing a 10-unit supported housing facility for persons with HIV/AIDS. The capital costs of these developments have been funded with state and federal housing grants and are not municipal expenditures. The Town operates a municipal nursing home, Cape End Manor.

Culture & Recreation

Library: Improvements to make the Library handicapped-accessible (an elevator and accessible bathroom) have been completed. No expansion needs or additional capital expenditures are expected, other than routine maintenance.

Community/Senior Center: The Town's Senior Center, located in the same building as the Department of Public Works, is slated for an expansion in 1994, financed with a $180,000 grant from the Massachusetts Executive Office of Communities and Development.

Open Space: The Town has just approved the acquisition of Foss Woods for open space and conservation. No additional Town open space acquisition costs are anticipated.

Capital Facility Investment Summary—Provincetown

Budget Category	Detail	Total Cost (1995)	Start Year
Major NonGrowth Capital Facility Investments			
Fire	Shankpainter Road Station	$1,200,000	1992
Sewerage	Potential Future Town Sewerage Facility	$6,000,000	2005
Subtotal for NonGrowth		$7,200,000	

Major Growth Related Capital Investments			
Traffic	Local road improvements (CCC est.)	$278,000	2000
"	"	$278,000	2005
"	"	$278,000	2010
"	"	$278,000	2015
Subtotal for Growth Costs		$1,112,000	

Baseline Scenario

Major Non-Growth Capital Needs: Few major capital facility investments were identified by Provincetown officials. Under the non-growth related category, only the Shankpainter Road fire station (completed) and the potential town sewerage facility were identified. These investments will cost the Town approximately $84,000 to $680,000 per year during the retirement of the debt. The $6 million sewerage facility is the large cost item here.

Property Tax Bill: If the Town's budget continues to be supported at the same proportion by non-real estate tax sources (i.e., state support or local user fees) and assuming that there is no growth of residential or commercial real estate, then Provincetown's average residential tax bill will remain relatively stable with only a $33 increase by 2015.

Total Costs: The total costs faced by the town to operate will also be fairly stable from 1995 to 2015. A $339,000 increase in costs will occur during this period.

Property Tax Levy: From now until 2015, if no growth proceeds, the annual property tax levy will increase by about $182,000.

Growth Scenarios

Housing Unit Growth: The number of housing units in Provincetown will rise from 3,942 in 1995 to 4,502 in 2015 for an increase of 560 units. If the mix of year-round and seasonally occupied units remains constant, Provincetown will have a total of 2,827 year-round units in 2015. If there is a 50% shift from seasonal to year-round use, then the number of year-round units will rise to 3,665 and comprise 81% of the total housing stock.

Commercial Acreage Growth: Commercial development will hold steady at 151 acres due to the lack of vacant commercial land.

Real Estate Valuation: The estimated total valuation in the year 2015 under the growth scenario is $604 million, which is $42 million more than the 1995 total valuation. In other words, over the course of the next 20 years, as growth

proceeds, new development will provide an additional $42 million of value that can be taxed.

Major Growth-Related Investment Debt: Provincetown officials identified no major growth related capital investments that will be required. This is due to the Town's degree of buildout, its lack of developable commercial land, its full complement of public facilities, its excess school capacity and its small amount of potential further development. Staff of the Cape Cod Commission identified a modest level of investment in local roads ($1.4 million over 25 years), which translates into annual debt service costs of between $36,000 and $76,000.

Operating Costs with a Seasonal Shift in Residents: Compared to the other three Outer Cape towns, Provincetown already has a relatively high ratio of year-round to seasonal units. Consequently, the impact of the 50% shift from seasonal to year-round occupancy is less dramatic. Nonetheless, the Town's budget under this scenario would be $2.6 million greater than with the current mix of year-round and seasonal occupancy.

Total Costs: Provincetown's total annual costs rise by $1.4 million from its baseline figures to the year 2015, assuming no shift in seasonal to year round residents. If such a shift occurs, then the total costs could rise by an additional $2.6 million (21%).

Property Tax Levy: Provincetown's tax levy is projected to rise from $6.5 million to $7.4 million in the year 2015 with no seasonal shift and to $8.8 million if that shift occurs.

Property Tax Bill: The average property tax bill will remain relatively constant, increasing by $14 from 1995 to 2015 with no seasonal shift. With a shift to year-round occupancy the average property tax bill would increase by $223.

Summary

Provincetown faces the least impact from future growth, according to this model. It low level of necessary growth-related investments combined with its high year-round to seasonal housing unit mix, mean that it is best prepared to handle future change. The Town's current budget level is higher than the other Outer Cape towns ($12 million versus $5, $6 and $9 million in Truro, Wellfleet and Eastham, respectively) and its growth rate bylaw limits development to 28 units per year and thus limits the new growth revenues that the Town might garner. Thus, Provincetown will see less growth in revenues, but it will also see less growth in costs. Overall, tax bills by the year 2015 should decrease by 1.5% compared to the no-growth scenario. If the seasonal shift occurs, tax bills could be 17% higher in 2015 than the no-growth level.

Changes in Key Variables: Provincetown
(Difference from Baseline Forecasts)

	2005 Growth	2010 Growth	2015 Growth – Current Split	2015 Growth – Seasonal Shift
Housing Units	+ 7.1%	+ 10.7%	+ 14.2%	+ 14.2%
Commercial Acreage	+ 0.1%	+ 0.1%	+ 0.1%	+ 0.1%
Real Estate Valuation	+ 3.7%	+ 5.6%	+ 7.5%	+ 7.5%
Total Municipal Expenditures	+ 4.9%	+ 7.2%	+ 9.5%	+ 30.6%
Average Property Tax Bill	- 0.6%	- 1.1%	- 1.5%	+ 17.4%

SCENARIO SUMMARY: PROVINCETOWN

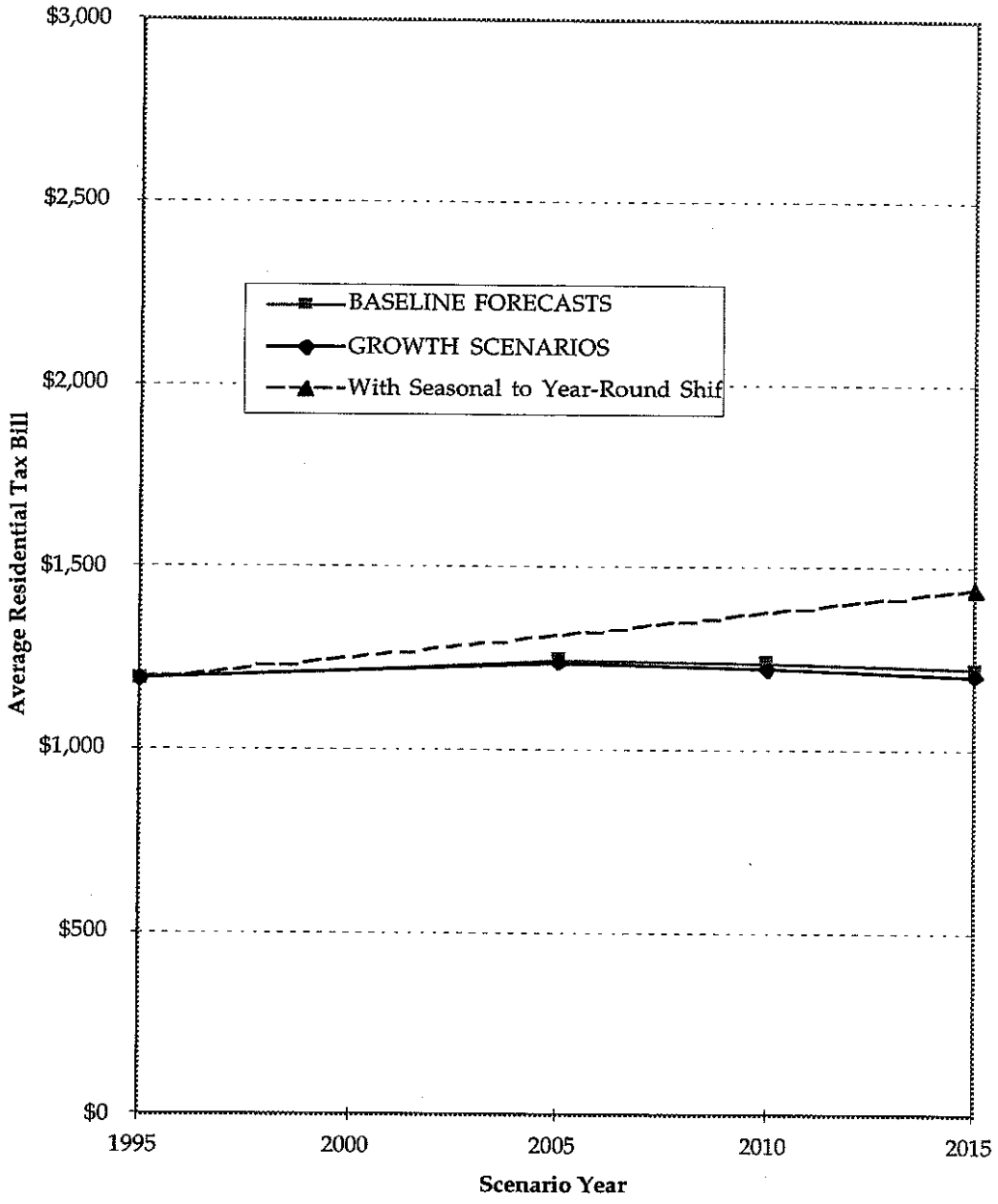
PART 1 — BASELINE FORECASTS

	1995	2005	2010	2015	2015
REAL ESTATE VALUATION					
• Residential	$403,913,423	$403,913,423	$403,913,423	$403,913,423	$403,913,423
• Commercial	$158,203,677	$158,203,677	$158,203,677	$158,203,677	$158,203,677
• Total	$562,117,100	$562,117,100	$562,117,100	$562,117,100	$562,117,100
MUNICIPAL COSTS					
Operating Costs (excluding debt service)	$11,317,307	$11,317,307	$11,317,307	$11,317,307	$11,317,307
Debt Service:					
• Major Non-Growth Investments	$111,000	$681,000	$591,000	$450,000	$450,000
• Other Debt Service	$736,976	$736,976	$736,976	$736,976	$736,976
• Total Debt Service	$847,976	$1,417,976	$1,327,976	$1,186,976	$1,186,976
Total Costs (Operating + Debt Service)	$12,165,283	$12,735,283	$12,645,283	$12,504,283	$12,504,283
PROPERTY TAX ANALYSIS					
• Property Tax Levy	$6,548,664	$6,855,499	$6,807,052	$6,731,150	$6,731,150
• Average Residential Tax Bill	$1,194	$1,250	$1,241	$1,227	$1,227
Tax Levy as % of Valuation	1.16%	1.22%	1.21%	1.20%	1.20%

PART 2 — GROWTH SCENARIOS

	1995	2005	2010	2015 - Current Mix	2015 - Seasonal Shift
Housing Units					
• Occupied Year Round	2,474	2,650	2,739	2,827	3,665
• Occupied Seasonally	1,468	1,572	1,623	1,675	838
• Total	3,942	4,222	4,362	4,502	4,502
Commercial Acreage	151	151	151	151	151
REAL ESTATE VALUATION					
• Residential	$403,913,423	$424,902,769	$435,397,441	$445,892,114	$445,892,114
• Commercial	$158,203,677	$158,284,240	$158,324,521	$158,364,803	$158,372,859
• Total	$562,117,100	$583,187,008	$593,721,963	$604,256,917	$604,264,973
MUNICIPAL COSTS					
Operating Costs (excluding debt service)	$11,317,307	$11,871,002	$12,151,366	$12,427,514	$15,062,514
Debt Service:					
• Major Non-Growth Investments	$111,000	$681,000	$591,000	$450,000	$450,000
• Major Growth-Related Investments	$0	$76,450	$76,450	$76,450	$76,450
• Other Debt Service	$736,976	$736,976	$736,976	$736,976	$736,976
• Total Debt Service	$847,976	$1,494,426	$1,404,426	$1,263,426	$1,263,426
Total Costs (Operating + Debt Service)	$12,165,283	$13,365,428	$13,555,792	$13,690,940	$16,325,940
PROPERTY TAX ANALYSIS					
• Property Tax Levy	$6,548,664	$7,194,711	$7,297,186	$7,369,937	$8,788,377
• Average Residential Tax Bill	$1,194	$1,242	$1,227	$1,208	$1,440
Change from Baseline Tax Bill	+ 0.00%	- 0.64%	- 1.13%	- 1.55%	+ 17.40%
Tax Levy as % of Valuation	1.16%	1.23%	1.23%	1.22%	1.45%

Estimated Average Tax Bills: Provincetown



THE MODEL'S IMPLICATIONS

The Outer Cape fiscal impact assessment model indicates that future growth will bring significant costs for the towns of Eastham and Wellfleet, but that Truro and Provincetown face stable or improving financial conditions as growth proceeds. The model casts light on the fiscal benefits that tourism communities accrue from seasonal homes: no school costs and few operating costs during most of the year. In communities where the percentage of seasonal homes is high (over 60%) and values of new homes are higher (as in Truro), future growth brings substantial fiscal benefits. It is estimated that Truro's average single tax bill could drop over the next 20 years if ongoing operating costs can be held in check.

This model also illustrates the degree to which most of the Outer Cape towns have made or are making capital facility investments that will be adequate to accommodate future growth. All Outer Cape towns are currently carrying higher debt burdens than in the past due to major capital facility investments they have taken on in recent years. The good news is that most of these investments will be adequate to accommodate expected future growth. Reinvestment will only be needed when the facilities are outdated.

The exception to that statement is the school system. Eastham and Wellfleet will face moderate increases in tax bills by the year 2015 due to growth-related school construction costs. Truro will also face a school addition, but its higher real estate values and its higher percentage of seasonal units will allow the Town to pay for the school and still see a decrease in relative tax bills compared with today. Provincetown faces a stable situation relative to growth, assuming that there is no shift toward more year-round units.

However, this rosy picture changes when the costs of potential water supply and local road improvements are factored in. These expenditures were not identified by local officials, perhaps because they represent significant changes in the roles that the Outer Cape towns will play as growth proceeds. In the case of transportation, most of the traffic growth to date has been accommodated by State-funded capacity improvements to Route 6, the area's main highway, and local roads have been able to absorb their share of the regional traffic that is distributed throughout the Outer Cape's road network. However, traffic projections made by the Cape Cod Commission indicate that local roads will be under increasing pressure as growth continues, and significant locally-financed expenditures will be required to provide the additional capacity that will be needed.

For Eastham and Wellfleet, the need to address water supply constraints will create much greater fiscal stresses, overshadowing all other capital facility investments. As a result, the negative fiscal impacts of growth in these two

towns will be significant: the growth scenario indicates that tax bills will be 19% higher in Eastham and 15% higher in Wellfleet due to the impact of water and road improvements combined with other locally-identified expenditures. In contrast, Truro and Provincetown will have smaller required investments in local roads and no major water system costs; consequently, the increased revenues from growth in these towns will be sufficient to cover the costs of providing new and expanded services and facilities.

The results from this analysis also suggest that demographic profiles of the Outer Cape towns are important factors in moderating the fiscal impacts of growth. In particular, these communities have high proportions of seasonal to year-round occupancy, and high proportions of retirees relative to families with children, both of which contribute to smaller school operating budgets than in other towns with comparable housing stocks. However, this also highlights the potential fiscal impacts as the mix of seasonal and year-round occupancy changes over time: increased year-round occupancy will bring significant increases in operating costs, with corresponding impacts on tax bills. If the percentage of housing units occupied on a seasonal basis is reduced by half during the next two decades (and the mix of families and retirees remains the same), average tax bills will more than double in Eastham, Wellfleet and Truro.

It should be noted that the National Seashore provides a real and lasting deterrent to growth on over 75% of the Outer Cape land base. The Seashore also provides a variety of public services-including public safety, public works and recreation-which supplement the corresponding municipal services provided by the host communities.

Thus, this analysis suggests that fiscal burdens will not be a great worry for the Outer Cape towns—*if* there is not a significant shift of seasonal homes to year-round homes with a commensurate increase in the proportion of families with children. If the Outer Cape becomes more of a commuting suburb for the Hyannis or even the Boston job markets, and this brings more families, then these communities will lose their delicate, favorable second home/retiree tax base and will then face the same fiscal strains as other non-tourism towns. In other words, if Outer Cape towns can continue along the path of recent years, pay off the long-term investments they have made, and keep their housing stocks at the current mix of year-round and seasonal households, then the fiscal prospect is reasonably bright. If not, their relatively weak commercial tax bases and their small school system infrastructures will not be sufficient to accommodate more year-round development without significant increases in tax bills.

Finally, the development of the fiscal impact assessment model shows that much of the annual increase in town budgets and in tax bills is due to

operating cost factors that are unrelated to growth, including inflation, changes in local policies and expectations, and state and federal standards and regulations. By isolating the fiscal impacts of growth from these non-growth costs, the analysis underlines the importance of looking at growth costs as a separate issue from the typical annual cost increases that are weighing on most town budgets.

APPENDIX A: DEVELOPMENT OF THE MODEL

The challenge in this project was to assemble a model that would realistically reflect the circumstances facing small towns. All the Outer Cape towns have populations of under 10,000 persons; and the literature on fiscal impact assessment provides no detail on communities of this size. In addition, published fiscal impact literature does not address the peculiarities of seasonal tourism towns which have both public service costs and property tax revenues that are high in relation to their year-round populations. Therefore, a model had to be developed that would be based on local data and circumstances but also reflect the broader experience of small towns and resort communities.

This process involved several separate analyses of cross-sectional data on groups of Massachusetts communities. The results of each analysis were then brought to bear on a simplified model of municipal finances, separating municipal expenditures into three categories: operating costs, major growth-related capital improvements, and major capital expenditures not required by growth. There were two fundamental approaches used in this model. The first assumed that a community's expenditures in a given year or in the past are indicative of its long-term expenditure pattern. That current and past data is used to estimate future expenditures based on an assumed link between population growth and associated municipal costs.

The second approach was to examine cross-sectional data on a sample of communities of varying sizes to find the degree to which there are predictable relationships between expenditures and population at various community sizes. These patterns were then applied to the Outer Cape communities. For instance, if the sample communities showed a direct relationship between growing populations and growing recreational budgets, then one might assume that this relationship would also apply to the study communities.

Each of these approaches—(1) projections from past and current trends, and (2) defining cost to population ratios based on comparative communities of varying sizes—was used solely or in combination in the iterations that produced this model. The project consisted of four separate iterations or phases. Each of these phases is reviewed below, even though only the Phase IV data is presented in this report. This Appendix serves as a record of the investigative process that the Commission, the project committee and the consultants pursued in order to develop the best possible model for the Outer Cape.

Phase I—Assuming that Current Expense Structures will Apply to the Future

The initial version of the fiscal impact model was based in part on the assumption that municipal *operating costs* of Massachusetts cities and towns would vary in an observable manner on the basis of population growth. The corollary to this assumption is that it should be possible to extrapolate from observed data and develop a multiplier or formula that would forecast future municipal operating costs based on projected population growth. Please note that all capital investments were calculated based on observed and department head projected needs. Only operating costs were subject to the need for assumptions on how they would change in the future.

Based on these assumptions, the initial model was constructed using actual current per capita expenditures for various expenditure categories for each town. The inputs into this model included actual expenditures in 14 functional categories (e.g., general government, police, fire, public works, education, etc.), and population figures for a specified base year. No inflation factor was included; all forecasts of costs and revenues were specified in current dollars.

Those reviewing this initial model raised questions about the fundamental assumptions underlying it, specifically, the assumption that there would be a direct relationship between a town's population and its operating costs. Thus, further analysis was performed as a part of this phase.

Community Size and Expenditure Patterns

In order to test whether there exists a demonstrable relationship between community size (i.e., population) and municipal expenditures, a series of multiple regression analyses was conducted relating municipal costs to demographic and tax base characteristics of Massachusetts communities. These analyses used data for Fiscal Year 1993 from the Massachusetts Department of Revenue's Municipal Database, which reports on municipal expenditures in 14 functional expenditure categories. The dependent variables were the *per capita* costs in each functional category (FY 1993 expenditures divided by 1990 population). The independent variables included total population (1990 Census), population change for two time periods (1970-1980 and 1970-1990), percentage of the population aged 60 or older, percentage of the housing stock represented by seasonally-occupied units, and percentage of total property valuation represented by residential properties. All 361 communities in Massachusetts were analyzed.

The assumptions tested in these analyses included the following:

1. Communities with higher percentages of seasonally-occupied dwellings might experience higher per capita costs for certain municipal functions, such as public safety and public works.

2. Communities with higher residential proportions of the tax base might experience higher per capita costs for education.

3. Communities with higher growth rates might experience higher debt service costs, reflecting the need to expand existing facilities and build new ones.

4. Communities with higher percentages of elderly residents might experience lower per capita costs for education.

Several of the analyses produced results that were highly significant (i.e., at the 95% significance level or greater). However, a review of these results revealed that relatively wide variations among communities with small populations were masked by the influence of cities with large populations. Although the overall explanatory power of the analyses were good in the context of the state's 351 cities and towns, the estimates produced for the four Outer Cape towns often varied from the actual figures by wide margins (in some cases, by as much as 600%).

A second series of analyses was then conducted in this phase, using a smaller sample of 61 communities with populations under 45,000 and using only population variables as independent variables. Once again, high correlation coefficients were generated for some expenditure categories (notably general government, police, education, highway and fixed costs), but the data plots continued to reveal a wide variation among smaller towns combined with a strong influence on the estimates by a few larger communities.

Finally, a series of scatter diagrams were generated, plotting expenditures *per capita* against population for all Massachusetts communities, using a log-log scale to provide a clearer view of the data for the many small towns, which otherwise would be compressed into a small area in one corner of the diagram. These scatter plots dramatically revealed the wide variation in per capita costs, but also made clear that these per capita costs are often much greater for smaller communities than for larger ones. This is particularly the case for the general government and highway categories, whereas per capita expenditures for education appear to be unaffected by population size.

Comparison with Massachusetts "Tourism" Communities

A comment frequently made during the course of this study is that residents of the Outer Cape must pay higher taxes because of the service demands created by tourists and seasonal residents. On the other hand, education costs in these towns are apt to be lower on a per taxpayer basis because of their large proportions of nonresident taxpayers: for example, education expenditures typically comprise 60 percent or more municipal budgets in Massachusetts towns, but represent only between 26 and 36 percent of the budgets of Outer

Cape towns. As a result, the educational costs may be high on a per student basis but low on a per taxpayer basis.

The scatter diagrams described above suggested that for some types of expenditures "seasonal" communities might have higher *per capita* expenditures. However, these seasonal communities also tend to have smaller populations which, as noted above, is associated with higher per capita costs—that is, it is not immediately clear from the available data whether it is the population of the community or the percentage of seasonal units that is more directly associated with per capita costs.

Regardless of which relationship was more important, it was decided to compare the costs of municipal service in Outer Cape towns with those of other small tourism communities. The costs per capita for each expenditure category were computed for each Outer Cape town and then compared against the same figures for a group of 43 Massachusetts communities in which 15 percent or more of the housing stock was held in seasonal use. In addition to the 15 towns in Barnstable County, these "tourism" communities included 28 other towns, primarily on the islands, along the coast or in the Berkshires. The assumption was that the municipal costs experienced by the Outer Cape towns would fall within the range of per capita costs in all towns with a large seasonal population.

The results of this analysis are presented in the table on the following page. These figures indicate that per capita expenditures for education and highways by the Outer Cape towns are at or below the median levels for all resort towns. Outer Cape towns are generally in the top 25% of tourism towns with respect to expenditures for general government, public safety, debt service and fixed costs.

Outer Cape Towns—FY 1993 Per Capita Municipal Costs
Comparison with Massachusetts Resort Towns

Budget Category	Massachusetts Resort Towns				
	Minimum	1st Quartile	Median	3rd Quartile	Maximum
General Govt.	$33	$77	$121	$199	$1,159
Police	$1	$13	$82	$138	$690
Fire	$0	$11	$23	$57	$668
Other Public Safety	$2	$10	$20	$36	$436
Education	$200	$601	$701	$842	$2,099
Public Works—Highways	$32	$84	$151	$233	$661
Other Public Works	$0	$27	$51	$86	$581
Health & Welfare	$1	$9	$16	$33	$540
Culture and Recreation	$0	$8	$16	$58	$271
Debt Service	$0	$35	$76	$175	$1,238
Fixed Costs	$18	$82	$126	$217	$662
Intergovernmental	$0	$11	$26	$36	$260
Other	$0	$0	$1	$15	$128
Total	$649	$1,221	$1,499	$2,193	$5,372

Budget Category	Outer Cape Towns			
	Provincetown	Truro	Wellfleet	Eastham
General Govt.	$259	$227	$239	$122
Police	$205	$381	$229	$134
Fire	$47	$39	$105	$114
Other Public Safety	$102	$76	$23	$39
Education	$573	$613	$700	$468
Public Works—Highways	$76	$148	$193	$38
Other Public Works	$199	$67	$43	$43
Health & Welfare	$438	$18	$48	$39
Culture and Recreation	$48	$126	$86	$46
Debt Service	$238	$310	$408	$400
Fixed Costs	$416	$270	$217	$134
Intergovernmental	$26	$60	$44	$35
Other	$103	$0	$0	$20
Total	$2,730	$2,335	$2,335	$1,632

Summary from Phase I

An important conclusion from the Phase I analyses was that operating costs do not increase in direct relation to population growth; rather, per capita costs are actually higher for the smallest communities and decrease with increasing population. This conclusion makes sense, since towns must provide a minimal level of some services—general government, education, public safety—regardless of population. Over wide ranges of population, there are probably many thresholds above which a community must go to a new level of service that will increase per capita costs; however, these thresholds depend on other factors in addition to population (for example, a small town near Boston may shift from a call fire department to full-time personnel at a lower population than a rural town, because of differences in the relative workplace locations of suburban vs. rural residents).

This conclusion was supported by discussions with various department heads in the Outer Cape towns. In many cases, these officials stated that increases in service levels would not be required as a result of population growth, and that other factors (changes in regulations, changes in expectations, or changes in the socioeconomic character of the population) would have a greater impact on service needs.

Furthermore, the potential population changes in the Outer Cape towns are not large within the context of Massachusetts communities. None of the four towns is expected to increase its year round population to more than 10,000.

Accepting that there is not a direct correlation between population growth and municipal expenditure increases, the question then became how to separate the aspects of expenditure growth that are dependent on population growth (or other indicators of community growth, such as housing units or commercial floor area) from those that may be considered "background" factors. These background factors include inflation, changes in municipal policies, changes in state or federal mandates, and so on. This was the focus of Phase II.

Phase II—Population Growth is Removed and Inflation is Added

In Phase II it was assumed that population growth would have an insignificant impact on the operating expenditures of the four Outer Cape towns. Because of the wide margin of error and the comparatively narrow range of variation within each town in terms of population growth and anticipated expenditures, the model was thoroughly revised. In Phase II of model development, the detailed function-by-function expenditure projections based on constant per capita ratios were replaced with more general forecasts of total operating costs and debt service costs based on assumed inflation and interest rate changes over time. In other words, it was assumed that current operating expenses would increase into the future based on

inflation not in any direct correlation to population growth. The following three categories of debt service costs were presented: (1) those resulting from specific major capital expenditures unrelated to future growth, (2) those resulting from specific major capital expenditures required by anticipated future growth and (3) those for all other expenditures, including smaller individual expenditures packaged in a single bond issue.

After reviewing the Phase II draft, the Steering Committee decided that the model should be revised again. The Committee's key concerns were (1) that population multipliers should be used even though not clearly supported by the analysis but instead due to a sense that common sense suggests that costs must go up as population increases, and (2) that the inflation rates for municipal costs and real estate values (4% and 3%, respectively) should be based on the experience of Outer Cape towns, rather than using the admittedly conservative figures chosen by the consultants.

Estimating Background Expenditure Growth in the Outer Cape Towns

A further analysis was therefore undertaken to isolate population-based factors (school costs per student, non-school costs per capita) from inflationary and other non-population factors. The results suggested that both the real estate appreciation rates and the municipal expenditure growth rates in the Outer Cape towns were higher than estimated in the preceding analysis. More importantly, the differential between actual cost inflation rates (8%) and actual appreciation of the property tax base (4%) on the Outer Cape appeared to be wider than estimated at first. This meant that, in the next version of the model, costs outstripped revenue growth even faster, and that as a result baseline tax rates rose faster. Preliminary results from this adjusted version of the model were reviewed by staff of the Cape Cod Commission and the Steering Committee and the decision was made to reject the model's use of inflation and appreciation. The figures generated over twenty years rose to such a high level that laypeople would find it hard to believe the model's findings. It was decided that including inflation and appreciation rates hid the central objective of the study which is to isolate and understand the differential between growth related costs and non-growth related costs. As such, Phase III sought to refine the assumptions for future operating budgets by performing an analysis that looked at how population and budget changed over time for a selected set of communities.

Phase III—Inflation is Removed and Operating Cost Ratios are Refined

In the final phase of the analysis, inflation was removed from the model and a set of analyses looked at how operating costs and population levels have changed for towns over time.

The initial step involved estimating trend lines for school and non-school expenditures using population growth rates as the independent variable. Data

from 236 Massachusetts communities with 1990 populations less than 15,000 were used in the analysis. The analysis took into account an assumed lag relationship between population growth and expenditure increases: that is, it was assumed that population growth in one period would require the community to increase operating costs, but that these expenditures would not show up in town budgets immediately. Therefore, the independent variable was average annual population growth over the 20-year period from 1970 to 1990, and the dependent variables were average annual increases in school and non-school expenditures over the 7-year period from 1986-1993 (the longest period for which consistent data were available for all communities). All data were entered as percentages.

The consultants then computed the percentage difference between the beginning and the end of the analysis period (i.e., 1970 and 1990 populations; 1986 and 1993 expenditures), and then converted this difference into an average annual percentage change. The general form of this formula is :

$$\text{Annual \% Change} = \left(\frac{\text{Ending Value}}{\text{Beginning Value}}\right)^{\left(\frac{1}{\text{No. of Years}}\right)} - 1$$

The values computed for the four Outer Cape towns are as follows:

Town	Average Annual Population Growth, 1970-90	Average Annual Increase in School Expenditures, 1986-93	Average Annual Increase in Non-School Expenditures, 1986-93
Eastham	3.98%	8.50%	13.57%
Provincetown	1.01%	4.22%	4.62%
Truro	1.22%	5.59%	12.63%
Wellfleet	1.81%	11.06%	9.67%

The results of this analysis indicate a positive, but weak, relationship between population growth and increases in school and non-school expenditures. Specifically, the analysis estimates a 0.72% incremental rate of increase in school expenditures and a 0.61% incremental rate of increase in non-school expenditures for each 1% annual growth in population.

In other words, this analysis suggests that over the long term, school expenditures can be expected to grow at about 72% the rate of population growth, and non-school expenditures will grow at about 61% of the population growth rate, in addition to the increase in expenditures attributable to non-growth factors (inflation, mandates, policy changes, etc.).

The analysis also suggests that for a town that is not growing at all, the expected increases would be 5.1% for school expenditures and 4.9% for non-school expenditures. These estimated "inflationary" increases are lower than those that were estimated based solely on data from the four Outer Cape towns.

The results of this initial analysis suggested that increases in municipal expenditures combine both growth-related and underlying "inflationary" components. The components not related to growth include at least three types of factors: inflation in the price of goods and services that communities buy (including labor costs); policy and program changes (for example, changes in local expectations regarding classroom size, or shifts from volunteer to full-time fire departments); and mandates from higher levels of government (e.g., special education, or accessibility requirements for disabled persons).

As a final step, it was hypothesized that the small towns of Cape Cod might have a different growth/cost relationship than exists in small towns in the rest of Massachusetts. (This difference might result from different expectation regarding service levels in communities with high proportions of retirees and seasonal residents, or from different service demands due to their coastal location and/or seasonality of population.) Therefore, the analysis was run again, this time using data only from the 10 Barnstable County towns with populations less than 15,000. Other changes in the revised analysis included:

- using the 10-year population change from 1980 to 1990 as the dependent variable, rather than the 20-year period;
- using absolute changes in population and expenditures rather than rates of change; and
- controlling the expenditures for inflation using a "Fixed-Weight Price Index" for state and local government goods and services, computed by the U.S. Bureau of Commerce, which is similar to the Consumer Price Index but based on the types of purchases that government agencies typically make.

The results of the analysis suggested that on average, school expenditures for smaller Cape Cod towns have increased by about $1,133 for every new resident, and that non-school expenditures have increased by about $975 for every new resident. These figures were used as inputs in the fiscal forecast models to increase operating costs as town populations were forecast to grow.

Conclusions

In summary, the process used to develop this fiscal model needed two methods to estimate future costs. For capital costs (i.e., new buildings, other capital investments), future costs were based on already planned investments,

investments that department heads can already foresee, and the consultant's opinion on when additional facilities will be needed based on the buildout analysis. This aspect of the cost project was relatively straightforward.

The second component of the cost estimate method involved the operating budgets for each department. It is less clear when cost increases will occur and how they relate to population growth. Thus, several types of analyses were performed to clarify this issue and produce for the Outer Cape Cod Capacity Steering Committee a model that seemed realistic, valid and understandable to the lay public.

In the end, the relationship between operating cost increases and population was based on historic data from 10 Cape Cod towns that suggested that for every new year round resident, school costs increase by $1,133 per year and non-school costs increase by $975 per year. These figures were used in the forecasts that comprise this model.

APPENDIX B: BASELINE AND GROWTH BUDGET FORECASTS BY TOWN

The Outer Cape Capacity Study

Detailed Forecasts: Eastham

EASTHAM MODEL INPUTS

Starting Year	1995
Growth Interval (Years)	1

Development	Start Year	Annual Increase	% of Annual Growth	Buildout
Year Round Units	2,543		47%	3,216
Seasonal Units	2,820		53%	3,428
Total Units	5,363	100		
Population	4,916			
Persons per Year round Unit	1.93			
School-Age Children/YR Unit	0.30			
Commercial Acreage	140	1		160

Growth-Related Operating Cost Increases

Non-School Expenditures:	$975	per new resident
School Expenditures:	$1,133	per new resident

Property Valuation

Total Residential Valuation	$781,400,000
Average Residential Value per Unit	$145,702
Average Valuation Increase per New Residential Unit*	$109,277
Total Commercial Valuation	$72,600,000
Average Commercial Valuation per Acre	$518,571
Average Assessed Valuation Increase per Commercial Acre*	$388,929

Bond Rates

Minimum Length of Bond	1	6	11
Interest Rate	5.00%	5.00%	5.00%

All debt repayments are calculated on bond basis.

*It is assumed that 25% of average new residential and commercial value is attributable to land value which is already assessed and included in the town's residential and commercial valuation. Therefore, the increase in valuation from new development will be assumed to be 75% of average value.

EASTHAM CAPITAL COSTS

Budget Category	Detail	Total Facility Cost (1995)	Start Year	Term of Bond	Starting Balance (Approx.)
Major NonGrowth Capital Facility Investments					
General Govt	Town Hall improvements	$1,700,000	1995	20	$1,700,000
Fire	Station improvements	$1,000,000	1997	20	$1,000,000
Solid waste	Landfill capping	$1,450,000	1997	20	$1,450,000
Open space	Land purchases every five years	$500,000	1998	5	$500,000
"	"	$500,000	2003	5	$500,000
"	"	$500,000	2008	5	$500,000
"	"	$500,000	2013	5	$500,000
"	"	$500,000	2018	5	$500,000
Police	Station improvements	$500,000	2005	7	$500,000
DPW	Refurbished highway garage in 2010	$500,000	2010	5	$500,000
Water	New system: Rte. 6 corridor and landfill area	$7,500,000	2000	20	$7,500,000
Subtotal for NonGrowth		$15,150,000			$15,150,000
Major Growth Related Capital Investments					
School	Nauset expansion	$2,187,000	1998	20	$2,187,000
School	Future elementary addition	$500,000	2000	10	$500,000
School	Future elementary addition	$500,000	2015	10	$500,000
Library	New or improved library	$1,000,000	2010	20	$1,000,000
Water	Expand system to residential areas (CCC est.)	$4,125,000	2005	20	$4,125,000
"	"	$6,187,500	2010	20	$6,187,500
"	"	$6,187,500	2015	20	$6,187,500
Traffic	Local road improvement costs (CCC est.)	$722,000	2000	10	$722,000
"	"	$722,000	2005	10	$722,000
"	"	$722,000	2010	10	$722,000
"	"	$722,000	2015	10	$722,000
Subtotal for Growth Costs		$23,575,000			$23,575,000
Other Debt					
Total Capital Costs					

EASTHAM

Budget Category	Detail	1995	1996	1997	1998	1999	2000	2001	2002
Major NonGrowth Capital Facility Investments									
General Govt	Town Hall improvements	$170,000	$165,750	$161,500	$157,250	$153,000	$148,750	$144,500	$140,250
Fire	Station improvements			$100,000	$97,500	$95,000	$92,500	$90,000	$87,500
Solid waste	Landfill capping			$145,000	$141,375	$137,750	$134,125	$130,500	$126,875
Open space	Land purchases every five years				$125,000	$120,000	$115,000	$110,000	$105,000
"	"								
"	"								
"	"								
"	"								
Police	Station improvements								
DPW	Refurbished highway garage in 2010								
Water	New system: Rte. 6 corridor and landfill area						$750,000	$731,250	$712,500
Subtotal for NonGrowth		$170,000	$165,750	$406,500	$521,125	$505,750	$1,240,375	$1,206,250	$1,172,125
Major Growth Related Capital Investments									
School	Nauset expansion				$218,700	$213,233	$207,765	$202,298	$196,830
School	Future elementary addition						$75,000	$72,500	$70,000
School	Future elementary addition								
Library	New or improved library								
Water	Expand system to residential areas (CCC est.)								
"	"								
"	"								
Traffic	Local road improvement costs (CCC est.)						$108,300	$104,690	$101,080
"	"								
"	"								
"	"								
Subtotal for Growth Costs		$0	$0	$0	$218,700	$213,233	$391,065	$379,488	$367,910
Other Debt		$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
Total Capital Costs		$1,564,332	$1,560,082	$1,800,832	$2,134,157	$2,113,315	$3,025,772	$2,980,070	$2,934,367

EASTHAM

Budget Category	Detail	2003	2004	2005	2006	2007	2008	2009	2010
Major NonGrowth Capital Facility Investments									
General Govt	Town Hall improvements	$136,000	$131,750	$127,500	$123,250	$119,000	$114,750	$110,500	$106,250
Fire	Station improvements	$85,000	$82,500	$80,000	$77,500	$75,000	$72,500	$70,000	$67,500
Solid waste	Landfill capping	$123,250	$119,625	$116,000	$112,375	$108,750	$105,125	$101,500	$97,875
Open space	Land purchases every five years								
"	"	$125,000	$120,000	$115,000	$110,000	$105,000			
"	"						$125,000	$120,000	$115,000
"	"								
"	"								
Police	Station improvements			$96,429	$92,857	$89,286	$85,714	$82,143	$78,571
DPW	Refurbished highway garage in 2010								$125,000
Water	New system: Rte. 6 corridor and landfill area	$693,750	$675,000	$656,250	$637,500	$618,750	$600,000	$581,250	$562,500
Subtotal for NonGrowth		$1,163,000	$1,128,875	$1,191,179	$1,153,482	$1,115,786	$1,103,089	$1,065,393	$1,152,696
Major Growth Related Capital Investments									
School	Nauset expansion	$191,363	$185,895	$180,428	$174,960	$169,493	$164,025	$158,558	$153,090
School	Future elementary addition	$67,500	$65,000	$62,500	$60,000	$57,500	$55,000	$52,500	
School	Future elementary addition								
Library	New or improved library								$100,000
Water	Expand system to residential areas (CCC est.)			$412,500	$402,188	$391,875	$381,563	$371,250	$360,938
"	"								$618,750
"	"								
Traffic	Local road improvement costs (CCC est.)	$97,470	$93,860	$90,250	$86,640	$83,030	$79,420	$75,810	
"	"			$108,300	$104,690	$101,080	$97,470	$93,860	$90,250
"	"								$108,300
"	"								
Subtotal for Growth Costs		$356,333	$344,755	$853,978	$828,478	$802,978	$777,478	$751,978	$1,431,328
Other Debt		$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
Total Capital Costs		$2,913,665	$2,867,962	$3,439,488	$3,376,292	$3,313,095	$3,274,899	$3,211,702	$3,978,356

EASTHAM

Budget Category	Detail	2011	2012	2013	2014	2015
Major NonGrowth Capital Facility Investments						
General Govt	Town Hall improvements	$102,000	$97,750	$93,500	$89,250	
Fire	Station improvements	$65,000	$62,500	$60,000	$57,500	$55,000
Solid waste	Landfill capping	$94,250	$90,625	$87,000	$83,375	$79,750
Open space	Land purchases every five years					
"	"					
"	"	$110,000	$105,000			
"	"			$125,000	$120,000	$115,000
"	"					
Police	Station improvements	$75,000				
DPW	Refurbished highway garage in 2010	$120,000	$115,000	$110,000	$105,000	
Water	New system: Rte. 6 corridor and landfill area	$543,750	$525,000	$506,250	$487,500	$468,750
Subtotal for NonGrowth		$1,110,000	$995,875	$981,750	$942,625	$718,500
Major Growth Related Capital Investments						
School	Nauset expansion	$147,623	$142,155	$136,688	$131,220	$125,753
School	Future elementary addition					
School	Future elementary addition					$75,000
Library	New or improved library	$97,500	$95,000	$92,500	$90,000	$87,500
Water	Expand system to residential areas (CCC est.)	$350,625	$340,313	$330,000	$319,688	$309,375
"	"	$603,281	$587,813	$572,344	$556,875	$541,406
"	"					$618,750
Traffic	Local road improvement costs (CCC est.)					
"	"	$86,640	$83,030	$79,420	$75,810	
"	"	$104,690	$101,080	$97,470	$93,860	$90,250
"	"					$108,300
Subtotal for Growth Costs		$1,390,359	$1,349,390	$1,308,421	$1,267,453	$1,956,334
Other Debt		$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
Total Capital Costs		$3,894,691	$3,739,597	$3,684,503	$3,604,410	$4,069,166

EASTHAM GROWTH SUMMARY

PART 1 — BASELINE FORECASTS

FUTURE MUNICIPAL COSTS AND REQUIRED PROPERTY TAX REVENUES ASSUMING NO FURTHER RESIDENTIAL OR COMMERCIAL DEVELOPMENT

	1993	1994	1995	1996	1997	1998	1999
REAL ESTATE VALUATION							
• Residential	$781,405,400	$787,061,900	$733,384,100	$733,384,100	$733,384,100	$733,384,100	$733,384,100
• Commercial	$72,200,200	$69,363,800	$60,446,800	$60,446,800	$60,446,800	$60,446,800	$60,446,800
• Total	$853,605,600	$856,425,700	$793,830,900	$793,830,900	$793,830,900	$793,830,900	$793,830,900
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$5,490,452	$4,562,512	$4,562,512	$4,562,512	$4,562,512	$4,562,512	$4,562,512
• School	$3,037,047	$3,356,323	$3,356,323	$3,356,323	$3,356,323	$3,356,323	$3,356,323
Debt Service:							
• Major Non-Growth Investments			$170,000	$165,750	$406,500	$521,125	$505,750
• Other Debt Service			$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
• Total Debt Service	$1,165,000	$1,564,332	$1,564,332	$1,560,082	$1,800,832	$1,915,457	$1,900,082
Total Costs (Operating + Debt Service)	$9,692,499	$9,483,167	$9,483,167	$9,478,917	$9,719,667	$9,834,292	$9,818,917
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues	16.69%	15.56%	11.27%	see Note (1)			
• Portion of Total Costs to be Paid from Property Tax Levy	83.31%	84.44%	88.73%	see Note (1)			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$8,075,109	$8,007,580	$8,414,608	$8,410,837	$8,624,459	$8,726,168	$8,712,526
• Average Residential Tax Bill			$1,450	$1,449	$1,486	$1,503	$1,501

Notes:

(1) Because of the uncertainty regarding future state aid levels, this analysis assumes that the current percentage of total costs paid by state aid and other non-property-tax sources will remain constant (see rows 22 & 23).

EASTHAM

PART 1 — BASELINE FORECASTS

	2000	2001	2002	2003	2004	2005	2006
REAL ESTATE VALUATION							
• Residential	$733,384,100	$733,384,100	$733,384,100	$733,384,100	$733,384,100	$733,384,100	$733,384,100
• Commercial	$60,446,800	$60,446,800	$60,446,800	$60,446,800	$60,446,800	$60,446,800	$60,446,800
• Total	$793,830,900	$793,830,900	$793,830,900	$793,830,900	$793,830,900	$793,830,900	$793,830,900
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$4,562,512	$4,562,512	$4,562,512	$4,562,512	$4,562,512	$4,562,512	$4,562,512
• School	$3,356,323	$3,356,323	$3,356,323	$3,356,323	$3,356,323	$3,356,323	$3,356,323
Debt Service:							
• Major Non-Growth Investments	$1,240,375	$1,206,250	$1,172,125	$1,163,000	$1,128,875	$1,191,179	$1,153,482
• Other Debt Service	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
• Total Debt Service	$2,634,707	$2,600,582	$2,566,457	$2,557,332	$2,523,207	$2,585,511	$2,547,814
Total Costs (Operating + Debt Service)	$10,553,542	$10,519,417	$10,485,292	$10,476,167	$10,442,042	$10,504,346	$10,466,649
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues							
• Portion of Total Costs to be Paid from Property Tax Levy							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$9,364,374	$9,334,094	$9,303,814	$9,295,717	$9,265,437	$9,320,721	$9,287,272
• Average Residential Tax Bill	$1,613	$1,608	$1,603	$1,601	$1,596	$1,606	$1,600

EASTHAM

PART 1 — BASELINE FORECASTS

	2007	2008	2009	2010	2011	2012	2013
REAL ESTATE VALUATION							
• Residential	$733,384,100	$733,384,100	$733,384,100	$733,384,100	$733,384,100	$733,384,100	$733,384,100
• Commercial	$60,446,800	$60,446,800	$60,446,800	$60,446,800	$60,446,800	$60,446,800	$60,446,800
• Total	$793,830,900	$793,830,900	$793,830,900	$793,830,900	$793,830,900	$793,830,900	$793,830,900
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$4,562,512	$4,562,512	$4,562,512	$4,562,512	$4,562,512	$4,562,512	$4,562,512
• School	$3,356,323	$3,356,323	$3,356,323	$3,356,323	$3,356,323	$3,356,323	$3,356,323
Debt Service:							
• Major Non-Growth Investments	$1,115,786	$1,103,089	$1,065,393	$1,152,696	$1,110,000	$995,875	$981,750
• Other Debt Service	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
• Total Debt Service	$2,510,118	$2,497,421	$2,459,725	$2,547,028	$2,504,332	$2,390,207	$2,376,082
Total Costs (Operating + Debt Service)	$10,428,953	$10,416,256	$10,378,560	$10,465,863	$10,423,167	$10,309,042	$10,294,917
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues							
• Portion of Total Costs to be Paid from Property Tax Levy							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$9,253,823	$9,242,557	$9,209,108	$9,286,575	$9,248,689	$9,147,424	$9,134,890
• Average Residential Tax Bill	$1,594	$1,592	$1,586	$1,600	$1,593	$1,576	$1,574

EASTHAM

PART 1 — BASELINE FORECASTS

	2014	2015	2015
REAL ESTATE VALUATION			
• Residential	$733,384,100	$733,384,100	$733,384,100
• Commercial	$60,446,800	$60,446,800	$60,446,800
• Total	$793,830,900	$793,830,900	$793,830,900
MUNICIPAL COSTS			
Operating Costs (excluding debt service)			
• Non-School	$4,562,512	$4,562,512	$4,562,512
• School	$3,356,323	$3,356,323	$3,356,323
Debt Service:			
• Major Non-Growth Investments	$942,625	$718,500	$718,500
• Other Debt Service	$1,394,332	$1,394,332	$1,394,332
• Total Debt Service	$2,336,957	$2,112,832	$2,112,832
Total Costs (Operating + Debt Service)	$10,255,792	$10,031,667	$10,031,667
PROPERTY TAX ANALYSIS			
• Portion of Total Costs Paid from State Aid & Other Local Revenues			
• Portion of Total Costs to be Paid from Property Tax Levy			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$9,100,174	$8,901,303	$8,901,303
• Average Residential Tax Bill	$1,568	$1,533	$1,533

PART 2 — GROWTH SCENARIOS

FUTURE MUNICIPAL COSTS AND REQUIRED PROPERTY TAX REVENUES
ASSUMING BASELINE PLUS RESIDENTIAL AND COMMERCIAL GROWTH

	1993	1994	1995	1996	1997	1998	1999
Housing Units							
• Occupied Year Round	2,449	2,496	2,543	2,590	2,637	2,684	2,731
• Occupied Seasonally	2,714	2,767	2,820	2,873	2,926	2,979	3,032
• Total	5,163	5,263	5,363	5,463	5,563	5,663	5,763
Population Level	4,735	4,825	4,916	5,007	5,098	5,189	5,280
School Age Children	725	739	753	767	781	795	809
Commercial Acreage	138	139	140	141	142	143	144
REAL ESTATE VALUATION							
• Residential	$781,405,400	$787,061,900	$733,384,100	$744,311,752	$755,239,405	$766,167,057	$777,094,710
• Commercial	$72,200,200	$69,363,800	$60,446,800	$60,835,729	$61,224,657	$61,613,586	$62,002,514
• Total	$853,605,600	$856,425,700	$793,830,900	$805,147,481	$816,464,062	$827,780,643	$839,097,224
Real Estate Valuation Increase from Growth			$0	$11,316,581	$22,633,162	$33,949,743	$45,266,324
MUNICIPAL COSTS							
Operating Costs (excluding debt service)	$8,527,499						
• Non-School	$5,490,452	$4,562,512	$4,562,512	$4,650,925	$4,739,650	$4,828,375	$4,917,100
• School	$3,037,047	$3,356,323	$3,356,323	$3,459,064	$3,562,167	$3,665,270	$3,768,373
Debt Service:							
• Major Non-Growth Investments			$170,000	$165,750	$406,500	$521,125	$505,750
• Major Growth-Related Investments			$0	$0	$0	$218,700	$213,233
• Other Debt Service			$1,564,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
• Total Debt Service	$1,165,000	$1,564,332	$1,564,332	$1,560,082	$1,800,832	$2,134,157	$2,113,315
Total Costs (Operating + Debt Service)	$9,692,499	$9,483,167	$9,483,167	$9,670,071	$10,102,649	$10,627,802	$10,798,787
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995	16.69%	15.56%	11.27%	see Note (1)			
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995	83.31%	84.44%	88.73%	see Note (1)			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$8,075,109	$8,007,580	$8,414,608	$8,580,452	$8,964,287	$9,430,266	$9,581,985
• Average Residential Tax Bill			$1,450	$1,452	$1,491	$1,541	$1,540
Change from Baseline Tax Bill			- 0.00%	+ 0.21%	+ 0.33%	+ 2.53%	+ 2.60%

PART 2 — GROWTH SCENARIOS

	2000	2001	2002	2003	2004	2005	2006
Housing Units							
• Occupied Year Round	2,778	2,825	2,872	2,919	2,966	3,013	3,060
• Occupied Seasonally	3,085	3,138	3,191	3,244	3,297	3,350	3,403
• Total	5,863	5,963	6,063	6,163	6,263	6,363	6,463
Population Level	5,371	5,462	5,552	5,643	5,734	5,825	5,916
School Age Children	823	837	851	865	879	892	906
Commercial Acreage	145	146	147	148	149	150	151
REAL ESTATE VALUATION							
• Residential	$788,022,362	$798,950,015	$809,877,667	$820,805,319	$831,732,972	$842,660,624	$853,588,277
• Commercial	$62,391,443	$62,780,371	$63,169,300	$63,558,229	$63,947,157	$64,336,086	$64,725,014
• Total	$850,413,805	$861,730,386	$873,046,967	$884,363,548	$895,680,129	$906,996,710	$918,313,291
Real Estate Valuation Increase from Growth	$56,582,905	$67,899,486	$79,216,067	$90,532,648	$101,849,229	$113,165,810	$124,482,391
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$5,005,825	$5,094,550	$5,182,300	$5,271,025	$5,359,750	$5,448,475	$5,537,200
• School	$3,871,476	$3,974,579	$4,076,549	$4,179,652	$4,282,755	$4,385,858	$4,488,961
Debt Service:							
• Major Non-Growth Investments	$1,240,375	$1,206,250	$1,172,125	$1,163,000	$1,128,875	$1,191,179	$1,153,482
• Major Growth-Related Investments	$391,065	$379,488	$367,910	$356,333	$344,755	$853,978	$828,478
• Other Debt Service	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
• Total Debt Service	$3,025,772	$2,980,070	$2,934,367	$2,913,665	$2,867,962	$3,439,488	$3,376,292
Total Costs (Operating + Debt Service)	$11,903,073	$12,049,198	$12,193,216	$12,364,341	$12,510,467	$13,273,821	$13,402,453
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995							
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$10,561,840	$10,691,500	$10,819,290	$10,971,133	$11,100,793	$11,778,133	$11,892,270
• Average Residential Tax Bill	$1,669	$1,662	$1,655	$1,652	$1,646	$1,720	$1,710
Change from Baseline Tax Bill	+ 3.48%	+ 3.38%	+ 3.28%	+ 3.18%	+ 3.12%	+ 7.11%	+ 6.91%

PART 2 — GROWTH SCENARIOS

	2007	2008	2009	2010	2011	2012	2013
Housing Units							
• Occupied Year Round	3,107	3,154	3,201	3,216	3,216	3,216	3,216
• Occupied Seasonally	3,428	3,428	3,428	3,428	3,428	3,428	3,428
• Total	6,535	6,582	6,629	6,644	6,644	6,644	6,644
Population Level	6,007	6,098	6,188	6,217	6,217	6,217	6,217
School Age Children	920	934	948	953	953	953	953
Commercial Acreage	152	153	154	155	156	157	158
REAL ESTATE VALUATION							
• Residential	$861,456,187	$866,592,183	$871,728,180	$873,367,328	$873,367,328	$873,367,328	$873,367,328
• Commercial	$65,113,943	$65,502,871	$65,891,800	$66,280,729	$66,669,657	$67,058,586	$67,447,514
• Total	$926,570,129	$932,095,055	$937,619,980	$939,648,056	$940,036,985	$940,425,913	$940,814,842
Real Estate Valuation Increase from Growth	$132,739,229	$138,264,155	$143,789,080	$145,817,156	$146,206,085	$146,595,013	$146,983,942
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$5,625,925	$5,714,650	$5,802,400	$5,830,675	$5,830,675	$5,830,675	$5,830,675
• School	$4,592,064	$4,695,167	$4,797,137	$4,829,994	$4,829,994	$4,829,994	$4,829,994
Debt Service:							
• Major Non-Growth Investments	$1,115,786	$1,103,089	$1,065,393	$1,152,696	$1,110,000	$995,875	$981,750
• Major Growth-Related Investments	$802,978	$777,478	$751,978	$1,431,328	$1,390,359	$1,349,390	$1,308,421
• Other Debt Service	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332	$1,394,332
• Total Debt Service	$3,313,095	$3,274,899	$3,211,702	$3,978,356	$3,894,691	$3,739,597	$3,684,503
Total Costs (Operating + Debt Service)	$13,531,084	$13,684,716	$13,811,239	$14,639,025	$14,555,360	$14,400,266	$14,345,172
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995							
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$12,006,408	$12,142,728	$12,254,995	$12,989,506	$12,915,268	$12,777,650	$12,728,765
• Average Residential Tax Bill	$1,708	$1,715	$1,719	$1,817	$1,806	$1,786	$1,778
Change from Baseline Tax Bill	+ 7.15%	+ 7.73%	+ 8.34%	+ 13.59%	+ 13.36%	+ 13.34%	+ 13.02%

PART 2 — GROWTH SCENARIOS

	2014	2015	w/ shift 2015
Housing Units			
• Occupied Year Round	3,216	3,216	4,930
• Occupied Seasonally	3,428	3,428	1,714
• Total	6,644	6,644	6,644
Population Level	6,217	6,217	9,531
School Age Children	953	953	1,460
Commercial Acreage	159	160	160
REAL ESTATE VALUATION			
• Residential	$873,367,328	$873,367,328	$873,367,328
• Commercial	$67,836,443	$68,225,371	$68,225,371
• Total	$941,203,771	$941,592,699	$941,592,699
Real Estate Valuation Increase from Growth	$147,372,871	$147,761,799	$147,761,799
MUNICIPAL COSTS			
Operating Costs (excluding debt service)			
• Non-School	$5,830,675	$5,830,675	$9,061,825
• School	$4,829,994	$4,829,994	$8,584,756
Debt Service:			
• Major Non-Growth Investments	$942,625	$718,500	$718,500
• Major Growth-Related Investments	$1,267,453	$1,956,334	$1,956,334
• Other Debt Service	$1,394,332	$1,394,332	$1,394,332
• Total Debt Service	$3,604,410	$4,069,166	$4,069,166
Total Costs (Operating + Debt Service)	$14,265,078	$14,729,835	$21,715,747
PROPERTY TAX ANALYSIS			
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995			
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$12,657,696	$13,070,084	$19,268,826
• Average Residential Tax Bill	$1,768	$1,825	$2,690
Change from Baseline Tax Bill	+ 12.77%	+ 19.00%	+ 75.43%

The Outer Cape Capacity Study

Detailed Forecasts: Wellfleet

WELLFLEET MODEL INPUTS

Starting Year	1995
Growth Interval (Years)	1

Development	Start Year	Annual Increase	% of Annual Growth	Buildout
Year Round Units	1,402		37%	1,938
Seasonal Units	2,399		63%	3,313
Total Units	3,801	45		5,251
Population	2,650			
Persons per Year round Unit	1.89			
School-Age Children / YR Unit	0.24			
Commercial Acreage	281	0.8		360

Growth-Related Operating Cost Increases

Non-School Expenditures:	$975	per new resident
School Expenditures:	$1,133	per new resident

Property Valuation

Total Residential Valuation	$623,000,000
Average Residential Value per Unit	$163,904
Average Valuation Increase per New Residential Unit*	$122,928
Total Commercial Valuation	$67,700,000
Average Commercial Valuation per Acre	$240,925
Average Assessed Valuation Increase per Commercial Acre*	$180,694

Bond Rates

Minimum Length of Bond	1	6	11
Interest Rate	5.00%	5.00%	5.00%

All debt repayments are calculated on bond basis.

*It is assumed that 25% of average new residential and commercial value is attributable to land value which is already assessed and included in the town's residential and commercial valuation. Therefore, the increase in valuation from new development will be assumed to be 75% of average value.

WELLFLEET CAPITAL COSTS

Budget Category	Detail	Total Facility Cost (1995)	Start Year	Term of Bond	Starting Balance (Approx.)
Major NonGrowth Capital Facility Investments					
Buildings	Town Hall (Note 1)	$349,400	1995		$181,000
Water supply	Coles Neck Water Supply	$600,000	1995	10	$375,000
Solid Waste	Transfer Station	$260,000	1995		$53,625
DPW	Landfill Closure	$800,000	1995		
DPW	28-acre purchase	$860,000	1995	10	$450,000
Buildings	Library Renovation	$1,105,760	1995	8.5	$580,000
Buildings	Elementary Expansion	$4,500,000	1995	20	$4,275,000
DPW	Highway Garage - Design	$40,000	1996		$40,000
DPW	Highway Garage	$800,000	1997	10	$800,000
DPW	Bridge Replacement	$40,000	1998		
Wastewater	Sewer Central Village	$10,000,000	2010	20	$5,000,000
Water supply	New system: Wellfleet Ctr. & Rte. 6 corridor	$5,000,000	2000	20	$5,000,000
Subtotal for NonGrowth		$24,355,160			$16,754,625
Major Growth Related Capital Investments					
Buildings	Nauset Expansion	$749,000	1997	20	$749,000
Buildings	New Elementary School	$5,000,000	2005	20	$5,000,000
Water supply	Expand system to residential areas (CCC est.)	$1,375,000	2005	20	$1,375,000
"	"	$2,062,500	2010	20	$2,062,500
"	"	$2,062,500	2015	20	$2,062,500
Traffic	Local road improvements (CCC est.)	$874,000	2000	10	$874,000
"	"	$874,000	2005	10	$874,000
"	"	$874,000	2010	10	$874,000
"	"	$874,000	2015	10	$874,000
Subtotal for Growth Costs		$14,745,000			$14,745,000
Other Debt					
Total Capital Costs					

Note:

1. Town Hall: Recent renovations funded through appropriation from general fund; not included in debt service.

WELLFLEET

Budget Category	Detail	1995	1996	1997	1998	1999	2000	2001	2002
Major NonGrowth Capital Facility Investments									
Buildings	Town Hall (Note 1)								
Water supply	Coles Neck Water Supply	$82,050	$77,850	$73,650	$69,450	$65,250	$61,050		
Solid Waste	Transfer Station	$53,625							
DPW	Landfill Closure	$34,585	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
DPW	28-acre purchase	$111,480	$105,460	$99,440	$93,420	$87,400	$20,000		
Buildings	Library Renovation	$161,583	$152,477	$143,371	$134,264	$59,642			
Buildings	Elementary Expansion	$468,000	$454,500	$441,000	$427,500	$414,000	$400,500	$387,000	$373,500
DPW	Highway Garage - Design		$40,000						
DPW	Highway Garage			$120,000	$116,000	$112,000	$108,000	$104,000	$100,000
DPW	Bridge Replacement				$40,000				
Wastewater	Sewer Central Village								
Water supply	New system: Wellfleet Ctr. & Rte. 6 corridor						$500,000	$487,500	$475,000
Subtotal for NonGrowth		$911,323	$880,287	$927,461	$930,634	$788,292	$1,139,550	$1,028,500	$998,500
Major Growth Related Capital Investments									
Buildings	Nauset Expansion			$74,900	$73,028	$71,155	$69,283	$67,410	$65,538
Buildings	New Elementary School								
Water supply	Expand system to residential areas (CCC est.)								
"	"								
"	"								
Traffic	Local road improvements (CCC est.)						$131,100	$126,730	$122,360
"	"								
"	"								
"	"								
Subtotal for Growth Costs		$0	$0	$74,900	$73,028	$71,155	$200,383	$194,140	$187,898
Other Debt		$20,978	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978
Total Capital Costs		$932,301	$901,265	$1,023,339	$1,024,640	$880,425	$1,360,911	$1,243,618	$1,207,376

Note:

1. Town Hall: Recent renovations funded through appropriation from general fund; not included in debt service.

WELLFLEET

Budget Category	Detail	2003	2004	2005	2006	2007	2008	2009	2010
Major NonGrowth Capital Facility Investments									
Buildings	Town Hall (Note 1)								
Water supply	Coles Neck Water Supply								
Solid Waste	Transfer Station								
DPW	Landfill Closure	$50,000	$50,000	$50,000	$50,000	$50,000			
DPW	28-acre purchase								
Buildings	Library Renovation								
Buildings	Elementary Expansion	$360,000	$346,500	$333,000	$319,500	$306,000	$292,500	$279,000	$265,500
DPW	Highway Garage - Design								
DPW	Highway Garage	$96,000	$92,000	$88,000	$84,000				
DPW	Bridge Replacement								
Wastewater	Sewer Central Village								$500,000
Water supply	New system: Wellfleet Ctr. & Rte. 6 corridor	$462,500	$450,000	$437,500	$425,000	$412,500	$400,000	$387,500	$375,000
Subtotal for NonGrowth		$968,500	$938,500	$908,500	$878,500	$768,500	$692,500	$666,500	$1,140,500
Major Growth Related Capital Investments									
Buildings	Nauset Expansion	$63,665	$61,793	$59,920	$58,048	$56,175	$54,303	$52,430	$50,558
Buildings	New Elementary School			$500,000	$487,500	$475,000	$462,500	$450,000	$437,500
Water supply	Expand system to residential areas (CCC est.)			$137,500	$134,063	$130,625	$127,188	$123,750	$120,313
"	"								$206,250
"	"								
Traffic	Local road improvements (CCC est.)	$117,990	$113,620	$109,250	$104,880	$100,510	$96,140	$91,770	
"	"			$131,100	$126,730	$122,360	$117,990	$113,620	$109,250
"	"								$131,100
"	"								
Subtotal for Growth Costs		$181,655	$175,413	$937,770	$911,220	$884,670	$858,120	$831,570	$1,054,970
Other Debt		$20,978	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978
Total Capital Costs		$1,171,133	$1,134,891	$1,867,248	$1,810,698	$1,674,148	$1,571,598	$1,519,048	$2,216,448

Note:

1. Town Hall: Recent renovations funded through appropriation from general fund; not included in debt service.

WELLFLEET

Budget Category	Detail	2011	2012	2013	2014	2015
Major NonGrowth Capital Facility Investments						
Buildings	Town Hall (Note 1)					
Water supply	Coles Neck Water Supply					
Solid Waste	Transfer Station					
DPW	Landfill Closure					
DPW	28-acre purchase					
Buildings	Library Renovation					
Buildings	Elementary Expansion	$252,000	$238,500	$225,000		
DPW	Highway Garage - Design					
DPW	Highway Garage					
DPW	Bridge Replacement					
Wastewater	Sewer Central Village	$487,500	$475,000	$462,500	$450,000	$437,500
Water supply	New system: Wellfleet Ctr. & Rte. 6 corridor	$362,500	$350,000	$337,500	$325,000	$312,500
Subtotal for NonGrowth		$1,102,000	$1,063,500	$1,025,000	$775,000	$750,000
Major Growth Related Capital Investments						
Buildings	Nauset Expansion	$48,685	$46,813	$44,940	$43,068	$41,195
Buildings	New Elementary School	$425,000	$412,500	$400,000	$387,500	$375,000
Water supply	Expand system to residential areas (CCC est.)	$116,875	$113,438	$110,000	$106,563	$103,125
"	"	$201,094	$195,938	$190,781	$185,625	$180,469
"	"					$206,250
Traffic	Local road improvements (CCC est.)					
"	"	$104,880	$100,510	$96,140	$91,770	
"	"	$126,730	$122,360	$117,990	$113,620	$109,250
"	"					$131,100
Subtotal for Growth Costs		$1,023,264	$991,558	$959,851	$928,145	$1,146,389
Other Debt		$20,978	$20,978	$20,978	$20,978	$20,978
Total Capital Costs		$2,146,242	$2,076,036	$2,005,829	$1,724,123	$1,917,367

Note:

1. Town Hall: Recent renovations funded through appropriation from general fund; not included in debt service.

WELLFLEET GROWTH SUMMARY

PART 1 — BASELINE FORECASTS

FUTURE MUNICIPAL COSTS AND REQUIRED PROPERTY TAX REVENUES ASSUMING NO FURTHER RESIDENTIAL OR COMMERCIAL DEVELOPMENT

	1993	1994	1995	1996	1997	1998	1999
REAL ESTATE VALUATION							
• Residential	$623,620,550	$635,257,100	$613,428,216	$613,428,216	$613,428,216	$613,428,216	$613,428,216
• Commercial	$67,495,806	$69,137,207	$69,200,501	$69,200,501	$69,200,501	$69,200,501	$69,200,501
• Total	$691,116,356	$704,394,307	$682,628,717	$682,628,717	$682,628,717	$682,628,717	$682,628,717
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$3,604,689	$3,569,316	$3,569,316	$3,569,316	$3,569,316	$3,569,316	$3,569,316
• School	$2,099,030	$2,098,771	$2,098,771	$2,098,771	$2,098,771	$2,098,771	$2,098,771
Debt Service:							
• Major Non-Growth Investments			$911,323	$880,287	$927,461	$930,634	$788,292
• Other Debt Service			$20,978	$20,978	$20,978	$20,978	$20,978
• Total Debt Service	$1,017,114	$932,301	$932,301	$901,265	$948,439	$951,612	$809,270
Total Costs (Operating + Debt Service)	$6,720,833	$6,600,388	$6,600,388	$6,569,352	$6,616,526	$6,619,699	$6,477,357
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues	15.78%	12.60%	14.16%	see Note (1)			
• Portion of Total Costs to be Paid from Property Tax Levy	84.22%	87.40%	85.84%	see Note (1)			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$5,660,243	$5,768,989	$5,665,818	$5,639,176	$5,679,671	$5,682,395	$5,560,207
• Average Residential Tax Bill			$1,340	$1,333	$1,343	$1,343	$1,315

Notes:

(1) Because of the uncertainty regarding future state aid levels, this analysis assumes that the current percentage of total costs paid by state aid and other non-property-tax sources will remain constant (see rows 22 & 23).

WELLFLEET

PART 1 — BASELINE FORECASTS

	2000	2001	2002	2003	2004	2005	2006
REAL ESTATE VALUATION							
• Residential	$613,428,216	$613,428,216	$613,428,216	$613,428,216	$613,428,216	$613,428,216	$613,428,216
• Commercial	$69,200,501	$69,200,501	$69,200,501	$69,200,501	$69,200,501	$69,200,501	$69,200,501
• Total	$682,628,717	$682,628,717	$682,628,717	$682,628,717	$682,628,717	$682,628,717	$682,628,717
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$3,569,316	$3,569,316	$3,569,316	$3,569,316	$3,569,316	$3,569,316	$3,569,316
• School	$2,098,771	$2,098,771	$2,098,771	$2,098,771	$2,098,771	$2,098,771	$2,098,771
Debt Service:							
• Major Non-Growth Investments	$1,139,550	$1,028,500	$998,500	$968,500	$938,500	$908,500	$878,500
• Other Debt Service	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978
• Total Debt Service	$1,160,528	$1,049,478	$1,019,478	$989,478	$959,478	$929,478	$899,478
Total Costs (Operating + Debt Service)	$6,828,615	$6,717,565	$6,687,565	$6,657,565	$6,627,565	$6,597,565	$6,567,565
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues							
• Portion of Total Costs to be Paid from Property Tax Levy							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$5,861,730	$5,766,404	$5,740,651	$5,714,899	$5,689,147	$5,663,395	$5,637,643
• Average Residential Tax Bill	$1,386	$1,363	$1,357	$1,351	$1,345	$1,339	$1,333

WELLFLEET

PART 1 — BASELINE FORECASTS

	2007	2008	2009	2010	2011	2012	2013
REAL ESTATE VALUATION							
• Residential	$613,428,216	$613,428,216	$613,428,216	$613,428,216	$613,428,216	$613,428,216	$613,428,216
• Commercial	$69,200,501	$69,200,501	$69,200,501	$69,200,501	$69,200,501	$69,200,501	$69,200,501
• Total	$682,628,717	$682,628,717	$682,628,717	$682,628,717	$682,628,717	$682,628,717	$682,628,717
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$3,569,316	$3,569,316	$3,569,316	$3,569,316	$3,569,316	$3,569,316	$3,569,316
• School	$2,098,771	$2,098,771	$2,098,771	$2,098,771	$2,098,771	$2,098,771	$2,098,771
Debt Service:							
• Major Non-Growth Investments	$768,500	$692,500	$666,500	$1,140,500	$1,102,000	$1,063,500	$1,025,000
• Other Debt Service	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978
• Total Debt Service	$789,478	$713,478	$687,478	$1,161,478	$1,122,978	$1,084,478	$1,045,978
Total Costs (Operating + Debt Service)	$6,457,565	$6,381,565	$6,355,565	$6,829,565	$6,791,065	$6,752,565	$6,714,065
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues							
• Portion of Total Costs to be Paid from Property Tax Levy							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$5,543,218	$5,477,979	$5,455,660	$5,862,545	$5,829,496	$5,796,448	$5,763,399
• Average Residential Tax Bill	$1,311	$1,295	$1,290	$1,386	$1,378	$1,370	$1,363

WELLFLEET

PART 1 — BASELINE FORECASTS

	2014	2015	2015
REAL ESTATE VALUATION			
• Residential	$613,428,216	$613,428,216	$613,428,216
• Commercial	$69,200,501	$69,200,501	$69,200,501
• Total	$682,628,717	$682,628,717	$682,628,717
MUNICIPAL COSTS			
Operating Costs (excluding debt service)			
• Non-School	$3,569,316	$3,569,316	$3,569,316
• School	$2,098,771	$2,098,771	$2,098,771
Debt Service:			
• Major Non-Growth Investments	$775,000	$750,000	$750,000
• Other Debt Service	$20,978	$20,978	$20,978
• Total Debt Service	$795,978	$770,978	$770,978
Total Costs (Operating + Debt Service)	$6,464,065	$6,439,065	$6,439,065
PROPERTY TAX ANALYSIS			
• Portion of Total Costs Paid from State Aid & Other Local Revenues			
• Portion of Total Costs to be Paid from Property Tax Levy			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$5,548,797	$5,527,337	$5,527,337
• Average Residential Tax Bill	$1,312	$1,307	$1,307

PART 2 — GROWTH SCENARIOS

FUTURE MUNICIPAL COSTS AND REQUIRED PROPERTY TAX REVENUES
ASSUMING BASELINE PLUS RESIDENTIAL AND COMMERCIAL GROWTH

	1993	1994	1995	1996	1997	1998	1999
Housing Units							
• Occupied Year Round	1,369	1,385	1,402	1,419	1,435	1,452	1,469
• Occupied Seasonally	2,342	2,371	2,399	2,427	2,456	2,484	2,512
• Total	3,711	3,756	3,801	3,846	3,891	3,936	3,981
Population Level	2,588	2,618	2,650	2,682	2,712	2,744	2,777
School Age Children	323	326	330	334	338	342	346
Commercial Acreage	279	280	281	282	283	283	284
REAL ESTATE VALUATION							
• Residential	$623,620,550	$635,257,100	$613,428,216	$618,959,984	$624,491,752	$630,023,520	$635,555,288
• Commercial	$67,495,806	$69,137,207	$69,200,501	$69,345,056	$69,489,611	$69,634,166	$69,778,722
• Total	$691,116,356	$704,394,307	$682,628,717	$688,305,040	$693,981,363	$699,657,686	$705,334,009
Real Estate Valuation Increase from Growth			$0	$5,676,323	$11,352,646	$17,028,969	$22,705,292
MUNICIPAL COSTS							
Operating Costs (excluding debt service)	$5,703,719						
• Non-School	$3,604,689	$3,569,316	$3,569,316	$3,600,637	$3,629,887	$3,661,087	$3,693,262
• School	$2,099,030	$2,098,771	$2,098,771	$2,135,168	$2,169,158	$2,205,414	$2,242,803
Debt Service:							
• Major Non-Growth Investments			$911,323	$880,287	$927,461	$930,634	$788,292
• Major Growth-Related Investments			$0	$0	$74,900	$73,028	$71,155
• Other Debt Service			$20,978	$20,978	$20,978	$20,978	$20,978
• Total Debt Service	$1,017,114	$932,301	$932,301	$901,265	$1,023,339	$1,024,640	$880,425
Total Costs (Operating + Debt Service)	$6,720,833	$6,600,388	$6,600,388	$6,637,070	$6,822,384	$6,891,141	$6,816,490
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995	15.78%	12.60%	14.16%	see Note (1)			
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995	84.22%	87.40%	85.84%	see Note (1)			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$5,660,243	$5,768,989	$5,665,818	$5,801,051	$5,963,022	$6,023,118	$5,957,870
• Average Residential Tax Bill			$1,340	$1,356	$1,379	$1,378	$1,349
Change from Baseline Tax Bill			+ 0.00%	+ 1.74%	+ 2.70%	+ 2.57%	+ 2.59%

PART 2 — GROWTH SCENARIOS

	2000	2001	2002	2003	2004	2005	2006
Housing Units							
• Occupied Year Round	1,485	1,502	1,519	1,535	1,552	1,569	1,585
• Occupied Seasonally	2,541	2,569	2,597	2,626	2,654	2,683	2,711
• Total	4,026	4,071	4,116	4,161	4,206	4,252	4,296
Population Level	2,807	2,839	2,871	2,901	2,933	2,966	2,996
School Age Children	350	354	358	362	366	370	374
Commercial Acreage	285	286	287	287	288	289	290
REAL ESTATE VALUATION							
• Residential	$641,087,056	$646,618,824	$652,150,592	$657,682,360	$663,214,128	$668,868,824	$674,277,664
• Commercial	$69,923,277	$70,067,832	$70,212,387	$70,356,942	$70,501,497	$70,646,053	$70,790,608
• Total	$711,010,333	$716,686,656	$722,362,979	$728,039,302	$733,715,625	$739,514,876	$745,068,271
Real Estate Valuation Increase from Growth	$28,381,616	$34,057,939	$39,734,262	$45,410,585	$51,086,908	$56,886,159	$62,439,554
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$3,722,512	$3,753,712	$3,784,912	$3,814,162	$3,845,362	$3,877,537	$3,906,787
• School	$2,276,793	$2,313,049	$2,349,305	$2,383,295	$2,419,551	$2,456,940	$2,490,930
Debt Service:							
• Major Non-Growth Investments	$1,139,550	$1,028,500	$998,500	$968,500	$938,500	$908,500	$878,500
• Major Growth-Related Investments	$200,383	$194,140	$187,898	$181,655	$175,413	$937,770	$911,220
• Other Debt Service	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978
• Total Debt Service	$1,360,911	$1,243,618	$1,207,376	$1,171,133	$1,134,891	$1,867,248	$1,810,698
Total Costs (Operating + Debt Service)	$7,360,216	$7,310,379	$7,341,593	$7,368,590	$7,399,804	$8,201,725	$8,208,415
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995							
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$6,433,107	$6,389,548	$6,416,830	$6,440,427	$6,467,709	$7,168,618	$7,174,466
• Average Residential Tax Bill	$1,441	$1,416	$1,407	$1,398	$1,390	$1,525	$1,511
Change from Baseline Tax Bill	+ 3.96%	+ 3.87%	+ 3.70%	+ 3.49%	+ 3.34%	+ 13.89%	+ 13.39%

PART 2 — GROWTH SCENARIOS

	2007	2008	2009	2010	2011	2012	2013
Housing Units							
• Occupied Year Round	1,602	1,618	1,635	1,652	1,668	1,685	1,702
• Occupied Seasonally	2,739	2,768	2,796	2,824	2,853	2,881	2,909
• Total	4,341	4,386	4,431	4,476	4,521	4,566	4,611
Population Level	3,028	3,058	3,090	3,122	3,153	3,185	3,217
School Age Children	378	381	385	389	393	397	401
Commercial Acreage	291	291	292	293	294	295	295
REAL ESTATE VALUATION							
• Residential	$679,809,431	$685,341,199	$690,872,967	$696,404,735	$701,936,503	$707,468,271	$713,000,039
• Commercial	$70,935,163	$71,079,718	$71,224,273	$71,368,828	$71,513,384	$71,657,939	$71,802,494
• Total	$750,744,594	$756,420,918	$762,097,241	$767,773,564	$773,449,887	$779,126,210	$784,802,533
Real Estate Valuation Increase from Growth	$68,115,877	$73,792,201	$79,468,524	$85,144,847	$90,821,170	$96,497,493	$102,173,816
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$3,937,987	$3,967,237	$3,998,437	$4,029,637	$4,059,862	$4,091,062	$4,122,262
• School	$2,527,186	$2,561,176	$2,597,432	$2,633,688	$2,668,811	$2,705,067	$2,741,323
Debt Service:							
• Major Non-Growth Investments	$768,500	$692,500	$666,500	$1,140,500	$1,102,000	$1,063,500	$1,025,000
• Major Growth-Related Investments	$884,670	$858,120	$831,570	$1,054,970	$1,023,264	$991,558	$959,851
• Other Debt Service	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978	$20,978
• Total Debt Service	$1,674,148	$1,571,598	$1,519,048	$2,216,448	$2,146,242	$2,076,036	$2,005,829
Total Costs (Operating + Debt Service)	$8,139,321	$8,100,011	$8,114,917	$8,879,773	$8,874,915	$8,872,165	$8,869,414
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995							
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$7,114,075	$7,079,716	$7,092,745	$7,761,258	$7,757,012	$7,754,608	$7,752,204
• Average Residential Tax Bill	$1,484	$1,462	$1,451	$1,573	$1,557	$1,542	$1,527
Change from Baseline Tax Bill	+ 13.23%	+ 12.92%	+ 12.50%	+ 13.48%	+ 12.98%	+ 12.53%	+ 12.10%

PART 2 — GROWTH SCENARIOS

	2014	2015	w/ shift 2015
Housing Units			
• Occupied Year Round	1,718	1,735	3,218
• Occupied Seasonally	2,938	2,966	1,483
• Total	4,656	4,701	4,701
Population Level	3,247	3,279	6,082
School Age Children	405	409	758
Commercial Acreage	296	297	298
REAL ESTATE VALUATION			
• Residential	$718,531,807	$724,063,575	$724,063,575
• Commercial	$71,947,049	$72,091,604	$72,236,159
• Total	$790,478,856	$796,155,179	$796,299,734
Real Estate Valuation Increase from Growth	$107,850,139	$113,526,462	$113,671,017
MUNICIPAL COSTS			
Operating Costs (excluding debt service)			
• Non-School	$4,151,512	$4,182,712	$6,915,637
• School	$2,775,313	$2,811,569	$5,987,368
Debt Service:			
• Major Non-Growth Investments	$775,000	$750,000	$750,000
• Major Growth-Related Investments	$928,145	$1,146,389	$1,146,389
• Other Debt Service	$20,978	$20,978	$20,978
• Total Debt Service	$1,724,123	$1,917,367	$1,917,367
Total Costs (Operating + Debt Service)	$8,650,948	$8,911,648	$14,820,372
PROPERTY TAX ANALYSIS			
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995			
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$7,561,256	$7,789,118	$12,953,566
• Average Residential Tax Bill	$1,476	$1,507	$2,506
Change from Baseline Tax Bill	+ 12.53%	+ 15.31%	+ 91.74%

The Outer Cape Capacity Study

Detailed Forecasts: Truro

TRURO MODEL INPUTS

Starting Year	1995
Growth Interval (Years)	1

Development	Start Year	Annual Increase	% of Annual Growth	Buildout
Year Round Units	873		37%	1,452
Seasonal Units	1,502		63%	2,526
Total Units	2,375	40		
Population	1,719			
Persons per Year round Unit	1.97			
School-Age Children/YR Unit	0.20			
Commercial Acreage	264	0.25		271

Growth-Related Operating Cost Increases

Non-School Expenditures:	$975	per new resident
School Expenditures:	$1,133	per new resident

Property Valuation

Total Residential Valuation	$496,167,000
Average Residential Value per Unit	$208,912
Average Valuation Increase per New Residential Unit*	$156,684
Total Commercial Valuation	$57,600,000
Average Commercial Valuation per Acre	$218,182
Average Assessed Valuation Increase per Commercial Acre*	$163,636

Bond Rates

Minimum Length of Bond	1	6	11
Interest Rate	5.00%	5.00%	5.00%

All debt repayments are calculated on bond basis.

*It is assumed that 25% of average new residential and commercial value is attributable to land value which is already assessed and included in the town's residential and commercial valuation. Therefore, the increase in valuation from new development will be assumed to be 75% of average value.

TRURO

CAPITAL COSTS

Budget Category	Detail	Total Facility Cost (1995)	Start Year	Term of Bond	Starting Balance (Approx.)
Major NonGrowth Capital Facility Investments					
Schools	Former Elementary Addition	$2,500,000	1995	20	$1,750,000
Public Safety	Safety Complex	$1,700,000	1995	20	$1,500,000
Harbor	Current dredging	$110,000	1995	10	$110,000
Library	New facility	$450,000	1997	20	$450,000
Buildings	Town Hall improvements	$1,000,000	1998	20	$1,000,000
DPW	Landfill capping	$550,000	1999	10	$550,000
DPW	New transfer station	$200,000	2000	5	$200,000
DPW	New highway garage	$1,000,000	2005	20	$1,000,000
Harbor	Dredging in 2005	$100,000	2005	10	$100,000
DPW	Partial sewerage system	$500,000	2005	20	$500,000
General Govt	Build senior center	$500,000	2005	20	$500,000
DPW	Partial public water system	$1,000,000	2010	20	$1,000,000
Harbor	Dredging in 2015	$100,000	2015	10	$100,000
Subtotal for NonGrowth		$9,710,000			$8,760,000
Major Growth Related Capital Investments					
Schools	Future Elementary Expansion	$1,000,000	2010	20	$1,000,000
Traffic	Local road improvements (CCC est.)	$578,000	2000	10	$578,000
"	"	$578,000	2005	10	$578,000
"	"	$578,000	2010	10	$578,000
"	"	$578,000	2015	10	$578,000
Subtotal for Growth Costs		$3,312,000			$3,312,000
Other Debt					
Total Capital Costs					

TRURO

Budget Category	Detail	1995	1996	1997	1998	1999	2000	2001	2002
Major NonGrowth Capital Facility Investments									
Schools	Former Elementary Addition	$175,000	$170,625	$166,250	$161,875	$157,500	$153,125	$148,750	$144,375
Public Safety	Safety Complex	$150,000	$146,250	$142,500	$138,750	$135,000	$131,250	$127,500	$123,750
Harbor	Current dredging	$16,500	$15,950	$15,400	$14,850	$14,300	$13,750	$13,200	$12,650
Library	New facility			$45,000	$43,875	$42,750	$41,625	$40,500	$39,375
Buildings	Town Hall improvements				$100,000	$97,500	$95,000	$92,500	$90,000
DPW	Landfill capping					$82,500	$79,750	$77,000	$74,250
DPW	New transfer station						$50,000	$48,000	$46,000
DPW	New highway garage								
Harbor	Dredging in 2005								
DPW	Partial sewerage system								
General Govt	Build senior center								
DPW	Partial public water system								
Harbor	Dredging in 2015								
Subtotal for NonGrowth		$341,500	$332,825	$369,150	$459,350	$529,550	$564,500	$547,450	$530,400
Major Growth Related Capital Investments									
Schools	Future Elementary Expansion								
Traffic	Local road improvements (CCC est.)						$86,700	$83,810	$80,920
"	"								
"	"								
"	"								
Subtotal for Growth Costs		$0	$0	$0	$0	$0	$86,700	$83,810	$80,920
Other Debt		$168,260	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260
Total Capital Costs		$509,760	$501,085	$537,410	$627,610	$697,810	$819,460	$799,520	$779,580

TRURO

Budget Category	Detail	2003	2004	2005	2006	2007	2008	2009	2010
Major NonGrowth Capital Facility Investments									
Schools	Former Elementary Addition	$140,000	$135,625	$131,250	$126,875	$122,500	$118,125	$113,750	$109,375
Public Safety	Safety Complex	$120,000	$116,250	$112,500	$108,750	$105,000	$101,250	$97,500	$93,750
Harbor	Current dredging	$12,100	$11,550						
Library	New facility	$38,250	$37,125	$36,000	$34,875	$33,750	$32,625	$31,500	$30,375
Buildings	Town Hall improvements	$87,500	$85,000	$82,500	$80,000	$77,500	$75,000	$72,500	$70,000
DPW	Landfill capping	$71,500	$68,750	$66,000	$63,250	$60,500	$57,750		
DPW	New transfer station	$44,000	$42,000						
DPW	New highway garage			$100,000	$97,500	$95,000	$92,500	$90,000	$87,500
Harbor	Dredging in 2005			$15,000	$14,500	$14,000	$13,500	$13,000	$12,500
DPW	Partial sewerage system			$50,000	$48,750	$47,500	$46,250	$45,000	$43,750
General Govt	Build senior center								
DPW	Partial public water system								
Harbor	Dredging in 2015								
Subtotal for NonGrowth		$513,350	$496,300	$593,250	$574,500	$555,750	$537,000	$463,250	$447,250
Major Growth Related Capital Investments									
Schools	Future Elementary Expansion								$100,000
Traffic	Local road improvements (CCC est.)	$78,030	$75,140	$72,250	$69,360	$66,470	$63,580	$60,690	
"	"			$86,700	$83,810	$80,920	$78,030	$75,140	$72,250
"	"								$86,700
"	"								
Subtotal for Growth Costs		$78,030	$75,140	$158,950	$153,170	$147,390	$141,610	$135,830	$258,950
Other Debt		$168,260	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260
Total Capital Costs		$759,640	$739,700	$920,460	$895,930	$871,400	$846,870	$767,340	$874,460

TRURO

Budget Category	Detail	2011	2012	2013	2014	2015
Major NonGrowth Capital Facility Investments						
Schools	Former Elementary Addition	$105,000	$100,625	$96,250	$91,875	
Public Safety	Safety Complex	$90,000	$86,250	$82,500	$78,750	
Harbor	Current dredging					
Library	New facility	$29,250	$28,125	$27,000	$25,875	$24,750
Buildings	Town Hall improvements	$67,500	$65,000	$62,500	$60,000	$57,500
DPW	Landfill capping					
DPW	New transfer station					
DPW	New highway garage	$85,000	$82,500	$80,000	$77,500	$75,000
Harbor	Dredging in 2005	$12,000	$11,500	$11,000	$10,500	
DPW	Partial sewerage system	$42,500	$41,250	$40,000	$38,750	$37,500
General Govt	Build senior center					
DPW	Partial public water system					
Harbor	Dredging in 2015					
Subtotal for NonGrowth		$431,250	$415,250	$399,250	$383,250	$194,750
Major Growth Related Capital Investments						
Schools	Future Elementary Expansion	$97,500	$95,000	$92,500	$90,000	$87,500
Traffic	Local road improvements (CCC est.)					
"	"	$69,360	$66,470	$63,580	$60,690	
"	"	$83,810	$80,920	$78,030	$75,140	$72,250
"	"					$86,700
Subtotal for Growth Costs		$250,670	$242,390	$234,110	$225,830	$246,450
Other Debt		$168,260	$168,260	$168,260	$168,260	$168,260
Total Capital Costs		$850,180	$825,900	$801,620	$777,340	$609,460

TRURO GROWTH SUMMARY

PART 1 — BASELINE FORECASTS

FUTURE MUNICIPAL COSTS AND REQUIRED PROPERTY TAX REVENUES ASSUMING NO FURTHER RESIDENTIAL OR COMMERCIAL DEVELOPMENT

	1993	1994	1995	1996	1997	1998	1999
REAL ESTATE VALUATION							
• Residential	$496,167,500	$501,480,700	$508,990,100	$508,990,100	$508,990,100	$508,990,100	$508,990,100
• Commercial	$57,374,813	$57,865,183	$57,559,205	$57,559,205	$57,559,205	$57,559,205	$57,559,205
• Total	$553,542,313	$559,345,883	$566,549,305	$566,549,305	$566,549,305	$566,549,305	$566,549,305
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$2,650,768	$2,878,078	$2,878,078	$2,878,078	$2,878,078	$2,878,078	$2,878,078
• School	$1,455,638	$1,466,966	$1,466,966	$1,466,966	$1,466,966	$1,466,966	$1,466,966
Debt Service:							
• Major Non-Growth Investments			$341,500	$332,825	$369,150	$459,350	$529,550
• Other Debt Service			$168,260	$168,260	$168,260	$168,260	$168,260
• Total Debt Service	$487,770	$509,760	$509,760	$501,085	$537,410	$627,610	$697,810
Total Costs (Operating + Debt Service)	$4,594,176	$4,854,804	$4,854,804	$4,846,129	$4,882,454	$4,972,654	$5,042,854
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues	27.23%	25.57%	21.11%	see Note (1)			
• Portion of Total Costs to be Paid from Property Tax Levy	72.77%	74.43%	78.89%	see Note (1)			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$3,343,396	$3,613,374	$3,829,873	$3,823,030	$3,851,686	$3,922,843	$3,978,223
• Average Residential Tax Bill			$1,449	$1,446	$1,457	$1,484	$1,505

Notes:

(1) Because of the uncertainty regarding future state aid levels, this analysis assumes that the current percentage of total costs paid by state aid and other non-property-tax sources will remain constant (see rows 22 & 23).

TRURO

PART 1 — BASELINE FORECASTS

	2000	2001	2002	2003	2004	2005	2006
REAL ESTATE VALUATION							
• Residential	$508,990,100	$508,990,100	$508,990,100	$508,990,100	$508,990,100	$508,990,100	$508,990,100
• Commercial	$57,559,205	$57,559,205	$57,559,205	$57,559,205	$57,559,205	$57,559,205	$57,559,205
• Total	$566,549,305	$566,549,305	$566,549,305	$566,549,305	$566,549,305	$566,549,305	$566,549,305
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$2,878,078	$2,878,078	$2,878,078	$2,878,078	$2,878,078	$2,878,078	$2,878,078
• School	$1,466,966	$1,466,966	$1,466,966	$1,466,966	$1,466,966	$1,466,966	$1,466,966
Debt Service:							
• Major Non-Growth Investments	$564,500	$547,450	$530,400	$513,350	$496,300	$593,250	$574,500
• Other Debt Service	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260
• Total Debt Service	$732,760	$715,710	$698,660	$681,610	$664,560	$761,510	$742,760
Total Costs (Operating + Debt Service)	$5,077,804	$5,060,754	$5,043,704	$5,026,654	$5,009,604	$5,106,554	$5,087,804
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues							
• Portion of Total Costs to be Paid from Property Tax Levy							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$4,005,794	$3,992,344	$3,978,893	$3,965,443	$3,951,992	$4,028,475	$4,013,683
• Average Residential Tax Bill	$1,515	$1,510	$1,505	$1,500	$1,495	$1,524	$1,518

TRURO

PART 1 — BASELINE FORECASTS

	2007	2008	2009	2010	2011	2012	2013
REAL ESTATE VALUATION							
• Residential	$508,990,100	$508,990,100	$508,990,100	$508,990,100	$508,990,100	$508,990,100	$508,990,100
• Commercial	$57,559,205	$57,559,205	$57,559,205	$57,559,205	$57,559,205	$57,559,205	$57,559,205
• Total	$566,549,305	$566,549,305	$566,549,305	$566,549,305	$566,549,305	$566,549,305	$566,549,305
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$2,878,078	$2,878,078	$2,878,078	$2,878,078	$2,878,078	$2,878,078	$2,878,078
• School	$1,466,966	$1,466,966	$1,466,966	$1,466,966	$1,466,966	$1,466,966	$1,466,966
Debt Service:							
• Major Non-Growth Investments	$555,750	$537,000	$463,250	$447,250	$431,250	$415,250	$399,250
• Other Debt Service	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260
• Total Debt Service	$724,010	$705,260	$631,510	$615,510	$599,510	$583,510	$567,510
Total Costs (Operating + Debt Service)	$5,069,054	$5,050,304	$4,976,554	$4,960,554	$4,944,554	$4,928,554	$4,912,554
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues							
• Portion of Total Costs to be Paid from Property Tax Levy							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$3,998,892	$3,984,100	$3,925,920	$3,913,298	$3,900,676	$3,888,053	$3,875,431
• Average Residential Tax Bill	$1,513	$1,507	$1,485	$1,480	$1,476	$1,471	$1,466

TRURO

PART 1 — BASELINE FORECASTS

	2014	2015	2015
REAL ESTATE VALUATION			
• Residential	$508,990,100	$508,990,100	$508,990,100
• Commercial	$57,559,205	$57,559,205	$57,559,205
• Total	$566,549,305	$566,549,305	$566,549,305
MUNICIPAL COSTS			
Operating Costs (excluding debt service)			
• Non-School	$2,878,078	$2,878,078	$2,878,078
• School	$1,466,966	$1,466,966	$1,466,966
Debt Service:			
• Major Non-Growth Investments	$383,250	$194,750	$194,750
• Other Debt Service	$168,260	$168,260	$168,260
• Total Debt Service	$551,510	$363,010	$363,010
Total Costs (Operating + Debt Service)	$4,896,554	$4,708,054	$4,708,054
PROPERTY TAX ANALYSIS			
• Portion of Total Costs Paid from State Aid & Other Local Revenues			
• Portion of Total Costs to be Paid from Property Tax Levy			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$3,862,809	$3,714,105	$3,714,105
• Average Residential Tax Bill	$1,461	$1,405	$1,405

PART 2 — GROWTH SCENARIOS

FUTURE MUNICIPAL COSTS AND REQUIRED PROPERTY TAX REVENUES ASSUMING BASELINE PLUS RESIDENTIAL AND COMMERCIAL GROWTH

	1993	1994	1995	1996	1997	1998	1999
Housing Units							
• Occupied Year Round	843	858	873	888	903	917	932
• Occupied Seasonally	1,452	1,477	1,502	1,527	1,552	1,578	1,603
• Total	2,295	2,335	2,375	2,415	2,455	2,495	2,535
Population Level	1,660	1,689	1,719	1,748	1,778	1,805	1,835
School Age Children	167	170	173	176	179	182	185
Commercial Acreage	264	264	264	264	265	265	265
REAL ESTATE VALUATION							
• Residential	$496,167,500	$501,480,700	$508,990,100	$515,257,473	$521,524,845	$527,792,218	$534,059,591
• Commercial	$57,374,813	$57,865,183	$57,559,205	$57,600,114	$57,641,023	$57,681,932	$57,722,841
• Total	$553,542,313	$559,345,883	$566,549,305	$572,857,587	$579,165,868	$585,474,150	$591,782,432
Real Estate Valuation Increase from Growth				$6,308,282	$12,616,563	$18,924,845	$25,233,127
MUNICIPAL COSTS							
Operating Costs (excluding debt service)	$4,106,406						
• Non-School	$2,650,768	$2,878,078	$2,878,078	$2,906,661	$2,935,911	$2,962,236	$2,991,486
• School	$1,455,638	$1,466,966	$1,466,966	$1,500,180	$1,534,170	$1,564,761	$1,598,751
Debt Service:							
• Major Non-Growth Investments			$341,500	$332,825	$369,150	$459,350	$529,550
• Major Growth-Related Investments			$0	$0	$0	$0	$0
• Other Debt Service			$168,260	$168,260	$168,260	$168,260	$168,260
• Total Debt Service	$487,770	$509,760	$509,760	$501,085	$537,410	$627,610	$697,810
Total Costs (Operating + Debt Service)	$4,594,176	$4,854,804	$4,854,804	$4,907,926	$5,007,491	$5,154,607	$5,288,047
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995	27.23%	25.57%	21.11%	see Note (1)			
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995	72.77%	74.43%	78.89%	see Note (1)			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$3,343,396	$3,613,374	$3,829,873	$3,871,780	$3,950,325	$4,066,383	$4,171,651
• Average Residential Tax Bill			$1,449	$1,442	$1,449	$1,469	$1,485
Change from Baseline Tax Bill			- 0.00%	- 0.29%	- 0.55%	- 0.99%	- 1.31%

PART 2 — GROWTH SCENARIOS

	2000	2001	2002	2003	2004	2005	2006
Housing Units							
• Occupied Year Round	947	962	977	991	1,006	1,021	1,036
• Occupied Seasonally	1,628	1,653	1,678	1,704	1,729	1,754	1,779
• Total	2,575	2,615	2,655	2,695	2,735	2,775	2,815
Population Level	1,864	1,894	1,923	1,951	1,981	2,010	2,040
School Age Children	188	191	194	197	200	203	206
Commercial Acreage	265	266	266	266	266	267	267
REAL ESTATE VALUATION							
• Residential	$540,326,963	$546,594,336	$552,861,708	$559,129,081	$565,396,454	$571,663,826	$577,931,199
• Commercial	$57,763,750	$57,804,660	$57,845,569	$57,886,478	$57,927,387	$57,968,296	$58,009,205
• Total	$598,090,714	$604,398,995	$610,707,277	$617,015,559	$623,323,841	$629,632,122	$635,940,404
Real Estate Valuation Increase from Growth	$31,541,409	$37,849,690	$44,157,972	$50,466,254	$56,774,536	$63,082,817	$69,391,099
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$3,019,761	$3,049,011	$3,077,286	$3,104,586	$3,133,836	$3,162,111	$3,191,361
• School	$1,631,608	$1,665,598	$1,698,455	$1,730,179	$1,764,169	$1,797,026	$1,831,016
Debt Service:							
• Major Non-Growth Investments	$564,500	$547,450	$530,400	$513,350	$496,300	$593,250	$574,500
• Major Growth-Related Investments	$86,700	$83,810	$80,920	$78,030	$75,140	$158,950	$153,170
• Other Debt Service	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260
• Total Debt Service	$819,460	$799,520	$779,580	$759,640	$739,700	$920,460	$895,930
Total Costs (Operating + Debt Service)	$5,470,829	$5,514,129	$5,555,321	$5,594,405	$5,637,705	$5,879,597	$5,918,307
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995							
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$4,315,845	$4,350,004	$4,382,499	$4,413,332	$4,447,491	$4,638,315	$4,668,853
• Average Residential Tax Bill	$1,514	$1,504	$1,494	$1,484	$1,475	$1,518	$1,507
Change from Baseline Tax Bill	- 0.07%	- 0.39%	- 0.72%	- 1.07%	- 1.33%	- 0.41%	- 0.72%

PART 2 — GROWTH SCENARIOS

	2007	2008	2009	2010	2011	2012	2013
Housing Units							
• Occupied Year Round	1,051	1,065	1,080	1,095	1,110	1,125	1,139
• Occupied Seasonally	1,804	1,830	1,855	1,880	1,905	1,930	1,956
• Total	2,855	2,895	2,935	2,975	3,015	3,055	3,095
Population Level	2,069	2,097	2,126	2,156	2,185	2,215	2,242
School Age Children	209	211	214	217	220	223	226
Commercial Acreage	267	267	268	268	268	268	269
REAL ESTATE VALUATION							
• Residential	$584,198,572	$590,465,944	$596,733,317	$603,000,689	$609,268,062	$615,535,435	$621,802,807
• Commercial	$58,050,114	$58,091,023	$58,131,932	$58,172,841	$58,213,750	$58,254,660	$58,295,569
• Total	$642,248,686	$648,556,967	$654,865,249	$661,173,531	$667,481,813	$673,790,094	$680,098,376
Real Estate Valuation Increase from Growth	$75,699,381	$82,007,662	$88,315,944	$94,624,226	$100,932,508	$107,240,789	$113,549,071
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$3,219,636	$3,246,936	$3,275,211	$3,304,461	$3,332,736	$3,361,986	$3,388,311
• School	$1,863,873	$1,895,597	$1,928,454	$1,962,444	$1,995,301	$2,029,291	$2,059,882
Debt Service:							
• Major Non-Growth Investments	$555,750	$537,000	$463,250	$447,250	$431,250	$415,250	$399,250
• Major Growth-Related Investments	$147,390	$141,610	$135,830	$258,950	$250,670	$242,390	$234,110
• Other Debt Service	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260	$168,260
• Total Debt Service	$871,400	$846,870	$767,340	$874,460	$850,180	$825,900	$801,620
Total Costs (Operating + Debt Service)	$5,954,909	$5,989,403	$5,971,005	$6,141,365	$6,178,217	$6,217,177	$6,249,813
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995							
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$4,697,728	$4,724,939	$4,710,425	$4,844,820	$4,873,891	$4,904,626	$4,930,372
• Average Residential Tax Bill	$1,497	$1,486	$1,462	$1,485	$1,476	$1,467	$1,456
Change from Baseline Tax Bill	- 1.06%	- 1.40%	- 1.52%	+ 0.33%	+ 0.00%	- 0.28%	- 0.65%

PART 2 — GROWTH SCENARIOS

	2014	2015	w/ shift 2015
Housing Units			
• Occupied Year Round	1,154	1,169	2,172
• Occupied Seasonally	1,981	2,006	1,003
• Total	3,135	3,175	3,175
Population Level	2,272	2,301	4,276
School Age Children	229	232	431
Commercial Acreage	269	269	269
REAL ESTATE VALUATION			
• Residential	$628,070,180	$634,337,553	$634,337,553
• Commercial	$58,336,478	$58,377,387	$58,418,296
• Total	$686,406,658	$692,714,939	$692,755,849
Real Estate Valuation Increase from Growth	$119,857,353	$126,165,634	$126,206,544
MUNICIPAL COSTS			
Operating Costs (excluding debt service)			
• Non-School	$3,417,561	$3,445,836	$5,371,461
• School	$2,093,872	$2,126,729	$4,364,404
Debt Service:			
• Major Non-Growth Investments	$383,250	$194,750	$194,750
• Major Growth-Related Investments	$225,830	$246,450	$246,450
• Other Debt Service	$168,260	$168,260	$168,260
• Total Debt Service	$777,340	$609,460	$609,460
Total Costs (Operating + Debt Service)	$6,288,773	$6,182,025	$10,345,325
PROPERTY TAX ANALYSIS			
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995			
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$4,961,107	$4,876,896	$8,161,253
• Average Residential Tax Bill	$1,448	$1,407	$2,354
Change from Baseline Tax Bill	- 0.90%	+ 0.12%	+ 67.53%

The Outer Cape Capacity Study

Detailed Forecasts: Provincetown

PROVINCETOWN MODEL INPUTS

Starting Year	1995
Growth Interval (Years)	1

Development	Start Year	Annual Increase	% of Annual Growth	Buildout
Year Round Units	2,474		63%	3,172
Seasonal Units	1,468		37%	1,976
Total Units	3,942	28		
Population	3,692			
Persons per Year round Unit	1.49			
School-Age Children/YR Unit	0.14			
Commercial Acreage	151	0.01		152

Growth-Related Operating Cost Increases

Non-School Expenditures:	$975	per new resident
School Expenditures:	$1,133	per new resident

Property Valuation

Total Residential Valuation	$394,000,000
Average Residential Value per Unit	$99,949
Average Valuation Increase per New Residential Unit*	$74,962
Total Commercial Valuation	$162,200,000
Average Commercial Valuation per Acre	$1,074,172
Average Assessed Valuation Increase per Commercial Acre*	$805,629

Bond Rates

Minimum Length of Bond	1	6	11
Interest Rate	5.00%	5.00%	5.00%

All debt repayments are calculated on bond basis.

*It is assumed that 25% of average new residential and commercial value is attributable to land value which is already assessed and included in the town's residential and commercial valuation. Therefore, the increase in valuation from new development will be assumed to be 75% of average value.

PROVINCETOWN CAPITAL COSTS

Budget Category	Detail	Total Facility Cost (1995)	Start Year	Term of Bond	Starting Balance (Approx.)
Major NonGrowth Capital Facility Investments					
Fire	Shankpainter Road Station	$1,200,000	1992	20	$1,200,000
Sewerage	Potential Future Town Sewerage Facility	$6,000,000	2005	20	$6,000,000
Subtotal for NonGrowth		$7,200,000			$7,200,000
Major Growth Related Capital Investments					
Traffic	Local road improvements (CCC est.)	$278,000	2000	10	$278,000
"	"	$278,000	2005	10	$278,000
"	"	$278,000	2010	10	$278,000
"	"	$278,000	2015	10	$278,000
Subtotal for Growth Costs		$1,112,000			$1,112,000
Other Debt					
Total Capital Costs					

PROVINCETOWN

Budget Category	Detail	1995	1996	1997	1998	1999	2000	2001	2002
Major NonGrowth Capital Facility Investments									
Fire	Shankpainter Road Station	$111,000	$108,000	$105,000	$102,000	$99,000	$96,000	$93,000	$90,000
Sewerage	Potential Future Town Sewerage Facility								
Subtotal for NonGrowth		$111,000	$108,000	$105,000	$102,000	$99,000	$96,000	$93,000	$90,000
Major Growth Related Capital Investments									
Traffic	Local road improvements (CCC est.)						$41,700	$40,310	$38,920
"	"								
"	"								
"	"								
Subtotal for Growth Costs		$0	$0	$0	$0	$0	$41,700	$40,310	$38,920
Other Debt		$736,976	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976
Total Capital Costs		$847,976	$844,976	$841,976	$838,976	$835,976	$874,676	$870,286	$865,896

PROVINCETOWN

Budget Category	Detail	2003	2004	2005	2006	2007	2008	2009	2010
Major NonGrowth Capital Facility Investments									
Fire	Shankpainter Road Station	$87,000	$84,000	$81,000	$78,000	$75,000	$72,000	$69,000	$66,000
Sewerage	Potential Future Town Sewerage Facility			$600,000	$585,000	$570,000	$555,000	$540,000	$525,000
Subtotal for NonGrowth		$87,000	$84,000	$681,000	$663,000	$645,000	$627,000	$609,000	$591,000
Major Growth Related Capital Investments									
Traffic	Local road improvements (CCC est.)	$37,530	$36,140	$34,750	$33,360	$31,970	$30,580	$29,190	
"	"			$41,700	$40,310	$38,920	$37,530	$36,140	$34,750
"	"								$41,700
"	"								
Subtotal for Growth Costs		$37,530	$36,140	$76,450	$73,670	$70,890	$68,110	$65,330	$76,450
Other Debt		$736,976	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976
Total Capital Costs		$861,506	$857,116	$1,494,426	$1,473,646	$1,452,866	$1,432,086	$1,411,306	$1,404,426

PROVINCETOWN

Budget Category	Detail	2011	2012	2013	2014	2015
Major NonGrowth Capital Facility Investments						
Fire	Shankpainter Road Station	$63,000				
Sewerage	Potential Future Town Sewerage Facility	$510,000	$495,000	$480,000	$465,000	$450,000
Subtotal for NonGrowth		$573,000	$495,000	$480,000	$465,000	$450,000
Major Growth Related Capital Investments						
Traffic	Local road improvements (CCC est.)					
"	"	$33,360	$31,970	$30,580	$29,190	
"	"	$40,310	$38,920	$37,530	$36,140	$34,750
"	"					$41,700
Subtotal for Growth Costs		$73,670	$70,890	$68,110	$65,330	$76,450
Other Debt		$736,976	$736,976	$736,976	$736,976	$736,976
Total Capital Costs		$1,383,646	$1,302,866	$1,285,086	$1,267,306	$1,263,426

PROVINCETOWN GROWTH SUMMARY

PART 1 — BASELINE FORECASTS

FUTURE MUNICIPAL COSTS AND REQUIRED PROPERTY TAX REVENUES ASSUMING NO FURTHER RESIDENTIAL OR COMMERCIAL DEVELOPMENT

	1993	1994	1995	1996	1997	1998	1999
REAL ESTATE VALUATION							
• Residential	$394,517,037	$402,255,318	$403,913,423	$403,913,423	$403,913,423	$403,913,423	$403,913,423
• Commercial	$162,358,263	$160,432,382	$158,203,677	$158,203,677	$158,203,677	$158,203,677	$158,203,677
• Total	$556,875,300	$562,687,700	$562,117,100	$562,117,100	$562,117,100	$562,117,100	$562,117,100
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$8,407,997	$8,216,415	$8,216,415	$8,216,415	$8,216,415	$8,216,415	$8,216,415
• School	$2,900,494	$3,100,892	$3,100,892	$3,100,892	$3,100,892	$3,100,892	$3,100,892
Debt Service:							
• Major Non-Growth Investments			$111,000	$108,000	$105,000	$102,000	$99,000
• Other Debt Service			$736,976	$736,976	$736,976	$736,976	$736,976
• Total Debt Service	$846,315	$847,976	$847,976	$844,976	$841,976	$838,976	$835,976
Total Costs (Operating + Debt Service)	$12,154,806	$12,165,283	$12,165,283	$12,162,283	$12,159,283	$12,156,283	$12,153,283
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues	49.97%	49.12%	46.17%	see Note (1)			
• Portion of Total Costs to be Paid from Property Tax Levy	50.03%	50.88%	53.83%	see Note (1)			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$6,081,078	$6,189,565	$6,548,664	$6,547,049	$6,545,434	$6,543,819	$6,542,204
• Average Residential Tax Bill			$1,194	$1,193	$1,193	$1,193	$1,193

Notes:

(1) Because of the uncertainty regarding future state aid levels, this analysis assumes that the current percentage of total costs paid by state aid and other non-property-tax sources will remain constant (see rows 22 & 23).

PROVINCETOWN

PART 1 — BASELINE FORECASTS

	2000	2001	2002	2003	2004	2005	2006
REAL ESTATE VALUATION							
• Residential	$403,913,423	$403,913,423	$403,913,423	$403,913,423	$403,913,423	$403,913,423	$403,913,423
• Commercial	$158,203,677	$158,203,677	$158,203,677	$158,203,677	$158,203,677	$158,203,677	$158,203,677
• Total	$562,117,100	$562,117,100	$562,117,100	$562,117,100	$562,117,100	$562,117,100	$562,117,100
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$8,216,415	$8,216,415	$8,216,415	$8,216,415	$8,216,415	$8,216,415	$8,216,415
• School	$3,100,892	$3,100,892	$3,100,892	$3,100,892	$3,100,892	$3,100,892	$3,100,892
Debt Service:							
• Major Non-Growth Investments	$96,000	$93,000	$90,000	$87,000	$84,000	$681,000	$663,000
• Other Debt Service	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976
• Total Debt Service	$832,976	$829,976	$826,976	$823,976	$820,976	$1,417,976	$1,399,976
Total Costs (Operating + Debt Service)	$12,150,283	$12,147,283	$12,144,283	$12,141,283	$12,138,283	$12,735,283	$12,717,283
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues							
• Portion of Total Costs to be Paid from Property Tax Levy							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$6,540,589	$6,538,974	$6,537,360	$6,535,745	$6,534,130	$6,855,499	$6,845,810
• Average Residential Tax Bill	$1,192	$1,192	$1,192	$1,191	$1,191	$1,250	$1,248

PROVINCETOWN

PART 1 — BASELINE FORECASTS

	2007	2008	2009	2010	2011	2012	2013
REAL ESTATE VALUATION							
• Residential	$403,913,423	$403,913,423	$403,913,423	$403,913,423	$403,913,423	$403,913,423	$403,913,423
• Commercial	$158,203,677	$158,203,677	$158,203,677	$158,203,677	$158,203,677	$158,203,677	$158,203,677
• Total	$562,117,100	$562,117,100	$562,117,100	$562,117,100	$562,117,100	$562,117,100	$562,117,100
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$8,216,415	$8,216,415	$8,216,415	$8,216,415	$8,216,415	$8,216,415	$8,216,415
• School	$3,100,892	$3,100,892	$3,100,892	$3,100,892	$3,100,892	$3,100,892	$3,100,892
Debt Service:							
• Major Non-Growth Investments	$645,000	$627,000	$609,000	$591,000	$573,000	$495,000	$480,000
• Other Debt Service	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976
• Total Debt Service	$1,381,976	$1,363,976	$1,345,976	$1,327,976	$1,309,976	$1,231,976	$1,216,976
Total Costs (Operating + Debt Service)	$12,699,283	$12,681,283	$12,663,283	$12,645,283	$12,627,283	$12,549,283	$12,534,283
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues							
• Portion of Total Costs to be Paid from Property Tax Levy							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$6,836,120	$6,826,431	$6,816,741	$6,807,052	$6,797,362	$6,755,374	$6,747,299
• Average Residential Tax Bill	$1,246	$1,244	$1,243	$1,241	$1,239	$1,231	$1,230

PROVINCETOWN

PART 1 — BASELINE FORECASTS

	2014	2015	2015
REAL ESTATE VALUATION			
• Residential	$403,913,423	$403,913,423	$403,913,423
• Commercial	$158,203,677	$158,203,677	$158,203,677
• Total	$562,117,100	$562,117,100	$562,117,100
MUNICIPAL COSTS			
Operating Costs (excluding debt service)			
• Non-School	$8,216,415	$8,216,415	$8,216,415
• School	$3,100,892	$3,100,892	$3,100,892
Debt Service:			
• Major Non-Growth Investments	$465,000	$450,000	$450,000
• Other Debt Service	$736,976	$736,976	$736,976
• Total Debt Service	$1,201,976	$1,186,976	$1,186,976
Total Costs (Operating + Debt Service)	$12,519,283	$12,504,283	$12,504,283
PROPERTY TAX ANALYSIS			
• Portion of Total Costs Paid from State Aid & Other Local Revenues			
• Portion of Total Costs to be Paid from Property Tax Levy			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$6,739,225	$6,731,150	$6,731,150
• Average Residential Tax Bill	$1,228	$1,227	$1,227

PART 2 — GROWTH SCENARIOS

FUTURE MUNICIPAL COSTS AND REQUIRED PROPERTY TAX REVENUES
ASSUMING BASELINE PLUS RESIDENTIAL AND COMMERCIAL GROWTH

	1993	1994	1995	1996	1997	1998	1999
Housing Units							
• Occupied Year Round	2,439	2,456	2,474	2,492	2,509	2,527	2,545
• Occupied Seasonally	1,447	1,458	1,468	1,478	1,489	1,499	1,509
• Total	3,886	3,914	3,942	3,970	3,998	4,026	4,054
Population Level	3,640	3,665	3,692	3,719	3,745	3,771	3,798
School Age Children	331	334	336	338	341	343	346
Commercial Acreage	151	151	151	151	151	151	151
REAL ESTATE VALUATION							
• Residential	$394,517,037	$402,255,318	$403,913,423	$406,012,358	$408,111,292	$410,210,227	$412,309,161
• Commercial	$162,358,263	$160,432,382	$158,203,677	$158,211,733	$158,219,790	$158,227,846	$158,235,902
• Total	$556,875,300	$562,687,700	$562,117,100	$564,224,091	$566,331,082	$568,438,073	$570,545,063
Real Estate Valuation Increase from Growth			$0	$2,106,991	$4,213,982	$6,320,973	$8,427,963
MUNICIPAL COSTS							
Operating Costs (excluding debt service)	$11,308,491						
• Non-School	$8,407,997	$8,216,415	$8,216,415	$8,242,412	$8,267,762	$8,293,112	$8,319,437
• School	$2,900,494	$3,100,892	$3,100,892	$3,131,102	$3,160,560	$3,190,018	$3,220,609
Debt Service:							
• Major Non-Growth Investments			$111,000	$108,000	$105,000	$102,000	$99,000
• Major Growth-Related Investments			$0	$0	$0	$0	$0
• Other Debt Service			$736,976	$736,976	$736,976	$736,976	$736,976
• Total Debt Service	$846,315	$847,976	$847,976	$844,976	$841,976	$838,976	$835,976
Total Costs (Operating + Debt Service)	$12,154,806	$12,165,283	$12,165,283	$12,218,490	$12,270,298	$12,322,106	$12,376,022
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995	49.97%	49.12%	46.17%	see Note (1)			
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995	50.03%	50.88%	53.83%	see Note (1)			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$6,081,078	$6,189,565	$6,548,664	$6,577,306	$6,605,195	$6,633,083	$6,662,107
• Average Residential Tax Bill			$1,194	$1,192	$1,191	$1,189	$1,188
Change from Baseline Tax Bill			+ 0.00%	- 0.10%	- 0.21%	- 0.32%	- 0.42%

PART 2 — GROWTH SCENARIOS

	2000	2001	2002	2003	2004	2005	2006
Housing Units							
• Occupied Year Round	2,562	2,580	2,597	2,615	2,633	2,650	2,668
• Occupied Seasonally	1,520	1,530	1,541	1,551	1,561	1,572	1,582
• Total	4,082	4,110	4,138	4,166	4,194	4,222	4,250
Population Level	3,824	3,851	3,876	3,903	3,930	3,955	3,982
School Age Children	348	350	353	355	358	360	362
Commercial Acreage	151	151	151	151	151	151	151
REAL ESTATE VALUATION							
• Residential	$414,408,096	$416,507,030	$418,605,965	$420,704,899	$422,803,834	$424,902,769	$427,001,703
• Commercial	$158,243,958	$158,252,015	$158,260,071	$158,268,127	$158,276,184	$158,284,240	$158,292,296
• Total	$572,652,054	$574,759,045	$576,866,036	$578,973,027	$581,080,018	$583,187,008	$585,293,999
Real Estate Valuation Increase from Growth	$10,534,954	$12,641,945	$14,748,936	$16,855,927	$18,962,918	$21,069,908	$23,176,899
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$8,344,787	$8,371,112	$8,395,487	$8,421,812	$8,448,137	$8,472,512	$8,498,837
• School	$3,250,067	$3,280,658	$3,308,983	$3,339,574	$3,370,165	$3,398,490	$3,429,081
Debt Service:							
• Major Non-Growth Investments	$96,000	$93,000	$90,000	$87,000	$84,000	$681,000	$663,000
• Major Growth-Related Investments	$41,700	$40,310	$38,920	$37,530	$36,140	$76,450	$73,670
• Other Debt Service	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976
• Total Debt Service	$874,676	$870,286	$865,896	$861,506	$857,116	$1,494,426	$1,473,646
Total Costs (Operating + Debt Service)	$12,469,530	$12,522,056	$12,570,366	$12,622,892	$12,675,418	$13,365,428	$13,401,564
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995							
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$6,712,443	$6,740,718	$6,766,723	$6,794,999	$6,823,274	$7,194,711	$7,214,164
• Average Residential Tax Bill	$1,190	$1,189	$1,187	$1,185	$1,184	$1,242	$1,238
Change from Baseline Tax Bill	- 0.19%	- 0.29%	- 0.42%	- 0.52%	- 0.61%	- 0.64%	- 0.76%

PART 2 — GROWTH SCENARIOS

	2007	2008	2009	2010	2011	2012	2013
Housing Units							
• Occupied Year Round	2,686	2,703	2,721	2,739	2,756	2,774	2,792
• Occupied Seasonally	1,592	1,603	1,613	1,623	1,634	1,644	1,654
• Total	4,278	4,306	4,334	4,362	4,390	4,418	4,446
Population Level	4,009	4,034	4,061	4,088	4,113	4,140	4,167
School Age Children	365	367	370	372	374	377	379
Commercial Acreage	151	151	151	151	151	151	151
REAL ESTATE VALUATION							
• Residential	$429,100,638	$431,199,572	$433,298,507	$435,397,441	$437,496,376	$439,595,310	$441,694,245
• Commercial	$158,300,352	$158,308,409	$158,316,465	$158,324,521	$158,332,578	$158,340,634	$158,348,690
• Total	$587,400,990	$589,507,981	$591,614,972	$593,721,963	$595,828,953	$597,935,944	$600,042,935
Real Estate Valuation Increase from Growth	$25,283,890	$27,390,881	$29,497,872	$31,604,863	$33,711,853	$35,818,844	$37,925,835
MUNICIPAL COSTS							
Operating Costs (excluding debt service)							
• Non-School	$8,525,162	$8,549,537	$8,575,862	$8,602,187	$8,626,562	$8,652,887	$8,679,212
• School	$3,459,672	$3,487,997	$3,518,588	$3,549,179	$3,577,504	$3,608,095	$3,638,686
Debt Service:							
• Major Non-Growth Investments	$645,000	$627,000	$609,000	$591,000	$573,000	$495,000	$480,000
• Major Growth-Related Investments	$70,890	$68,110	$65,330	$76,450	$73,670	$70,890	$68,110
• Other Debt Service	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976	$736,976
• Total Debt Service	$1,452,866	$1,432,086	$1,411,306	$1,404,426	$1,383,646	$1,302,866	$1,285,086
Total Costs (Operating + Debt Service)	$13,437,700	$13,469,620	$13,505,756	$13,555,792	$13,587,712	$13,563,848	$13,602,984
PROPERTY TAX ANALYSIS							
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995							
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995							
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$7,233,616	$7,250,799	$7,270,251	$7,297,186	$7,314,369	$7,301,522	$7,322,590
• Average Residential Tax Bill	$1,235	$1,232	$1,229	$1,227	$1,223	$1,215	$1,212
Change from Baseline Tax Bill	- 0.87%	- 1.02%	- 1.12%	- 1.13%	- 1.26%	- 1.33%	- 1.43%

PART 2 — GROWTH SCENARIOS

	2014	2015	w/ shift 2015
Housing Units			
• Occupied Year Round	2,809	2,827	3,665
• Occupied Seasonally	1,665	1,675	838
• Total	4,474	4,502	4,502
Population Level	4,192	4,219	5,469
School Age Children	381	384	498
Commercial Acreage	151	151	151
REAL ESTATE VALUATION			
• Residential	$443,793,179	$445,892,114	$445,892,114
• Commercial	$158,356,747	$158,364,803	$158,372,859
• Total	$602,149,926	$604,256,917	$604,264,973
Real Estate Valuation Increase from Growth	$40,032,826	$42,139,817	$42,147,873
MUNICIPAL COSTS			
Operating Costs (excluding debt service)			
• Non-School	$8,703,587	$8,729,912	$9,948,662
• School	$3,667,011	$3,697,602	$5,113,852
Debt Service:			
• Major Non-Growth Investments	$465,000	$450,000	$450,000
• Major Growth-Related Investments	$65,330	$76,450	$76,450
• Other Debt Service	$736,976	$736,976	$736,976
• Total Debt Service	$1,267,306	$1,263,426	$1,263,426
Total Costs (Operating + Debt Service)	$13,637,904	$13,690,940	$16,325,940
PROPERTY TAX ANALYSIS			
• Portion of Total Costs Paid from State Aid & Other Local Revenues, FY 1995			
• Portion of Total Costs to be Paid from Property Tax Levy, FY 1995			
• Property Tax Levy Required to Pay Costs (= Total Costs x Tax Levy Portion)	$7,341,387	$7,369,937	$8,788,377
• Average Residential Tax Bill	$1,209	$1,208	$1,440
Change from Baseline Tax Bill	- 1.55%	- 1.55%	+ 17.40%

Outer Cape Capacity Study

Natural Resources and Open Space

Prepared for the Outer Cape Capacity Study Steering Committee

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Introduction

The four towns that make up the Outer Cape Capacity Analysis Study Area together comprise a regionally significant open space and natural resources resource for Cape Cod. Many of these resources have been protected from development -- by the federal legislation that created Cape Cod National Seashore; by the foresight of voters in the four towns who have spent town funds to acquire and protect open space; and by land trusts, environmental organizations and civic-minded landowners who have supplemented municipal efforts with additional land purchases and donations.

Ambitious land protection efforts have helped maintain the rural character of the region -- an important element in the Cape's economic base. It is worth noting that in the 1995 Cape Cod Residents' Survey 92% of the respondents indicated that the rural character of the Cape was an important factor in their deciding to live here, and 87% cited the amount of open space. Eighty (80%) percent identified the loss of open space as one of the most serious problems facing the Cape.

This section of the Outer Cape Capacity Study has several goals. These are to:

- inventory the critical natural resources within each of the towns;
- assess the status of protection of these critical natural resources;
- identify the impacts of increased growth on critical natural resources;
- analyze the Levels of Service of protected open space in each of the towns in the study area;
- identify how these Levels of Service will change in future years as the towns approach build out; and
- identify acquisition priorities and recommendations for the five towns.

It should be recognized at the outset that the determination of carrying capacity for natural resources and open space cannot be accomplished with the same degree of mathematical precision as similar determinations for capital facilities, transportation and water resources. With regard to natural resources, there are a wide range of variables that affect the functioning of ecosystems, many of which are far too complex to assess on a regional basis. These variables make up the long term productivity of a given site with respect to the support of floral and faunal species. Carrying capacity is directly related to the resources available on a site, for example, one measure of carrying capacity is the food supply over a given area and the number of animals that can be supported by this food source. A detailed biological capacity analysis could produce different carrying capacities for different species. This information would be of limited use to decision makers involved with local comprehensive plans on the Outer Cape and the results would not necessarily translate into an increased understanding of resource limitations in a planning

context. In addition, the measurement of carrying capacity is expensive, and time consumptive, involving the collection and assimilation of large volumes of information.

Calculations of open space, while more straightforward, become inherently subjective when one attempts to answer the question "how much open space is enough?" since individual perceptions of open space needs vary widely. There are those who feel that we already have far too much development on Cape Cod to suit their needs, while others value more urban settings. The future balance of open space and development in the Outer Cape Study Area will lie somewhere between these two extremes.

In a practical sense, the natural resources carrying capacity for the Outer Cape should shift slightly away from its rigorous definition and would instead, benefit from some simplifying assumptions. This simplification requires a somewhat less scientifically quantitative treatment of the concept of carrying capacity by expanding its meaning to encompass a broader range of issues. Rather than looking at a site's productivity species by species, a more general look at viable ecosystems and factors that contribute to a decline in ecosystem functioning is more productive and ultimately more useful for planning purposes. This presumes that a category or categories of ecosystems can be identified on the Outer Cape and the threat of impacts to these ecosystems can be roughly quantified.

The most realistic approach to the natural resource component of this element of the study is to identify the sensitive resources that exist on the Outer Cape. Potentially sensitive areas such as those found within the Cape Cod National Seashore, within Areas of Critical Environmental Concern (ACEC), Rare and Endangered Species and their habitat, wetlands and vernal pools, as well as all biological species on the Outer Cape are all candidates for inclusion in a carrying capacity analysis. In order to use the information for planning purposes, these sensitive resource types should be identified along major roadways and near areas of development potential such as Local Comprehensive Planning (LCP) designated growth centers. Areas in proximity to already developed areas should be included as well if they are sensitive and susceptible to development pressure.

Sensitive natural resources may not be threatened exclusively from development. Recreational use or overuse may also pose a threat to resources either directly or through the recreational uses location with respect to the resource. This situation will become increasingly important in the planning effort as the tourist industry and the resident and non-resident populations on Cape Cod continue to expand. Surface and ground water analysis is also important in any grouping of natural resources, however, this issue is covered in the water resources section of the Lower Cape Water Management Plan and the water resource element of this study.

A carrying capacity study must not only identify sensitive natural resource systems, but must also recognize the limitations of the resource and the perceived threats to the systems' health or perhaps more importantly, the systems' long-term viability.

The specific focus of this element of the report will be on resource types and general location, threshold levels for damage to resources where they can be quantified, what kind of growth or development related impacts pose the greatest threat to the resource, which areas have the greatest potential for natural resource damage and finally, what type of growth-related criteria can be used when examining undeveloped land for future potential value with respect to natural resources if left undeveloped.

Although much of Cape Cod and especially the Outer Cape is made up of coastal features such as dunes and beaches, harbors, shellfish habitat and eelgrass beds which are subject to heavy recreational pressures, these will not be dealt with specifically in this report. For the most part the impacts to beaches, dunes and other marine issues and the management of these resources is well documented. While an important topic, coastal carrying capacity issues are more management concerns that each and every town should deal with through itsLocal Comprehensive Plan and the Cape Cod National Seashore will address in its General Management Plan. From the outset, it was determined that a capacity analysis for these resources would be outside of the scope of this report.

Identification of Critical Natural Resources

The first step in assessing the status of protection of critical natural resources in each of the towns in the Study Area was to inventory these resources by Town. This inventory includes the following resources: Salt Marshes, Cedar Swamps, Vernal Pools, Quaking Bogs, Sphagnum Bogs, Barrier Beaches, Fish Runs, Rare Species Habitat and other Priority Habitat Areas, Coastal Plain Pond Shores and Unusual Upland Habitats. As noted above other resources have not been included in this analysis such as inland marshes and shrub swamps, streams and shellfish habitat. While these are also important, the focus of the analysis was on unusual or rare habitats found within the Study Area. The significance of each of these areas is described briefly below.

Freshwater systems

Inland Wetland Systems

Wetlands are areas of land that are covered by water in varying degrees for a portion of every year. The areas will usually exhibit conditions of saturated or hydric soils, and have a predominance of wetland vegetation. Wetlands serve a variety of functions including groundwater recharge, flood control, pollution prevention, and protection of fisheries and wildlife habitat. The Cape Cod Commission's Regional

Policy Plan defines "wetland" as: "An inland area of 500 square feet or greater or a coastal area including wet meadows, marshes, swamps, bogs, and areas of flowing or standing water, such as rivers, streams and ponds. Wetlands are characterized by the presence of wetland vegetation and hydrology as generally described in the Wetlands Protection Act and these areas shall be delineated in accordance with the Act and regulations in 310 CMR 10.00."

Sphagnum and Quaking Bogs

Sphagnum bogs are communities which are commonly made up of partially decayed and decaying plant matter and are characterized by floating mats of vegetation, primarily sphagnum moss. Quaking bogs are quite similar to sphagnum bogs, however, sphagnum bogs will form in low depressed areas where the groundwater is close to or at the surface. Quaking bogs form on the surface of shallow open water, usually starting close to shore and moving outward and away from the shore. The bogs generally get the majority of their water and nutrients through precipitation and groundwater and are therefore classified as ombrotrophic or rain fed. The nutrient level of the bogs is generally low, the water in the bog is oxygen deficient and the pH is also low, often in the 3-4 range. These bogs have an abundance of sphagnum moss (*Sphagnum spp.*) and a variety of more common low shrubs such as Leatherleaf (*Chamaedaphne calyculata*), a highly branching shrub that provides thick cover and excellent wildlife habitat, cranberries (*Vaccinium macrocarpon spp.*) and other plants such as Highbush Blueberry (*Vaccinium corymbosum*), and Swamp Azalea (*Rhododendron viscosum*) along the bog edges. Several fringed orchids, such as Arethusa (*Arethusa bulbosa*) among a wide variety of other plants are also found in this natural community.

Atlantic White Cedar Swamps

Cedar swamps are wetland communities that are dominated by an evergreen forest cover of cedar trees. These types of swamps are usually found on the Outer Cape's coastal plain in low areas that are covered by standing water where the sandy soil is usually topped by a saturated peat layer. It is not unusual for standing water to be present for at least half of the growing season. The water is typically nutrient poor. Organic content of the water is high, but is poorly decayed and the water is high in tannin and iron giving the water a rusty brown appearance. Atlantic White Cedar (*Chamaecyparis thyoides*), an evergreen of the cypress family is the characteristic tree found in the swamp. It is common to find a shrub layer of hollies in association with cedar swamps such as Common Winterberry (*Ilex verticillata*) and Inkberry (*I. glabra*) as well as ericaceous, or heath like shrubs, such as Sweet Pepperbush (*Clethra alnifolia*), Swamp Azalea (*Rhododendron viscosum*) and Poison-sumac (*Rhus vernix*). Atlantic White Cedar seedlings can not germinate or thrive under canopy cover and do not compete well in an environment that fosters competition. This is particularly true when the cedars are in competition with hardwood species such as Red Maple (*Acer rubrum*), a wetland species that does particularly well in the same environment as the cedar. The few remaining cedar swamps in Barnstable County

are thought to be remnants of as much as 6000 acres of cedar swamps that occurred when the Pilgrims arrived. The bogs were mined for their peat and the trees provided a source of fence posts and cedar shingles. Cedar swamps were also converted to cranberry bogs and cleared for agriculture.

Coastal Plain Ponds

Coastal plain ponds are freshwater bodies that occupy glacially formed depressions in the sandy soil found in the Outer Cape. The water in the ponds fluctuates seasonally in response to the ponds direct link with the area's water table. This seasonal fluctuation allows a diverse pond shore community to flourish. The dry years keep obligate wetland plants from establishing a permanent colony and the wet years keep the upland plants from taking over. Coastal plain pond shore communities often take root in zones along the shoreline depending on the plant's ability to tolerate wet conditions. Plants may be found on the higher zones along the shore away from the water, located in the intermediate zone and located in the submerged, or saturated areas close to the shore. It is not uncommon to find some of the more common marsh emergents such as rushes and sedges in the mix of plants. But it must be remembered that along with more common varieties of plants there are globally rare plants such as the Plymouth Gentian (*Sabatia kennedyana*).

Vernal Pools

A vernal pool is a temporary pool that forms during spring rains, through the retention of snowmelt or in low lying areas that intercept seasonally high water tables. The water is usually held in depressions or low areas and will persist until the heat of summer causes evaporation of the water. Although typically dry during the summer months, vernal pools may fill up again during late Autumn wet spells and may hold significant amounts of water through the winter. Although vernal pools are usually associated with woodlands, vernal pools have also been found in other low lying areas such as meadows and sandflats. Vernal pools are defined in the Commission's Regional Policy Plan as "a seasonal fresh water body contained in an isolated depression that holds water for at least two consecutive months in most years, is free of adult fish populations and provides breeding habitat for amphibians and invertebrates.... "

Vernal pools are important wildlife habitat for a variety of amphibian and invertebrate species, some of which are completely dependent on the pools for their survival. The temporal nature of the pools precludes the establishment of fish populations. Without predation by fish, amphibians eggs and larvae are able to mature, making these pools ideal habitat for certain species of frogs and salamanders, as well as other invertebrate species. These pools are particularly susceptible to changes in surface topography/hydrology and the introduction of pollutants through stormwater.

Fish Runs
Anadromous fish runs are streams linking marine and freshwater bodies which are used by migrating fish who spend their adult lives in marine waters was migrate into freshwater to spawn. Native species using such fish runs include alewives (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*) and white perch (*Morone americana*). Adult fish generally return to the same streams they followed to the ocean as juveniles.

Coastal Environment/Coastal Wetland Systems

Coastal wetlands lie between the ocean and inland freshwater systems and are often flooded by high tidal waters which controls and maintains the system. Coastal wetlands can be divided into 2 zones that are defined by the degree and duration of flooding: a regularly flooded zone and an irregularly flooded zone. The flooded zone is dominated by daily tidal fluctuation and the irregularly flooded zone is exposed to the air for much longer periods of time. Beach and dune systems are typically classified within coastal environments, however, as previously discussed, will not be covered here.

Salt Marshes
Salt marshes are tidal areas that are often found behind the protected shores of barrier beaches. There is a wide variation in salinity levels and the degree and duration of flooding which controls the types and amounts of vegetation that can be established. Salt meadow-grasses dominate the higher areas of the marsh. Saltmarsh Cordgrass (*Spartina alterniflora*) and Saltmeadow Cordgrass (*Spartina patens*) are the most common perennial, salt tolerant grass species in salt marshes, although other species such as Black Rush (*Juncus gerardi*) and Sea Lavender (*Limonium nashii)* may also be found. Salt marshes comprise one of the most productive ecosystems on earth, providing the basis for the food chain in both estuarine and marine environments. They also provide excellent wildlife habitat including migrating and overwintering waterfowl and shorebirds and the young of many species of marine organisms.

Barrier Beaches
Barrier beaches are low lying strips of coastal dune and beach that protect coastal salt marsh areas and adjacent inland areas behind the marshes.They serve as a buffer to storm waves and storm surges. They are dynamic areas where the beach and dunes are constantly changing, and gradually migrating landward, as a result of wind and wave action. This landward migration is part of the natural cycle of barrier beaches, and the process of overwash plays an important role in the dissipation of wave energy and protection of upland areas behind the barrier beach. As storm waves erode the seaward side of the barrier beach, overwashed material is carried into the marsh and provides a substrate for the formation of new dune areas, shifting the barrier beach landward. Barrier beaches provide nesting habitat for a wide variety of

birds including piping plover (*Charadrius melodus*) and least terns (*Sterna albifrons*).

Salt Ponds
Coastal salt ponds are shallow embayments whose inlets are subject to opening and closure by sediment transport particularly during coastal storms and migrating barrier beaches. Changes in the inlets' morphology create different water conditions within the salt ponds. When the inlets are open, tidal flow mixes with groundwater entering the salt pond creating moderately saline conditions. When the inlets are closed, the pond waters are not flushing and become more brackish. Inlet closings and the subsequent change in salinity may occur seasonally or periodically over time. Another feature of these environments is that salt ponds exhibit differences in salinity as fresh water mixes with the tidal flow that enters from the mouth of the pond. Consequently, plant and animal species flourish or decline based on their ability to become established in a fresh/saline environment that is constantly changing.

Critical Upland Natural Resources

Rare Species Habitat
Cape Cod contains an unusually diverse mix of wildlife and plant communities, including many species that are rare or declining in number. Fifty-seven species of plants and wildlife on Cape Cod are listed by the State Natural Heritage and Endangered Species Program (NHESP) as endangered or threatened, and another 48 are "special concern" species that are declining or could become threatened. An additional 17 species are on a "watch list" and could become listed in the future. NHESP has mapped "estimated habitat" areas for these species on Cape Cod that indicate the approximated extent of the most important sites for rare species and incorporate records of observations over a twenty five year period from 1970 through the present. The rare species areas listed in this study include both upland and wetland areas.

Critical Woodland Communities
There is a variety of small to medium sized woodland communities on the Outer Cape outside of the National Seashore that are made up of American Holly (*Ilex opaca*), American Beech (*Fagus grandifolia*) and Oak/Hickory trees. These small enclaves of native trees form the basis for the Cape's "Critical Woodland Communities." These communities are threatened as undeveloped land is cleared for development and what follows in succession is the pitch pine/oak forest that is more prevalent on Cape Cod. While the pioneering upland species of pines and oaks are often described as typical upland vegetation and unremarkable in function, these forests represent the majority of upland vegetation that makes up the rural character of many areas on Cape Cod.

Pitch Pine/Scrub Oak Barrens
Pitch pine/scrub oak barrens flourish on the relatively level sandy soils found on the Outer Cape. The Pitch Pine (*Pinus rigida*) occurs in an open pattern and have a dense understory of scrub oak (*Quercus ilicifolia*). Pitch pine is a relatively hardy tree that has a natural resistance to impact from fire. This natural fire resistance, which is due to the tree's thick bark, allows pitch pine forests to flourish on the dry Outer Cape. Lack of fire tolerance helps control the establishment of other hardwood species that would otherwise become more dominant, succeeding the pitch pine over time. The scrub oak understory shares the open spaces with plant species such as Bearberry (*Arctostaphylos uva-ursi*), sedges (*Carex spp.*) and lichens (*Caladonia spp.*)

Heathlands
Heathlands are low growing communities of shrubs that include Bearberry (*Arctostaphylos uva-ursi*), and Black Huckleberry (*Gaylussacia baccata*). Broom Crowberry (*Corema conradii*) , a plant of special concern, is also found, although infrequently, on the heathlands. Heathlands, like sandplain grasslands are successional communities that are usually maintained through natural fires or prescribed burning and through grazing. Without these influences, the community is invaded by trees which eventually shade out the heathland species.

Unfragmented Second Growth Pine/Oak Forest
Much of the second growth forest on Cape Cod has been described as ordinary and not of any particular importance. Yet it is these forests that makes up much of the undeveloped woodlands on the Cape. These "ordinary" forests will over time increase in significance as they grow increasingly scarce on Cape Cod. As the title implies, second growth pine/oak forest has sprung up on formerly cultivated lands that once were forested, prior to clearing by the Cape's original settlers. The pines and oaks are often 30 to 50 years old and are found on most undeveloped sites on the Cape. The vegetational community will continue to change in these areas as pines mature and give way to oaks and other hardwoods. These areas are considered the Cape's prime developable land and provide important upland wildlife and plant habitat.

Between 1971 and 1990, 24% of the Cape's forestland was lost, primarily to development. The Outer Cape Study Area as a whole, experienced approximately the same percentage change, with about 2852 acres of forestland lost. However individual towns had more variable rates as shown in Table 1 below.

Town	Acres of Forest Lost 1971-1990	% Lost	Acres Remaining 1990
Eastham	1311	32%	2820
Wellfleet	933	13%	6441
Truro	508	6%	7330
Provincetown	100	6%	1572

Table 1: Change in Forest Cover - Outer Cape Towns (1971-1990)

Outer Cape Natural Resource Inventory

The Critical Natural Resources described above are cataloged in the Association for the Preservation of Cape Cod's Critical Habitats Atlas (1990) and the Massachusetts Natural Heritage Atlas (1995), as well as the Cape Cod Commission's Geographic Information System (GIS). Each of these critical natural resources was identified and, in order to assess the level of protection afforded to each area, a determination was made as to whether each of these resources was contained wholly within permanently protected open space (those marked "YES), partially within open space areas ("PART") or not protected within open space areas ("NO"). For the purposes of the inventory overlapping areas were counted more than once. For example, a coastal plain pond shore which is also known to support populations of rare species was counted within each category. Inclusion of an area within protected open space does not necessarily means that the resources will be fully protected from damage resulting from recreational pressures and overuse, but will prevent direct alteration due to development. State and local regulations also provide some protection for many of these resources but may not prevent adjacent development which could adversely affect them. The results of this inventory are presented by Town below:

Eastham

Natural Resource	Protected?
Cedar Swamp along western shore of Great Pond	PART
Coastal Plain Pond Shores:	
Minister Pond	NO
Moll Pond	NO
Pond northeast of Moll Pond	NO
2 Ponds near intersection of Little Creek Road and Nauset Road	NO
3 small Ponds directly north of the Orleans Rotary	YES
Vernal Pools:	
10 vernal pools bounded by Cable Rd/ Ocean View Dr/ Nauset Rd.	YES
3 vernal pools along Nauset Road	PART
Vernal pool on Coastal Guard Beach	YES
Vernal pool on Route 6 near Massasoit Rd./Rt. 6 intersection	NO
Anadromous Fish Run up Rock Harbor Creek into Cedar Pond	PART
Anadromous Fish Run up Herring River into Herring Pond	PART
Anadromous Fish Run up Herring Brook/Great Pond and Depot Pond	PART
Salt Marsh along Rock Harbor Creek	PART
Salt Marsh along Boat Meadow River	PART
Salt Marsh along Herring River	PART
Salt Marsh on Nauset Harbor	YES
Salt Marsh around Salt Pond Bay	YES
Salt Marsh associated with Nauset Beach	YES
Salt Marsh associated with Sunken Meadow Beach/Hatches Creek	YES
Barrier Beach at Rock Harbor Creek	PART
Barrier Beach - Nauset Beach	YES
Barrier Beach - 2 at Hatch Beach	YES
Barrier Beach at Sunken Meadow Beach	NO
Heathland areas in the vicinity of Coast Guard Beach	YES
High Priority Habitat in vicinity of Sunken Meadow/Hatches Creek	PART
High Priority Habitat south of Cable Road	YES
High Priority Habitat along Nauset Beach	YES
High Priority Habitat north of Sunken Meadow Road	NO
High Priority Habitat associated with Minister Pond	NO
High Priority Habitat along northeast shore of Great Pond	PART
High Priority Habitat east of Great Pond	PART
High Priority Habitat associated with Boat Meadow Creek/Rock Harbor Creek area	PART
High Priority Habitat near Cove Burying Ground	NO
Inner Cape Cod Bay Area of Critical Environmental Concern	PART
Wellfleet Harbor Areas of Critical Environmental Concern	PART

Wellfleet

Natural Resource	Protected?
Cedar Swamp north of Nauset Regional School	YES
Cedar Swamp southeast of Paine Hollow Road	NO
Sphagnum Bog west of Marconi Beach	YES
Oak-Hickory forest in the Wellfleet Bay Audubon Sanctuary	YES
Beech Forest west of Herring Pond	YES
Pitch Pine-Scrub Oak Barrens on Great Island	YES
2 Heathland sites in the Marconi Beach area	YES
Heathland east of Nauset Regional School	YES
Vernal Pools:	
2 Vernal Pools Near Marconi Site	YES
Vernal Pool near Mayo Beach	NO
Vernal Pool along Duck Harbor River	YES
Vernal Pool at Bound Brook Island	YES
Vernal Pool south of Pamet Point Road	YES
Vernal Pool east of Williams Pond	YES
Vernal Pool north west of Gull Pond	YES
Vernal Pool west of Gull Pond	YES
3 Vernal Pools north of Long Pond	YES
Vernal Pool north of Spectacle Pond	YES
Vernal Pool east of Northeast Pond	YES
3 Vernal Pools in Wellfleet by the Sea/LeCount Hollow area	YES
Coastal Plain Pond Shores:	
Duck Pond	YES
Great Pond	YES
Turtle Pond	YES
Southeast Pond	YES
Northeast Pond	YES
Dyer Pond	YES
Long Pond	YES
Spectacle Pond	YES
Kinnacum Pond and the surrounding ponds	YES
Perch Pond	NO
A small pond to the southwest of Perch Pond	NO
Gull Pond	YES
Higgins Pond	YES
Herring Pond	YES
Williams Pond	YES
A small pond north of Duck Creek	NO
Anadromous Fish Runs up Herring River into Gull Pond	YES
Salt Marsh in vicinity of Audubon Sanctuary	YES

Wellfleet (continued)

Salt Marsh on Lieutenant's Island	YES
Salt Marsh on northeast side of Loagy Bay	PART
Salt Marsh associated with Blackfish Creek	PART
Salt Marsh around Drummer Cove	NO
Salt Marsh south of Pilgrim Spring Road	NO
Salt Marsh associated with Indian Neck Barrier Beach	NO
Salt Marsh west of Cove Road	NO

Natural Resource	**Protected?**
Salt Marsh near Duck Creek	YES
Salt Marsh behind Mayo Beach barrier	NO
Salt Marsh along Chequesset Neck Rd.	NO
Salt Marsh along The Gut	YES
2 Salt Marsh areas along Great Island	YES
3 Barrier Beaches on Lieutenant's Island	PART
2 Barrier Beaches on Old Wharf Point	NO
Barrier Beach at Field Point	NO
Barrier Beach across from Pleasant Point	NO
Barrier Beach on Indian Neck	NO
Barrier Beach at entrance to Wellfleet Harbor	PART
Barrier Beach at Mayo Beach	PART
7 Barrier Beach areas along Great Island	YES
Barrier Beach at Duck Harbor River	YES
Barrier Beach at Bound Brook	YES
High Priority Habitat associated with Great Island	YES
High Priority Habitat along Herring River	YES
High Priority Habitat along Bound Brook Island Road	YES
High Priority Habitat around Perch Pond	NO
High Priority Habitat around Wellfleet Center	NO
High Priority Habitat around Wellfleet Harbor/Indian Neck Lieutenant's Island, Audubon Sanctuary area	PART
High Priority Habitat along Marconi Beach	YES
High Priority Habitat associated with Duck/Great/Long Pond area	YES
High Priority Habitat associated with Spectacle/Kinnacum Pond area	YES
High Priority Habitat around Bog west of Gull Pond	YES
High Priority Habitat associated with Herring/Higgins Pond area	YES
High Priority Habitat along Old Railroad Grade/Seashore boundary	PART
Wellfleet Harbor Area of Critical Environmental Concern	PART

Truro

Natural Resource	Protected?
Sphagnum Bog between Route 6 and Head of the Meadow Beach	YES
Quaking Bog at Featherbed Swamp (Fox Bottom)	YES
Quaking Bog/small pond northeast of Round Pond	YES
Grassy Heaths at Corn Hill	NO
Grassy Heaths north of Pond Village	NO
Vernal Pools:	
Vernal Pool northeast of Bound Brook	YES
Vernal Pool north of Lombard Hollow Rd.	YES
2 Vernal pools west of Ryder Pond	YES
Vernal Pool east of Ryder Pond	YES
5 Vernal Pools along Old Kings Highway in S. Truro	YES
Vernal Pool east of Horseleech Pond	YES
2 Vernal pools north of Round Pond	YES
Vernal pool near Truro Transfer Station	YES
Vernal pool south of Old County Road	YES
2 Vernal pools north of N. Pamet Rd.	YES
Vernal pool east of S. Highland Rd.	YES
Vernal pool near Head of the Meadow campground	YES
Vernal pool southeast of Pilgrim Spring	YES
Vernal pool near High Head	YES
Coastal Plain Pond Shores:	
Slough Pond	YES
Horseleech Pond	YES
Round Pond	YES
Ryder Pond	YES
2 Ponds south of Fisher Road	YES
Pond north of North Pamet Road near Ballston Beach	YES
Pond south of Great Hollow Road	NO
2 Ponds in Great Swamp	NO
Anadromous Fish Run Into Pilgrim Lake	PART
Anadromous Fish Run Up the Pamet River	PART
Salt Marsh associated with Pamet Harbor/Pamet River	PART
Barrier Beach at Beach Point (Pilgrim Beach)	NO
Barrier Beach north of Pilgrim Lake extending to Head of the Meadow	YES
2 Barrier Beaches associated with Pamet Harbor	YES
Barrier Beach at Great Swamp	NO
Barrier Beach at Ballston Beach	YES
Barrier Beach at Ryder Beach	YES
High Priority Habitat south of Old County Road	YES
High Priority Habitat along Prince Valley Road	YES

Truro (continued)

High Priority Habitat near Fisher Road	NO
High Priority Habitat at Pamet Harbor	YES
High Priority Habitat at Prince Valley Road/Route 6	YES
High Priority Habitat west of Ryder Pond	YES
High Priority Habitat associated with Snow Pond and Great Pond	YES
High Priority Habitat associated with Slough Pond/Horseleech Pond	YES
High Priority Habitat off Millpond Road	NO
High Priority Habitat along Pamet River	PART
High Priority Habitat near Corn Hill	NO
High Priority Habitat along Route 6A/Priest Rd.	NO
High Priority Habitat along Route 6A north of Pond St.	NO
High Priority Habitat along South Highland Road	YES
High Priority Habitat along Head of the Meadow Beach and north	YES
High Priority Habitat on Head of the Meadow Road	YES
High Priority Habitat at Pilgrim Heights/High Head area	YES
High Priority Habitat on Corn Hill Road	NO
Wellfleet Harbor Area of Critical Environmental Concern	YES

Provincetown

Natural Resource	Protected?
Sphagnum Bogs at Southern Shankpainter Pond System	NO
Quaking Bog at Northern Shank Painter Pond System	NO
Quaking Bog North of Harry Kemp Way	NO
Two Quaking Bogs west of Duck Pond	PART
Quaking Bog Found in a pond to the east of Pasture Pond	YES
Quaking Bog To the east of Grassy Pond	YES
Quaking Bog Northwest of Telegraph Hill	NO
Quaking Bog south of Route 6 near RR ROW	NO
Two Quaking Bogs north of Clapps Pond	YES
4 cedar swamps along Rt. 6 and Harry Kemp Way	PART
Beech Forest exists southwest of the Provincelands Visitor Center	YES
Coastal Plain Pond Shores:	
2 small ponds along Herring Cove Rd.	PART
Shankpainter Pond	PART
Clapps Pond and associated small ponds	YES
Clapps Round Pond	YES
Pasture Pond and associated small ponds	YES
Duck Pond	NO
Bennett Pond	YES
Great Pond and associated small ponds	YES
Grassy Pond and associated small ponds	YES
3 Vernal Pools northwest of Mt. Ararat	YES
Salt Marsh areas associated with Long Point	YES
Salt Marsh at Hatches Harbor	YES
Barrier Beach at Long Point	YES
Barrier Beach at Race Point	YES
High Priority Habitat associated with Race Point Beach shoreline	YES
High Priority Habitat associated with all coastal plain ponds	PART
High Priority Habitat between Route 6 and 6A	NO
High Priority Habitat enc. Long Point to Race Point and pond areas	PART

Status of Protection of Critical Natural Resources

Table 2 identifies the total number of critical natural resource areas in each of the Towns, as well as the percentage of each that are fully protected, partially protected and unprotected. The towns are listed in order from highest percentage of protected natural resources to lowest percentage.

Town	Number Areas	% Protected	Partial Protection	% Not Protected
Truro	65	74%	6%	20%
Wellfleet	89	69%	11%	20%
Provincetown	37	51%	30%	19%
Eastham	51	47%	33%	20%

Table 2 : Natural Resource Protection by Town--Outer Cape

It can be seen from this Table that the majority of critical natural resources are protected within open space areas in the majority of towns on the Outer Cape. The percentage of resources that are not protected is roughly the same in each of the towns.

In acquiring and protecting critical natural resources, it is clear that the four towns have done a better job at protection of some types of areas than others. Table 3 indicates the percentage of each critical natural resource type that is protected. Those at the top of the list receive the highest amount of protection; those at the bottom of the list the lowest.

Critical Natural Resource Type	Number of Areas	% Protected	Partial Protected	% Not Protected
Sphagnum Bog	2	100%	0%	0%
Vernal Pool	56	91%	5%	4%
Upland Community	9	78%	0%	22%
Coastal Pond	44	66%	7%	27%
Barrier Beach	33	58%	18%	24%
Priority Habitat	44	52%	20%	27%
Salt Marsh	24	50%	25%	25%
Quaking Bog	12	50%	17%	33%
Fish Run	6	17%	83%	0%
Cedar Swamp	7	14%	71%	14%

Table 3: Natural Resource Protection by Type of Resource

It should be noted that protection of these areas through acquisition is not the only means of protection of these areas. The Massachusetts Endangered Species Act, Massachusetts Wetlands Protection Act and town wetland bylaws (where they exist) also provide some protection for many of these resources. Acquisition of these areas also is not a guarantee that the areas will not be subject to alteration and/or degradation through recreational use (a significant issue for many of these areas), or introduction of contaminants from stormwater or nutrients from outside the protected area. In many cases, the areas that have been acquired have high recreational values, such as barrier beaches and coastal plain pond shores.

Development Impacts on Natural Resources

The Outer Cape Capacity Study is an attempt to examine the impacts of future growth levels on various resources within the region. All of the region's critical natural resources are sensitive to development pressures as well as increases in population and the accompanying recreational pressures. The primary threats to each of these resources are described below:

Resource	Primary Threats
Salt Marsh	Dredging and filling (esp. docks/marinas) Adjacent development Ditching for mosquito control Excessive nutrient loading Stormwater runoff
Quaking/Sphagnum Bogs/ Cedar Swamps	Stormwater runoff Nutrient Loading Adjacent Development Changes in Hydrology
Vernal Pools	Changes in Hydrology/Surface Topography Stormwater runoff Adjacent Development Direct Loss to Development Not Identified/Certified/Lack of Protection Drawdown of Water Table
Fish Runs	Reduced stream flow Obstructions which block the fish passage Overfishing

Coastal Plain Pond Shores	Groundwater withdrawal/Drawdown Trampling of vegetation Off road vehicle use Nutrient loading Stormwater runoff Adjacent development
Barrier Beaches	Alteration by Development Shoreline protection structures Sediment starvation Off road vehicle use
Hardwood Tree Stands/ Unfragmented Forest	Direct Loss to Development

Each specific type of critical natural resource listed above has a threshold or tolerance to impacts from development or recreational use. However, these threshold points are not well documented in scientific literature. Development results in a variety of impacts on natural resources including clearing of land, creation of impervious surfaces that prohibit groundwater infiltration, drainage changes, erosion and sedimentation, elimination of habitat, introduction of nutrients from septic systems, changes in groundwater flow due to large numbers of private wells, noise pollution and disturbance of habitat, and visual impacts. The location and type of resource will determine which of these changes will have the greatest effect. For example, as a result of the regulatory protection afforded to wetlands, they are less likely to be threatened by direct alteration (filling), but more likely to be subject to changes from stormwater, nutrient loading or hydrology. Conversely, upland systems receive little protection and are more likely to subject to direct alteration by development.

The greatest threat to the critical natural resources of the Outer Cape is reduction, fragmentation and elimination of woodland habitat. For residential subdivisions, the amount of cleared vegetation for roadways and lots typically ranges between 40% and 80%, depending on zoning bylaws and subdivision regulations. It is not unusual for a residential or commercial site to be completely stripped of vegetation prior to its development. Removal of vegetation reduces or eliminates the ability of wildlife to breed, feed, take shelter and survive. Different species are affected in different ways. It is important to maintain unfragmented tracts of forest of sufficient size to support the Cape's overall diversity of wildlife species. Too often development projects contain inadequate wildlife corridors that provide little functional wildlife habitat, and are of little value to wildlife that require interior forest habitat. While this may result in local increases in diversity as "edge" species are attracted, the Cape's overall biodiversity will be reduced. An example of this is

the brown-headed cowbird (*Molothrus ater*) which lays its eggs in the nests of other birds such as flycatchers, vireos and warblers and devours the eggs and nestlings of these species. These birds are most often found at forest edges and will not penetrate forest interiors -- underscoring the importance of these interior refuges for successful reproduction of many species.

Most wildlife species move daily or seasonally to meet all of their survival needs. In many instances, this movement may be quite small in extent, such as with species of insects or invertebrates. In others it may be quite extensive such as with coyotes or in the extreme, migratory birds. In order to move, however, the animals depend upon properly located corridors of adequate width, or so-called "stepping stones" of appropriate habitat, that allow them to move. Different species move and disperse using different types of habitat. Habitat corridors is one term that is used to identify the areas of habitat that allow the spread of various taxa, or species, to move from one area or region to another. Another term that is descriptive as well as functional is the term filter. A filter functions as a dispersal route that contains a more limited spectrum of habitat types. This allows certain species to pass through an area while excluding others. A filter may also be a barrier that is constructed prohibiting movement. A road, for example, may be a filter that prohibits the migration of a species from an upland area to a wetland or vernal pool. Fences, driveways, large areas of lawn area and structures may also function as prohibitive filters. Salamanders and other small wetland dependent wildlife are good examples of species that would be adversely affected by a road system or other type of filter.

There are several fundamental ideas that must be recognized and understood if plant and wildlife species and therefore, natural resource capacity issues are to be incorporated into the planning process. These are as follows:

- Natural communities change through ecological time due to a variety of natural occurrences;

- Natural communities change due to human factors;

- All wildlife species are dependent on plant communities in one way or another for food and cover;

- Each species of plant and wildlife exhibits different tolerance to environmental and human induced change;

- Wildlife species composition in a given area changes in response to plant community change;

- Wildlife species are integral to the function of ecosystems through nutrient cycling and energy flow through the food chain and food web;

- Humans dominate ecological systems over time and possess the ability to cause changes that alter ecosystem function;

- Plants and wildlife are not equally valued by humans;

- Increased species diversity may result from forest fragmentation (through creation of more "edges"); however this local increase in diversity may occur at the expense of interior forest species whose habitat may be eliminated by this fragmentation.

- Plant and wildlife species cannot create their own habitat and rely on the resources present in existing natural systems to survive;

- Land use planning is the only effective way to ensure the viability of plant and animal species in developed areas.

The majority of these ideas are easily understood and rooted in common sense. Reading through the list only emphasizes the earlier point that plant and wildlife habitat must be preserved if we are to maintain the numbers and diversity of species that are currently found on Cape Cod. This is true of all species, but perhaps even more critical when looking at endangered and threatened species.

Protected Open Space Inventory

As noted above, the Outer Cape contains a tremendous resource of protected open space that serves local, regional, state and national recreation demands. In addition, some of the Outer Cape communities have acquired or otherwise protected additional areas for conservation, recreation and wellfield protection. Figures 4 and 5 compare the current acreage of protected open space in each of the 4 towns on the Outer Cape. This includes land protected for conservation purposes by towns, state and federal government, and land trusts.[1] It does not include privately owned golf courses, rod and gun clubs and other private recreational clubs, nor does it include municipal land held for landfill, public safety and related uses.

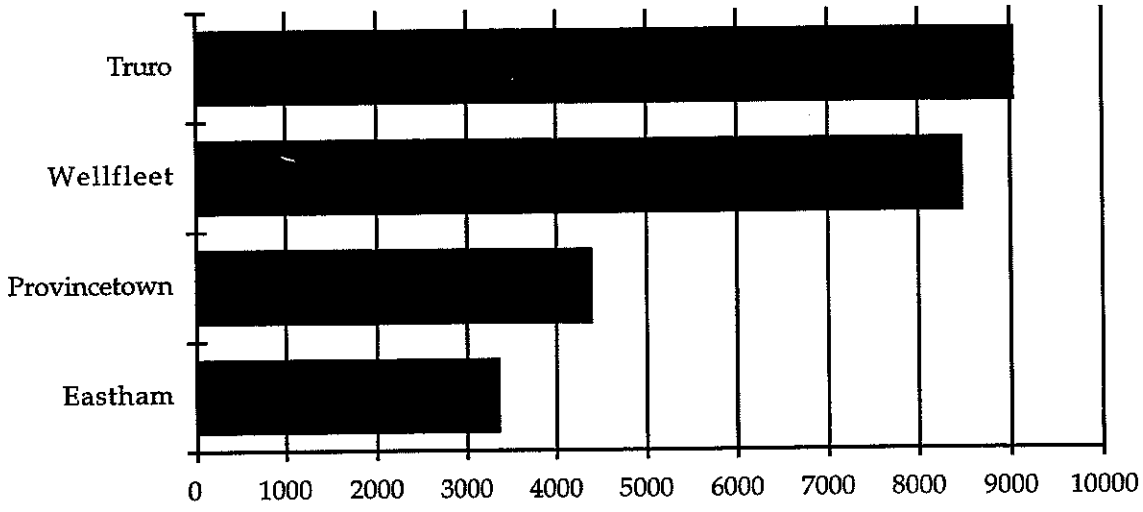

Figure 4: Acres of Open Space - Outer Cape Towns (1996)

[1]All of the open space acreage and cost figures are derived from information compiled by the Cape Cod Compact of Conservation Trusts.

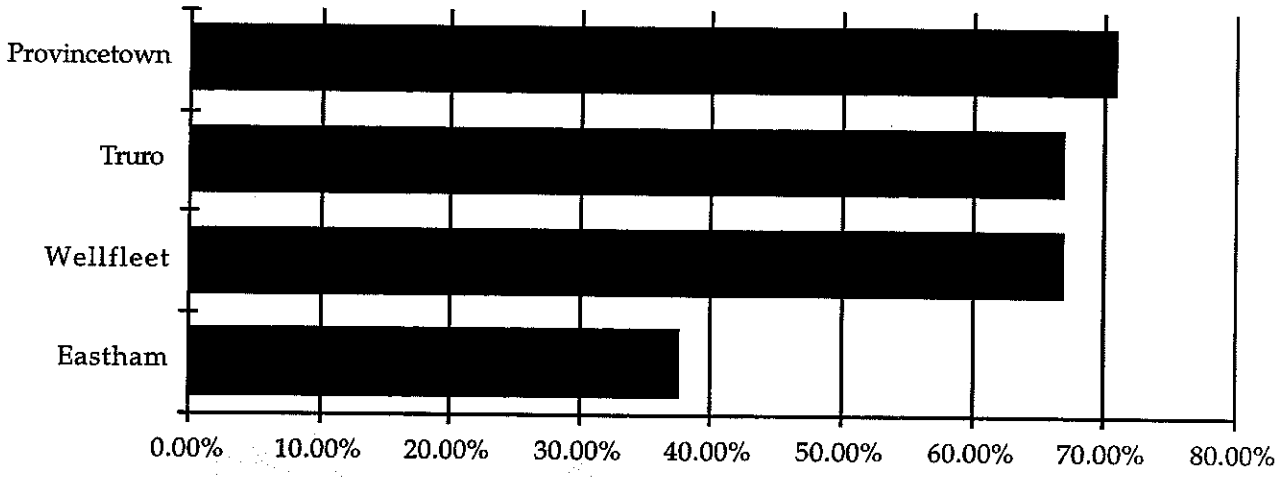

Figure 5: Percent of Land Area in Protected Open Space - Outer Cape Towns (1996)

Existing Open Space Level of Service

Because the percent of land in open space varies widely depending on the total land area, a more standardized measure that factors in changes in year-round population is the acreage of open space per capita. Using acres of open space per capita, it is possible to calculate an existing Level of Service (LOS) for protected open space for each of the towns in the Outer Cape Study Area and to determine how that LOS will change as the year-round population of a town grows, given a variety of acquisition scenarios. Unlike traffic LOS which is presented on a scale of "A" through "F", the open space LOS is a numerical representation. Figure 6 below identifies the existing (1996) open space LOS for each of the Outer Cape towns.

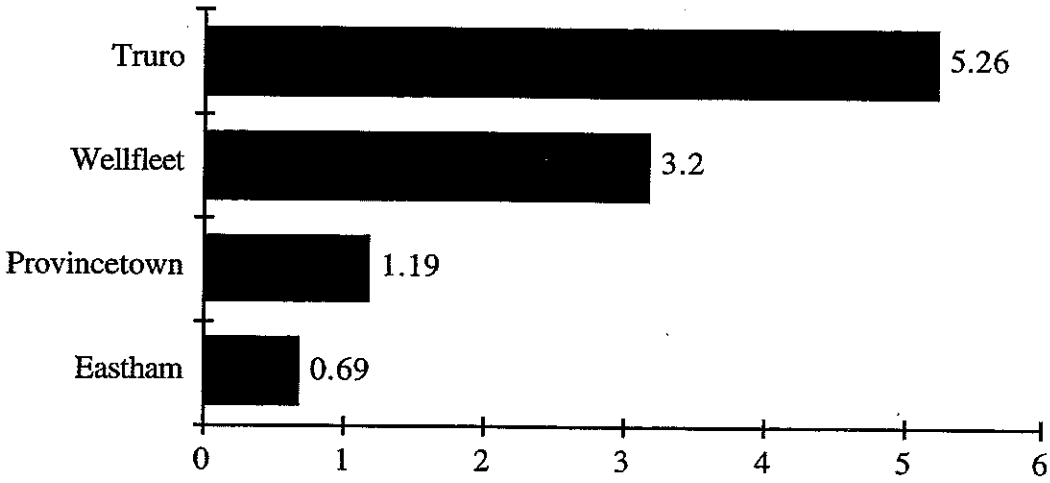

Figure 6: Acres of Protected Open Space per Capita - Outer Cape Towns (1996)

As can be seen from the graph above, the town of Truro has the highest amount of open space per person (5.26 acres) and the town of Eastham has the lowest amount per person (.69 acres). When compared with the figures for the entire Cape (Figure 7), however, it is clear that all four Outer Cape towns have Levels of Service for open space that are far higher than any other town on the Cape.

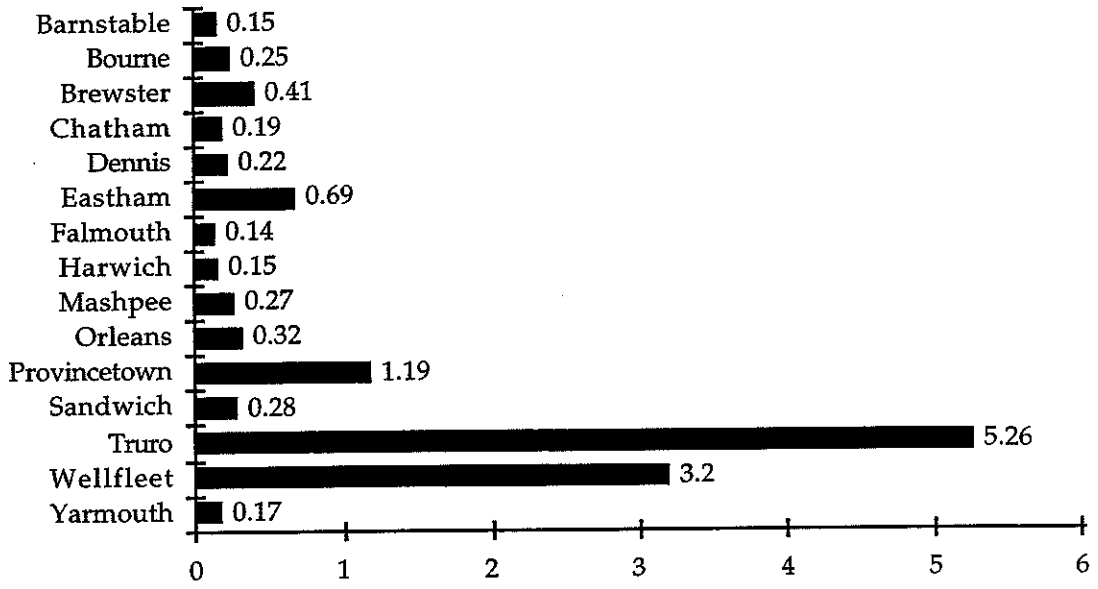

Figure 7 - Acres of Protected Open Space per Capita - Cape Cod Towns

What is an acceptable Level of Service for protected open space for the Cape's year round population? This is a difficult question to answer. It is clear that the figure varies widely across Cape Cod. For the Outer Cape as a whole the average is 1.95 acres/person. The average LOS for the remainder of the Cape outside the four primary National Seashore towns is .20 acres/person. This higher level on the Outer Cape is due in large part to the presence of the National Seashore and the fact that this part of the Cape serves as an open space and recreational attraction for the entire region. The seasonal population boom in these areas places heavy pressure on open space lands and greatly reduced LOS during the summer months.

Once a baseline LOS is established for protected open space for each town and the Study Area, it is possible to calculate how that LOS will change over time as a result of growth if no additional open space is acquired. As an example, Figure 8 shows the decline in LOS in each of the Study Area towns by buildout, assuming no additional open space is acquired based on the growth projections contained in this

study.

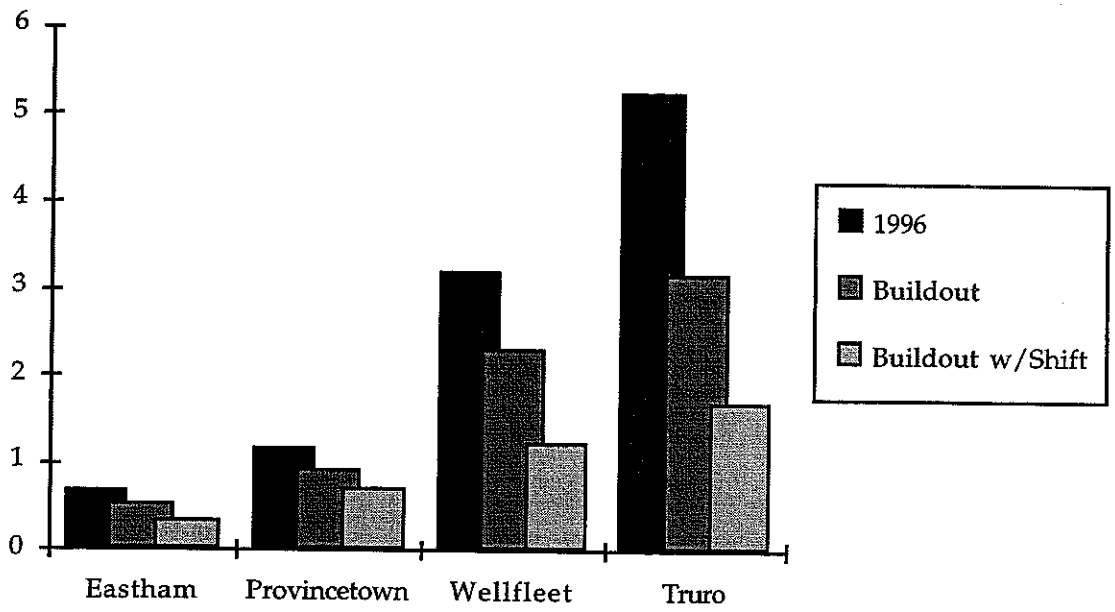

Figure 8: Changes in Open Space LOS as Outer Cape Towns Approach Buildout

Based on this scenario, the overall LOS in the Study Area would decline from 1.95 acres/capita to 1.45 acres/capita by buildout assuming the current ratio of seasonal to year round population is maintained. This LOS would decline further to .91 assuming a shift in seasonal to year round population.

Summary

Some general conclusions can be drawn from the information presented above:

- Without a continuing commitment to land protection, each of the towns on the Outer Cape will experience a decline in the Level of Service of protected open space as these towns continue to grow, and as the seasonal to year round population mix changes;

- Even with growth, the Outer Cape towns will continue to have a greater than

the average amount of open space due to the presence of a large amount of protected land, particularly within Cape Cod National Seashore.

• In addition to a loss of LOS of protected open space, the character of the Outer Cape will change as the amount of "perceived" open space (existing open lands) is reduced.

Conclusions and Recommendations

The single best way to protect natural communities and wildlife species is to preserve their habitat from destruction or alteration through land acquisition. The acquisition of open space will also have important benefits in terms of community of character, enhanced open space Levels of Service, and reduced transportation and water demands due to population reductions.

Given limited resources, it is important to prioritize acquisitions so that they can provide the maximum benefit. In order to maintain critical natural resources within the Study Area, efforts should be undertaken to preserve those natural resources currently lacking protection such as quaking bogs and cedar swamps that provide unusual habitat, or habitat for rare species. At the same time, communities should strive to protect the maximum amount of unfragmented forestland in order to maintain habitat for species that rely on such areas for cover, nesting and breeding habitat. The following areas should be considered the highest priorities for acquisition within the Outer Cape Study Area:

- Unprotected critical natural resources identified in this study
- Unfragmented forest lands greater than 125 acres in size
- Linkages between existing protected areas to provide wildlife travel corridors
- Developable residential land

These areas are not presented in priority order, but rather should be considered factors that should be weighed in determining what land should be acquired. The more factors present on a given parcel of land, the higher the priority for acquisition. Approaching land owners to acquire conservation easements on undeveloped property is also a worthwhile consideration. Working with local land and conservation trusts for the purposes of seeking assistance and funding help is also an option.

A natural resource management program could be initiated to assist with the identification, examination and assessment of the available undeveloped land on the Outer Cape, as well as the natural resource value of this land. It is more manageable to break the County into sub-regions as has been done for the capacity study, allowing large areas, encompassing several towns to examine and ultimately determine which areas are most vulnerable to development pressure and resource

loss. The natural resources map that has been prepared for this Capacity Study is an important first step in inventorying and assessing important areas. Towns might consider a cooperative effort to fund a shared staff person to develop regional natural resource management and protection alternatives.

Working through a regional agency such as the Cape Cod Commission, the entire Cape could benefit from a regional investigation of the resources that currently exist and cooperatively work toward a protection scheme. This would involve the initiation of an intensive resource management program, looking at resources county wide. The cooperative working group would then be in a position to apply for financial assistance to develop management programs and work toward protection of the resources.

Another option would be to seek the assistance of the federal government. Through the use of a Memorandum of Understanding, area towns could work out a cooperative agreement with the National Park Service to help identify and ultimately purchase and manage the natural areas that would be designated as Park Service holdings. One way to do this would be to establish identified areas under the cooperative agreement as Bioreserves or Ecoreserves for the primary purpose of protecting and preserving the land. While this would be a politically difficult decision to make, it may be the only viable means of protecting the land considering the potential cost.

Beyond the recommendation that towns consider resource driven acquisition of open space for the purposes of protecting and preserving available natural communities and habitat and maintaining current protected open space Levels of Service, there are other potential recommendations that should be considered by the four towns to maintain and enhance the protection of natural resources and open space within the Study Area. These are:

- increased efforts at regional protection and management of specific natural resources (joint efforts need to be taken between towns and with Cape Cod National Seashore). This is particularly important for addressing recreational use of critical natural resources;

- updating of open space and recreation plans (in order to qualify for state acquisition matching funds) and integration of open space planning efforts into Local Comprehensive Plans. Such open space plans should identify priority parcels for acquisition;

- adopting formal policies regarding the need for a comprehensive community approach to the acquisition of open space (such as that adopted by the Harwich Planning Board in 1996).

• adopting or revising local wetlands protection bylaws to provide a higher level of protection, including buffer areas, for critical natural resources (sphagnum bogs, quaking bogs, vernal pools, cedar swamps, barrier beaches, coastal plain ponds and salt marshes);

• increasing public education about the need to protect critical natural resources and maintain Levels of Service of protected open space;

• increasing staff resources devoted to natural resources and open space protection including hiring professional staff to assist volunteer conservation commissions and/or planning departments where none exist; and

• developing bylaws that provide incentives for the provision of high priority open areas in exchange for reduced standards (increased density or reduced setbacks).

It is widely believed that the manner in which communities respond to the next spurt of development will determine the future of Cape Cod. It is important for each of the Outer Cape towns to examine its options with regard to protection of open space and critical natural resources and make a decision about which path it wants to choose into the future, with consideration given to the short and long term cost of land protection versus the short and long term costs of growth -- with its requirements for water, roads, schools and other improvements. It is important that this decision be both a financial one as well as a determination about the character of the community that is desired.

Appendix A

Wildlife Species on the Outer Cape

The following list has been provided for a quick overview of animal species that can be found on the Outer Cape and roughly, their habitat requirements. The list is divided into two parts; amphibians and reptiles make up the first part of the list and mammals make up the second. Insects and plants are too numerous to list and consequently, only those insects and plants that are state listed as rare, endangered or threatened will be included in the appendix from the Natural Heritage and Endangered Species Program.

Species Habitat Requirements

Spotted Salamander
Ambystoma maculatum
Found in Mesic woods, require a pH range of 7-9 to breed, often move 300'- 600' in a day and may be found up to 1200' from nearest breeding pond. Utilizes all types of forest environments but prefers red maple forest type from sapling size of 1 to 3.9 cm diameter at breast height (dbh) to large stands up to 61 cm d.b.h. usually referred to as sawtimber size.

Red Spotted Newt
Notophthalmus v. viridescens
Adults require some permanent water with aquatic vegetation close by,often found up to 810' from breeding areas, average movement 10 - 11' per day, however most found within 5 ' of breeding area. Typically uses a variety of forest types including both soft and hard woods from seedling size to large size up to sawtimber.

Redback Salamander
Plethodon cinereus
Needs logs, stumps and large rocks as habitat, but will breed in any wet areas such as under leaves moss etc. The range is small due to restricted movement, move about 39 - 72 ' from breeding area. Typically uses all forest types as available.

Four Toed Salamander
Hemidactylium scutatum
Typically found in wet woodlands and prefers red maple woodlands from sapling to large sawtimber stands. The range for this species is undocumented.

Northern Two-lined Salamander
Eurycea b. bislineata

Typically requires moving water such as a streams for breeding and has an average movement of less than 42' from breeding areas. Typically uses most forest types for habitat.

Eastern Spadefoot
Scaphiopus h. holbrooki
Requires deep, sandy soils and temporary water in the form of pools for breeding, the mean home range 67 - 108' from breeding area. Typically uses oak-pine forested habitat.

Eastern American Toad
Bufo a. americanus
Homing behavior is to return to breeding site, typically uses all forest types, however there are no movement distances documented

Fowlers Toad
Bufo woodhousei fowleri
Night movement 200 - 700' to reach waters edge. Prefers sandy soil but frequently found in pine-oak forests or may be found in red maple swamps and stands.

Northern Spring Peeper
Hyla c. crucifer
Found in marshy or wet woods, second growth woodlots, non-wooded lowlands. Requires pools for breeding but may move quite far from water source during the day. Typically found in a variety of woodland/forest types and sizes.

Gray Treefrog
Hyla versicolor
Movement is currently undocumented, but the species breeds in both vernal pools and permanent water. May be found in red maple swamps or stands and in oak-pine forests.

Bullfrog
Rana catesbeiana
Seeks out deep permanent water with abundant floating aquatic vegetation. Movement is typically from 200 - 300' with evening movement up to 700'. Found in red maple swamps and associated areas.

Green Frog
Rana clamitans
Typically found in a variety of riparian habitats, particularly red maple swamps. Movement is generally restricted to a 60 - 600' territory around breeding area. Actual breeding area is restricted from 12 - 18' in size.

Woodfrog
Rana sylvatica
Found in vernal woodland pools and in areas of slow moving water. The woodfrog can be found in all forest types and the average home range is 221' but the woodfrog may move up to 1320'.

Northern Leopard Frog
Rana pipiens
Requires water pools for breeding in the spring, but typically found in wet meadows, open fields and open grassy woodlands in summer. Associated with red maple swamps and stands as a forest preference. Average movement is 15 - 30' with average night movement to 108' or more.

Pickeral frog
Rana palustris
Breeds in ponds of permanent, clear, but often shallow water of bogs and streams. Range is currently undocumented.

Common Snapping Turtle
Chelydra s. serpentina
Prefers aquatic habitat and is partial to banks that are sandy or gravelly in nature. Found in red maple swamps and stands but may also use oak-pine forested areas. Average movement is around 300'.

Stinkpot
Sternotherus odoratus
Typically utilizes non-forested upland and wetland sites however, breeds and uses relatively deep water pools, marshes and bogs with abundant aquatic vegetation. It has an average home range of 0.6 acres, with average movement 166 - 227'.

Spotted Turtle
Clemmys guttata
Uses non-forested upland and wetland sites. Sometimes found in small pools and ponds and in areas of dense vegetation. It has a home range that averages 1 - 3 acres.

Eastern Box Turtle
Terrapene c. carolina
Found in old fields, clearings and in transition areas with open areas and brush cover. Its range is 150 - 250', with an average diameter of home range up to 350'.

Eastern Painted Turtle
Chrysemys p. picta

Typically uses red maple swamps and pools or ponds that have stumps close to shore and/or floating logs. The painted turtle has a rather small home range and moves short distances, usually less than 100'.

Northern Water Snake
Nerodia s. sipedon
Requires aquatic and semi-aquatic environment, usually found in red maple swamps that typically have branches or limbs overhanging the surface waters. Known to move up to 380' from breeding area.

Northern Brown Snake
Storeria d. dekayi
Uses a variety of forest types and has an average daily movement of 10-15'.

Northern Redbelly
Storeria o. occipitomaculata
Prefers a variety of forest types, spending much of its time close to water. The redbelly may move up to 100' over a season.

Eastern Garter Snake
Thamnophis s, sirtalis
Home range may be up to 5 acres in open fields, 2 acres in woodlands and often has a home range of 22.2 - 35 acres in mixed habitat

Eastern Ribbon Snake
Thamnophis s. sauritus
Average activity area of up to 2 acres, particularly red maple swamp areas or other mesic woodlands with aquatic habitat close by. The average distance traveled is up to 280'.

Eastern Hognose Snake
Heterodon platyrhinos
Prefers sandy soils and open woodlands generally travels under 100' from breeding area.

Northern Ringneck Snake
Diadophis punctatus edwardsi
Requires mesic woodland areas with abundant vegetative cover. The ringneck's home range and movement is undocumented.

Northern Black Racer
Coluber c. constrictor
Requires large tracts of mixed old fields and woodlands, with a preference for oak-pine forested areas. The black racer travels up to 903' from breeding areas.

Eastern Smooth Green Snake
Opheodrys v. vernalis
This snake prefers upland grassy openings and uses oak-pine forest as part of it's habitat. It is known to move up to 90' from breeding area.

Eastern Milk Snake
Lampropeltis t. triangulum
Uses a variety of woodland types, and requires loose soil for egg laying. It has a home range of about 50 acres, with movement from 250' - 1300' in open woodlands.

Virginia Opossum
Didelphis virginiana
The opossum prefers large diameter trees in the red maple category and in oak-pine woodlands. It requires an average of 11.5 acres for life activities and will range on .33 to .58 acres. It tends to prefer sedge meadows, shrub swamps, shallow marsh and riparian areas in general.

Masked Shrew
Sorex cinereus
The masked shrew seeks mesic woodlands with abundant vegetative cover. It seeks out bogs and typically uses about 0.10 acres for a home range. It is not unusual to find as many as 9 individual shrews per acre.

Northern Short Tailed Shrew
Blarina brevicauda
Many types of forest cover are used along with low shrubby vegetation with abundant leaf litter. It requires 1 - 1.25 acres with up to 48 shrews per acre commonly found.

Hairy Tailed Mole
Parascalops breweri
Uses many forest/woodland types. Requires moist, well-drained soil and needs 0.2 acres for a home range with between 10 -12 individuals found per acre.
Eastern Mole
Scalopus aquaticus
The eastern mole is often found in soft moist soil and it requires about 0.3 acres for its home range.

Star Nosed Mole
Condylura cristata
Found in wet muck soil areas and often uses red maple stands and sedge meadows as part of it's habitat. It requires approximately 1 acre for a home range and 10 individuals per acre may be found.

Little Brown Myotis
Myotis lucifugus
Home range is undocumented, however females of the species tend to seek out warm, dark riparian spaces including marshes and bog edges for use as maternal colonies. They also make use of upland areas in grass, forb and shrub cover. Up to 26 individuals/acre have been recorded.

Keens Myotis
Myotis Keenii
They make use of a variety of riparian and upland areas, however their home range is undocumented.

Silver-Haired Bat
Lasionycteris noctivagans
They favor riparian areas and require dead trees with loose bark or cavities. Their home range is undocumented.

Eastern Pipistrelle
Pipistrellus subflavius
The pipistrelle has a home range radius of approximately 5 miles, mostly wooded areas

Big Brown Bat
Eptesicus fuscus
They tend to favor a wide variety of forest types and require cool dry areas for hibernation. This bat will frequent the complete spectrum of riparian areas and will also utilize slash and debris piles if a building or structure is not present.

Red Bat
Lasuirus borealis
The Red Bat uses deciduous trees on forest edges for roosting and also makes use of grass, forb, shrub fields and transition zones for normal activities.

Hoary bat
Lasiurus cinereus
The Hoary Bat uses upland fields for major activities and requires coniferous forest edges. The bat also uses a variety of swamp, bog, pond, marsh and stream riparian areas. Its not unusual for the young litter to be left in tree holes while the female hunts.

Eastern Cottontail
Sylvilagus floridanus

The Cottontail frequently uses a variety of upland field types requiring herbaceous and shrub cover for protection. Brush piles, dens, burrows and even stone walls may be used for nest site and for protection. The cottontail also uses sedge meadows, shallow marshes and shrub swamps for normal activities.

New England Cottontail
Sylvilagus transitionalis
Prefers shrubs and old fields for life activities and the New England cottontail also requires young woodlands with rather thick cover, typically 15 to 30% canopy cover with abundant seedlings, saplings and shrubs. This cottontail will also make use of debris and slash piles.

Snowshoe Hare
Lepus americanus
The Snowshoe hare uses dense brush cover and is typically found carrying out life activities in old fields. The hare uses shrub swamps and bogs, usually requiring a forest canopy cover of 70% or greater. The hare also makes use of coniferous seedlings and sapling cover along with ericacious ground vegetation.

Eastern Chipmunk
Tamias striatus
The chipmunk uses tree and shrub cover making use of branches and logs for elevated perch sites. It will use cultivated and formerly cultivated fields as well as deciduous seedlings. The chipmunk also makes use of subterranean habitat.

Woodchuck
Marmota monax
The woodchuck will use ericaceous shrub layers for cover and typically will be found in forest areas with a low density canopy cover, usually less than 15%. The woodchuck uses subterranean habitat as well. The woodchuck will make use of open fields or shrub/ grass fields.

Gray Squirrel
Sciurus carolinensis
This squirrel typically uses greater than 70% deciduous canopy cover making use of trees greater than 18" in DBH and that exhibit large limbs or broken tops. This squirrel will also utilize den holes or hollows in live trees larger than 24" dbh, but frequently makes its nests from leaves.

Red Squirrel
Tamiascuirus hudsonicus
The red squirrel prefers second growth forest with mature tree cover, particularly when the forest cover is conifer. The red squirrel requires similar habitat to the gray

squirrel needing 70% tree canopy cover and larger trees between 18" and 24" dbh. Unlike the gray squirrel, the red squirrel requires coniferous forest.

Southern Flying Squirrel
Glaucomys volans
This squirrel requires mature forest, which in the case of Cape Cod typically means second growth forest. Cavity trees with entrance diameters between 1.6" to 2" are a primary requirement for this species. This species uses dead and soft trees less than 6" DBH, but also uses live trees similar to the other species in the family Sciuridae from 8" to 24" dbh.

Beaver
Castor canadensis
The beaver requires wooded stream sites that can be readily converted to beaver ponds. The beaver requires softwoods located close to pond area for a food source and is sensitive to human disturbance.

White Footed Mouse
Peromyscus leucopus
This species makes extensive use of old cultivated fields and shrubby fields. They will typically use old slash and debris piles for nest sites as well. It prefers mast and fruit producing trees in close proximity to or within the field sites.

Meadow Vole
Microtus pennsylvanicus
This vole uses a variety of upland sites, but prefers to have springs, seeps or bogs in close proximity. It may also be found in shrub swamps and will often use debris piles or slash cover for protection and denning.

Woodland Vole
Microtus pinetorum
This vole needs to have a ground cover of leaves, forest litter and forest duff. It makes some use of subterranean habitat and requires moist but well drained soils.

Muskrat
Ondatra zibethicus
The muskrat is found in shallow waterways and marshes.

Southern Bog Lemming
Synaptomys cooperi
This species is found in a variety of forest types and a requires moist soils. It requires greater than 75% upland herbaceous cover along with some wetland vegetation in the vicinity.

Norway Rat
Rattus norvegicus
This species has no particular or special habitat requirements and thrives in most environments.

House Mouse
Mus musculus
Found in houses, fields and a variety of environments.

Meadow Jumping Mouse
Zapus hudsonius
This species requires up to 75% herbacious groundcover and rather loose soils similar to those found on Cape Cod. Mast and fruit bearing vegetation is also needed.

Coyote
Canis latrans
This species of dog utilizes all forest types and can be found in residential areas as well. Typically hunts open meadows and field sites.

Red Fox
Vulpes vulpes
This species is able to utilize a wide variety of forest cover types, but also requires open fields and meadows. Canopy cover in these areas should be less than 15% canopy cover and there should be fruit and mast producing vegetation.

Gray Fox
Urocyon cinereoargenteus
The Gray fox is found in all forest types but prefers hardwoods, oak-pine forests and red maple swamp areas. Typically, this fox requires a 70% forest cover and other specific habitat needs that include tree cavities and hollowed out logs. This species also uses shrub layers that consist of mixed deciduous and ericaceous vegetation and fruit and mast producing vegetation.

Raccoon
Procyon lotor
Raccoons use a variety of forest types, but prefer red maple trees. Some trees in the area should be at least 24" dbh and there should be a number of hollow trees that could be used for denning. These trees should be of substantial height due to the fact that raccoons tend to den at least 10' above the ground. They also seek out dead and downed material and are often found around water sources such as shallow marshes, and shrub swamps.

Ermine

Mustela erminea
Ermine usually are found in shrub fields and in adjacent to agricultural areas. They require dense cover and frequently use slash piles for cover and hunting. Otherwise, they use a wide variety of forest types.

Long tailed weasel
Mustela frenata
This species uses a variety of forest types with at least 70% canopy cover. They also use regenerating forest cover particularly when these forests are made up of young seedlings and saplings

Striped Skunk
Mephitis mephitis
This species is found in a variety of forest and open field environments.They require ample dead and downed trees for cover and denning. They also need bodies of water such as ponds and streams.

White Tailed Deer
Odocoileus virginianus
White tailed deer require a variety of forest types for normal life functions. They require a canopy cover of 31% to 70% as well as deciduous seedlings and saplings, ericaceous shrubs and fruit and mast vegetation.

Birds

Common Loon
Gavia immer
Requires large undisturbed bodies of water, more often found in nearshore coastal waters.

Pied-billed Grebe
Podilymbus podiceps
Found in both shallow and deep water marshes that are dominated by emergent vegetation.
Also requires and vegetation and shallow, temporary pools.

American Bittern
Botaurus lentiginosus
Requires shallow undisturbed marshes with tall vegetation.

Least Bittern
Ixobrychus exilis
Prefers deep marshes with slumps of emergent vegetation.

Great Blue Heron
Ardea herodias
Requires tall trees that are exposed for nesting and perching that are adjacent or in close proximity to shallow marsh, pond or wetland areas.

Green backed Heron
Butorides striatus
Requires shallow marshes with wetland shrubs, vegetation and temporary pools.

Black Crowned Night Heron
Nycticorax nycticorax
Prefers shrub swamps with abundant wetland vegetation.

Glossy Ibis
Plegadis falcinellus
Prefers bogs for breeding and other wetland areas for normal life functions.

Mute Swan
Cygnus olor
Prefers shallow ponds and streams with abundant vegetation.

Canada Goose
Branta canadensis
Prefers shallow marshes adjacent to open fields and agricultural lands for breeding and feeding.

Wood Duck
Aix sponsa
Needs trees that are at least 16 dbh with cavities with hole diameters of at least 4 inches. , close to the open water and trees with live large limbs or broken tops. Usually requires proximity to surface water of at least 5 acres in size. Overhanging vegetation from willows, buttonbush etc., or other types of emergent herbaceous vegetation is necessary for brood survival.

Green-Winged Teal
Anaas crecca
Requires shallow marsh with abundant wetland vegetation.

American Black Duck
Anas rubripes
Requires large tracts of shallow marsh in close proximity to open water. Home ranges may be as large as 5 square miles.

Mallard
Anas platyrhynchos
Will make use of all types of marsh, stream, bog and pond situations and can even be found on the ditches of cranberry bogs and in agricultural fields.

Northern Pintail
Anas acuta
The drakes need to be close to mudbanks and exposed shorelines of marsh areas and will take up breeding sites that are made up of small kettle ponds as well.

Blue winged Teal
Anas discors
Prefers shallow marsh areas but has been found in fields that are close to the water. The average distance between nesting pairs has been estimated at 50 yards, so that large flocks require a sizable tract of marsh.

Gadwall
Anas strepera
Requires larger bodies of water that typically have submeratic vegetation.

American Widgeon
Anas americana
Prefers lakes and large surface waters that have associated wetland areas.

Canvasback
Aythya valisineria
Prefers shallow and deep marshes that are close to open water and emergent vegetation.

Ring-necked Duck
Aythya collaris
Prefers lakes and ponds but will utilize any large expanse of open water.

Common Goldeneye
Bucephalea clangula
Prefers clear cold and shallow water but also requires cavity trees of at least 20 inches dbh.

Common Merganser
Mergus merganser
Requires undisturbed wooded areas associated with small ponds and kettle ponds.

Red-breasted Merganser
Mergus serrator

Requires areas of wetland shrubs associated with lakes.

Turkey Vulture
Cathartes aura
Requires fields and large stubs and limbs on dead tree trunks. The Turkey Vulture requires perching trees and canopy covers of 16 to 70 %.

Osprey
Pandion haliaetus
Requires clear water of ocean, lakes and streams that have close proximity to high perching opportunities. Artificial perches and nest poles have proven successful in many areas.

Bald Eagle
Haliaeetus leucocephalus
Requires large water bodies that contain fish and the eagle also requires large living trees near shorelines for purposes of nest making and breeding.

Northern Harrier
Circus cyaneus
Marshes or open fields and areas with less than 30 % canopy cover are needed for life functions.

Sharp-shinned Hawk
Accipiter striatus
The sharp shinned hawk requires greater than 70% canopy cover, particularly of coniferous trees. This hawk will also use large areas of mixed woodlands if the areas is relatively undisturbed.

Cooper's Hawk
Accipiter cooperii
Requires areas of woodland that range between 15 and 70 % deciduous canopy cover as well as close proximity to grass and shrub fields.

Northern Goshawk
Accipiter gentilis
Requires 30 to 70% canopy cover of either deciduous or coniferous forest but also requires upland fields made up of grasses, forbs and shrubs for hunting.

Red-shouldered Hawk
Buteo lineatus
Prefers cool moist deciduous forests of greater than 70% canopy cover. This hawk also makes use of streams and flowing water areas for life functions.

Red-tailed Hawk
Buteo jamaicensis
Makes use of forest and field transition areas, but also likes to hunt grass fields and agricultural fields. Requires exposed high branches but will seasonally make use of canopy covers that range from 15% to a high of 70%.

Rough-Legged Hawk
Buteo lagopus
This hawk requires open upland fields of all types, but also needs deciduous forest with a canopy cover of 15% or less.

American Kestrel
Falco sparverius
Requires tall trees located close to open fields with little topographical relief. This species also needs tall trees with cavities for perching and breeding that are at least 12 inches dbh.
The Kestrel typically utilizes wooded areas that have 15% canopy cover or less.

Merlin
Falco columbarius
The Merlin uses swamp areas along with marshes and bogs as well as non-waterside trees in low density wooded areas. Typically, the Merlin will use large trees of 12 dbh or greater with large broken tops or large limbs.

Peregrine Falcon
Falco peregrinus
Not typically found on the Outer Cape except as a migrant, but this species makes use of marshes and wetland areas that are relatively tree less.

Ring-necked Pheasant
Phasianus colchicus
This species makes use of cultivated fields, upland fields with abundant grasses shrubs and transition areas where there is abundant deciduous seedlings and saplings and may also be found in areas where there is a shrub layer that provides 75% or greater canopy cover.

Ruffed Grouse
Bonasa umbellus
Requires upland field areas where there are abundant fallen logs and a dense sapling understory. This species also requires a fairly dense canopy at different times of the year up to 70% particularly where there is a supply of mast and fruit trees.

Wild Turkey
Meleagris gallopavo

The Turkey needs a fairly dense shrub layer, a canopy layer up to 70% and mast and fruit trees. It also requires open, wooded areas and clearings along with conifers for roosting.

Northern Bobwhite
Colinus virginianus
The Bobwhite uses transition areas that are relatively well drained and a canopy cover that is between 16 and 30%.

King Rail
Rallus elegans
Requires wetland areas including shallow and deep marsh along with wet meadow habitat. Abundant wetland vegetation is also an important physical feature.

Virginia Rail
Rallus limicola
Prefers shallow marshes and wetlands with a variety of sedges and cattails.

American Coot
Fulica americana
Requires emergent vegetation with variable water depth from 1 to 4 feet and abundant wetland vegetation.

Killdeer
Charadrius vociferus
Uses upland fields and bare ground areas where there is abundant sand and gravel. Prefers cultivated fields or areas of sparse vegetation.

Spotted Sandpiper
Actitis macularia
Makes use of upland areas with abundant grasses but also requires and prefers close proximity to riparian systems.

Upland Sandpiper
Bartramia longicauda
Uses wetland and upland areas with abundant wetland vegetation or in upland areas, an herbaceous cover. Also prefers areas of old pasture or agricultural fields and grass areas.

Common Snipe
Gallinago gallinago
Prefers areas of moist organic soils and scattered low vegetation like that found in shrub swamps, shallow marshes and bogs.

American Woodcock
Scolopax minor
Prefers transition areas with small clearings and areas of variable topography. Often found in areas where the canopy cover is between 16 and 30%.

Eastern Screech-Owl
Otus asio
Requires a tree canopy coverage of 16 to 30% and also trees in the 12 to 18 inch dbh particularly with cavities. Also makes use of fields and transition and riparian areas.

Great Horned Owl
Bubo virginianus
Makes use of large tree cavities, sedge meadows, riparian areas and old fields. Prefers a coniferous canopy cover of 70% or greater.

Barred Owl
Strix varia
Prefers canopy cover of 70% deciduous with cavity trees of 20 inches dbh or greater and also seeks out damp lowlands and wetland/upland transition areas.

Long-eared Owl
Asio otus
Uses dense conifer thickets, but also makes use of grass and forb fields as well as sedge meadows, shallow marshes and bogs.

Short-eared Owl
Asio flammeus
Uses extensive grasslands and open dune topography. Often makes use of shallow marsh areas for hunting.

Common Nighthawk
Chordeiles minor
Makes use of upland areas in general, and also seeks out sand and gravel exposures.

Whip-poor-Will
Caprimulgus vociferus
Uses deciduous habitat with abundant seedlings and saplings and a canopy cover of 31 to 70%. This species is also found in a wide variety of upland habitat types.

Chimney Swift
Chaetura pelagica
Makes use of upland areas for general life functions as well as debris piles and derelict structures.

Ruby-throated Hummingbird
Archilochus colubris
Prefers forb and old shrub fields. Also uses deciduous growth with a canopy cover of greater than 30%.

Belted Kingfisher
Ceryle alcyon
This species can be found in banks and sand and clay cliff faces. It prefers close proximity to riparian areas and seeks out low hanging and dead limbs for perches.

Downy Woodpecker
Picoides pubescens
Uses a variety of tree types but prefers trees greater than 6 inches in diameter.

Hairy Woodpecker
Picoides villosus
Uses a variety of tree types preferring trees of 10 inches dbh.

Northern Flicker
Colaptes auratus
Uses open areas and trees greater than 12 inches dbh, particularly trees with heartrot. Prefers tree canopy cover between 15 and 30%.

Olive-sided Flycatcher
Contopus borealis
Prefers tall perch areas that are adjacent to low wetland areas and thickets.

Eastern Wood-Pewee
Contopus virens
Is found in riparian areas with low, exposed perches and canopy covers greater than 70%.

Willow Flycatcher
Empidonax traillii
Is found in low deciduous trees and shrubs in close proximity to clearings and transition areas.

Least Flycatcher
Empidonax minimus
Uses open deciduous forests but may be found in forests with up to 70% canopy cover. This species is also found in mixed forests and along forest edges.

Eastern Phoebe

Sayornis phoebe
Uses deciduous forest habitat and prefers streamside clearings.

Eastern Kingbird
Tyrannus tyrannus
Uses a wide variety of upland areas with low exposed perches and forest cover up to 30% canopy cover.

Horned Lark
Eremophila alpestris
Uses upland field habitat, particularly grass fields. This species also seeks out bare exposed soil areas.

Purple Martin
Progne subis
Is found in a variety of habitat types, but prefers to be near surface waters. Can often be found using dead waterside trees 6 inches dbh and dead interior trees between 12 and 16 inches dbh.

Tree Swallow
Tachycineta bicolor
Uses waterside and interior trees between 6 and 12 inches dbh and trees with a minimum dbh of 10 inches when close to open fields and transition areas.

Bank Swallow
Riparia riparia
Is found in open areas using a wide variety of upland habitat and is often found in vertical walls of sand and clay with grassy overhangs.

Cliff Swallow
Hirundo pyrrhonota
Prefers grassy upland fields and open areas in close proximity to vertical walls of mud with and overhang.

Blue Jay
Cyanocitta cristata
Uses both deciduous and coniferous forest in the midstory range of 10 to 30 feet in height.

American Crow
Corvus brachyrhychos
Prefers upland fields and coniferous forest cover for life functions.

Black-capped Chickadee

Parus atricapillus
Can be found in cavity trees in small woodlands, clearings or open spaced woodland areas. Also uses dead and soft wood trees greater than 6 inches dbh.

Tufted Titmouse
Parus bicolor
Prefers riparian areas for all life functions and also needs cavity trees at least 8 inches dbh.

Red-breasted Nuthatch
Sitta canadensis
Uses bog areas and low wetland areas. Can also be found in coniferous forests using cavity trees 12 inches dbh.

White-breasted Nuthatch
Sitta carolinensis
Seeks out riparian areas and tends to use cavity trees in hardwood or mixed hard and soft wood forests.

Brown Creeper
Certhia americana
Uses a variety of tree types both dead and live as well as woodland trees that have loose or sloughing bark.

Carolina Wren
Thryothorus ludovicianus
Is found in shrub and field environments using brushy vegetation and cavity trees. Is also found in deciduous seedling and sapling zones in transition areas.

House Wren
Troglodytes aedon
Prefers shrub and old formerly cultivated fields with cavity trees nearby. Is also known to use old slash and debris piles.

Marsh Wren
Cistothorus palustris
Is found in both shallow and deep water marshes. Prefers wetland areas with abundant wetland vegetation near breeding areas.

Veery
Catharus fuscescens
Prefers moist wooded areas with an understory of low trees and a shrub layer. Also uses upland areas including shrub and old fields. Can also be found in woodlands with a midstory of trees in the 10 to 30 foot high category.

Swainson's Thrush
Catharus ustulatus
Can be found in shrub areas, particularly areas of coniferous seedlings and saplings.

Hermit Thrush
Catharus guttatus
This species uses old fields, coniferous or mixed woodlands and areas that are characterized by dense undergrowth. Also uses bog areas for breeding and shrub swamps in winter months.

Wood Thrush
Hylocichla mustelina
Uses both coniferous and deciduous forest with at least a 70 % canopy cover. Also uses midstory height trees in the 10 to 30 foot category. Particularly prefers cool, moist deciduous forest that is somewhat mature.

American Robin
Turdus Migratorius
Uses a wide variety of habitat types including upland and wetland areas. Prefers forest canopy in the 16 to 30% cover category and also uses midstory height trees.

Gray Catbird
Dumetella carolinensis
Is found in shrub and forest cover, usually in canopy covers of less than 15 %. Often found in shrub thickets as well.

Northern Mockingbird
Mimus polyglottos
Utilizes terrestrial areas such as shrub and old fields. It prefers thickets that are low to the ground and seeks out perennial fruit and mast sources.

Brown Thrasher
Toxostoma rufum
Uses a hardwood forest and shrub field ecotone. Typically found in canopy covers of less than 15%.

Cedar Waxwing
Bombycilla cedrorum
Can be found in a wide variety of upland habitat types and typically uses canopy cover of 30% or less. This species also relies on fruit and mast trees particularly in the non-breeding season.

Northern Shrike

Utilizes coniferous forests with at least 70% canopy coverage and a mix of midstory trees under 30 feet high.

Blackburnian Warbler
Dendroica fusca
Uses mainly coniferous forest habitat with 70% verage and a mix of midstory trees under 30 feet high.

Pine Warbler
Dendroica pinus
This species is found in coniferous forest habitat with a variety of canopy coverage from 31% to greater than 70%.

Prairie Warbler
Dendroica discolor
Prefers canopy cover less than 15% . This species typically avoids dense woods, usually keeping to seedling and sapling areas found in transition zones and along forest/field edges. This warbler is rarely found above 10 feet.

Palm Warbler
Dendrocia palmarum
This warbler uses shrub layer habitat and areas of ground cover that have 75% coverage. It also makes use of shrub swamps and is found in bog habitat.

Blackpoll Warbler
Dendroica striata
Prefers stunted spruce forests and areas of coniferous seedlings and saplings.

Bay-breasted Warbler
Dendroica castanea
This species seeks out shrub and old fields and also makes use of thick stands of spruce forest.

Cerulean Warbler
Dendroica cerulea
Prefers riparian areas and forest with 70% canopy coverage.

Black-and-white Warbler
Mniotilta varia
Makes use of bog habitat as well as primary and particularly secondary forest cover.

American Redstart
Setophaga ruticilla

Uses deciduous shrub and seedling areas as well as midstory growth under 30 feet high. It also relies on second growth woodlands.

Prothonotary Warbler
Protonotaria citrea
Seeks out tree cavities in moist hardwood forested areas. It also uses dead and soft wood trees that are less than 6 inches dbh.

Worm-eating-Warbler
Helmitheros vermivorus
Uses forest canopy cover of 70% or greater and also requires abundant midstory trees under 30 feet high. It tends to prefer dry wooded areas and is often found along wooded hillsides.

Ovenbird
Seiurus aurocapillus
Requires areas of forest litter and moss in mature dry forest with sparse understory.

Louisiana Waterthrush
Seiurus motacilla
Prefers woodlands with flowing water and may locate along slow moving streams and seeps.

Mourning Warbler
Oporornis philadelphia
Uses shrub and old field habitat as well as areas of hardwood regeneration. It can also be found in dense thickets of fruiting shrubs and briars and in wet woods with thick undergrowth.

Common Yellowthroat
Geothlypis trichas
Uses shrub layers and areas of ground cover that exceed 75% coverage in the 2 foot range.

Hooded Warbler
Wilsonia citrina
Is found in shrub layers and areas of heavy ground cover. Can also be found in low lying gullies and in wooded swamps.

Wilson's Warbler
Wilsonia pusilla
Can be found in bogs, alder and willow thickets and in heavy shrub layers with abundant forest litter.

Canada Warbler
Wilsonia canadensis
Found in forested areas with canopy coverage of 70% or greater and in shrub layers with both deciduous and coniferous seedlings and saplings.

Yellow-breasted Chat
Icteria virens
Found in dense thickets and areas where there are abundant and immature trees. It also makes use of areas that are close to surface waters.

Scarlet Tanager
Piranga olivacea
Requires mature coniferous forest with greater than 70% canopy coverage. It is also frequently found in oak/pine mixed forests.

Northern Cardinal
Cardinalis cardinalis
Prefers thickets and vines, but can also be found in forested areas that have less than 15% canopy coverage. It can also be found in shrub swamps with abundant brushy areas.

Rose-breasted Grosbeak
Pheucticus ludovicianus
Uses midstory sized trees of 30 feet or shorter. It can also be found in forest/field transition zones and in thickets of hardwood seedlings and saplings.

Indigo Bunting
Passerina cyanea
Is found in forest/field transition areas and prefers the fields to be dominated by grasses.

Rufous-sided-Towhee
Pipilo erthrophthalmus
Prefers dense brushy areas forming the understory to coniferous forests.

American Tree Sparrow
Spizella arborea
Uses the complete range of upland habitat types and can also be found in shrub layers in the understory of second growth forest.

Chipping Sparrow
Spizella passerina

Prefers canopy coverage of 16 to 10 % with some exposed perches. It also makes use of a range of upland habitats. It is particularly fond of grassy woodland edges in the transition zone.

Field Sparrow
Spizella pusilla
Prefers old fields but will use a variety of upland habitat types.

Vesper Sparrow
Pooecetes gramineus
Will tend to use openings in wooded areas with short growing herbaceous vegetation. It also requires abundant perches.

Savannah Sparrow
Passerculus sandwichensis
Uses areas of herbaceous cover in typical upland habitat types, but will also use sedge meadows and shallow marsh areas for life functions.

Grasshopper Sparrow
Ammodramus savannarum
Requires exposed perches, ground cover that is less than 70% and heavily uses field habitat that is dominated by grass.

Henslow's Sparrow
Ammodramus henslowii
Uses densely vegetated areas that have abundant perches, moist ground litter, but may also be found in moist grassy areas such as wet meadows.

Fox Sparrow
Passerella iliaca
Uses shrub dominated fields and areas of coniferous forest undergrowth.

Song Sparrow
Melospiza melodia
Prefers grass fields but will use a wide variety of upland habitat types. It also requires exposed perches and adjacent shrub transition areas.

Lincoln's Sparrow
Melospiza lincolnii
Requires shrub and brush thickets close to openings that are dominated by sedges and grasses.

Swamp Sparrow
Melospiza georgiana

Will use a variety of swamp and marsh habitat, but is usually found in freshwater shrub swamps.

White-throated Sparrow
Zonotrichia albicollis
Requires open canopy cover of 15% or less and also uses shrubby areas. It may also be found in a variety of shallow marshes and swamps.

Dark-eyed-Junco
Junco hyemalis
Prefers coniferous overstory and groundcover areas that have at least 75% coverage. May also be found in mixed second growth forest and in thickets along cleared areas.

Lapland Longspur
Calcarius lapponicus
Uses a variety of upland habitats, particularly old cultivated fields. It also requires areas of exposed soil and sand.

Snow Bunting
Plectrophenax nivalis
Can be found in old grasslands, along backdune areas, beaches and in areas with greater than 75% groundcover.

Bobolink
Dolichonyx oryzivorus
Requires large open tracts of grasslands, but may also be found in areas where the groundcover is greater than 75% in the 0 - 2 foot range.

Red-winged Blackbird
Agelaius phoeniceus
Requires shallow marshes with tall growing vegetation such as cattails, phragmites etc. Can also be found around surface waters where the surrounding canopy cover is generally less than 15%.

Eastern Meadowlark
Sturnella magna
This species is found in areas where the canopy cover is less than 15% and where there is an abundance of exposed perch sites. Also makes use of grass upland sites.

Rusty Blackbird
Euphagus carolinus
This bird is typically found in wooded swamps and along bog edges. It also prefers coniferous forest areas.

Common Grackle
Quiscalus quiscula
Found in both coniferous forests, red maple swamps and near surface water bodies. It can also be found utilizing a variety of upland and wetland habitat types.

Brown-headed Cowbird
Molothrus ater
Found in a wide variety of upland sites, the Cowbird prefers grass fields and areas with both low and high exposed perches.

Orchard Oriole
Icterus spurius
Found in areas where the canopy coverage is in the 16 to 30% category. Also found in orchards as the name implies and in scattered tree cover that lies adjacent to surface waters.

Northern Oriole
Icterus galbula
Prefers tall scattered trees such as the American Elm and in areas of tall trees that provides a canopy cover of 15% or less.

Pine Grosbeak
Pinicola enucleator
Prefers canopy cover of 70% or greater and also makes use of midstory height trees. Can also be found where there are abundant fruiting trees.

Purple Finch
Carpodacus purpureus
Prefers coniferous trees, but will be found in mixed woodlands where homogenous stands of conifers are scarce.

House Finch
Carpodacus mexicanus
Ubiquitous in a variety of habitat types including around human dwellings.

Common Redpoll
Carduelis flammea
Prefers grass and forb dominated upland fields. It also makes use of shrub transition areas.

Hoary Redpoll
Carduelis hornemanni
Prefers grass and forb upland fields. It also uses coniferous shrub layers and areas where the ground cover is greater than 75%.

Pine Siskin
Carduelis pinus
Prefers coniferous forests with greater than 70% canopy coverage. It also makes use of midstory trees under 30 feet in height. This species can also be found in alder thickets.

American Goldfinch
Carduelis tristis
Prefers deciduous forests with a shrub understory, but can also be found in open fields with few trees.

Evening Grosbeak
Coccothraustes vespertinus
Prefers coniferous forests, particularly spruce and fir. May also utilize deciduous woodlands in winter months.

House Sparrow
Passer domesticus
Ubiquitous use of a variety of upland habitat types. This species can also be found in close proximity to transition areas near riparian habitat.

Appendix B

Glossary of Terms

biodiversity - the number and overall abundance of all of the species that can be found within a given locality or area.

canopy cover - the estimated or measured amount of ground covered by tree or shrub shadow.

diameter at breast height (dbh) - the measurement of a tree taken at 4 1/2 feet above level ground.

ecosystem - a functional unit of nature that combines the biotic and abiotic environments within which they interact.

emergents - a plant that has roots growing in shallow water but that projects above the water for the purposes of life functions.

ericaceous - shrub like plants that usually have leathery leaves and require acid soil.

faunal - a term indicating all of the animals of a particular area.

floral - a term indicating all of the plants of a particular area.

fragmentation - the splitting up of naturally vegetated areas that provide habitat for plants and animals to carry out their life functions. Fragmentation often leads to a lack of species diversity, reducing existing populations of animals using a given habitat to a level that over time could lead to local extinction.

guilds - groups of the same species of plants or animals using the same type of environment.

habitat - the area where a plant or animal usually carries out its life functions. Habitats often are characterized by physical features or dominant plant types.

hydric - mineral soils that are covered with standing water or are saturated with water for extended periods of time, particularly during the growing season.

macrophytes - typically an aquatic plant species that is macroscopic in size.

mesic - an environment that has moderate amounts of rainfall and is characterized by moist well drained soils. Also said of plant species that require abundant moisture..

obligate - requiring or tolerating a given condition. Obligate plants require or tolerate saturated soil conditions.

ombrotrophic - obtaining most or all of its nourishment from precipitation.

pH - a measure of the relative hydrogen ions in a solution. The lower the pH, the more acidic a solution is, the higher the pH the more alkaline the solution is. A pH of 7 is neutral.

rare and endangered species - species of plants and animals that have been identified at the state and federal level for having reduced populations that threaten the very existence of the species.

rushes - a plant with linear leaves, parallel veins and rather inconspicuous flowers.

sedges - a plant similar to a grass with solid, triangular stems.

species - a naturally occurring population of plants and animals that are reproductively isolated from other such populations or otherwise similar groups.

succession - the natural and usually gradual change that occurs between different types of ecosystems and communities.

tannin - a group of acidic organic compounds that come from the bark or leaves of plants that typically is found in water. High tannin content often turns the water a brownish color.

taxa - a group of organisms that have a formal taxonomic ranking such as genus, species, family etc.

threshold - the point or level at which a variable or stimulus begins to take effect.

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