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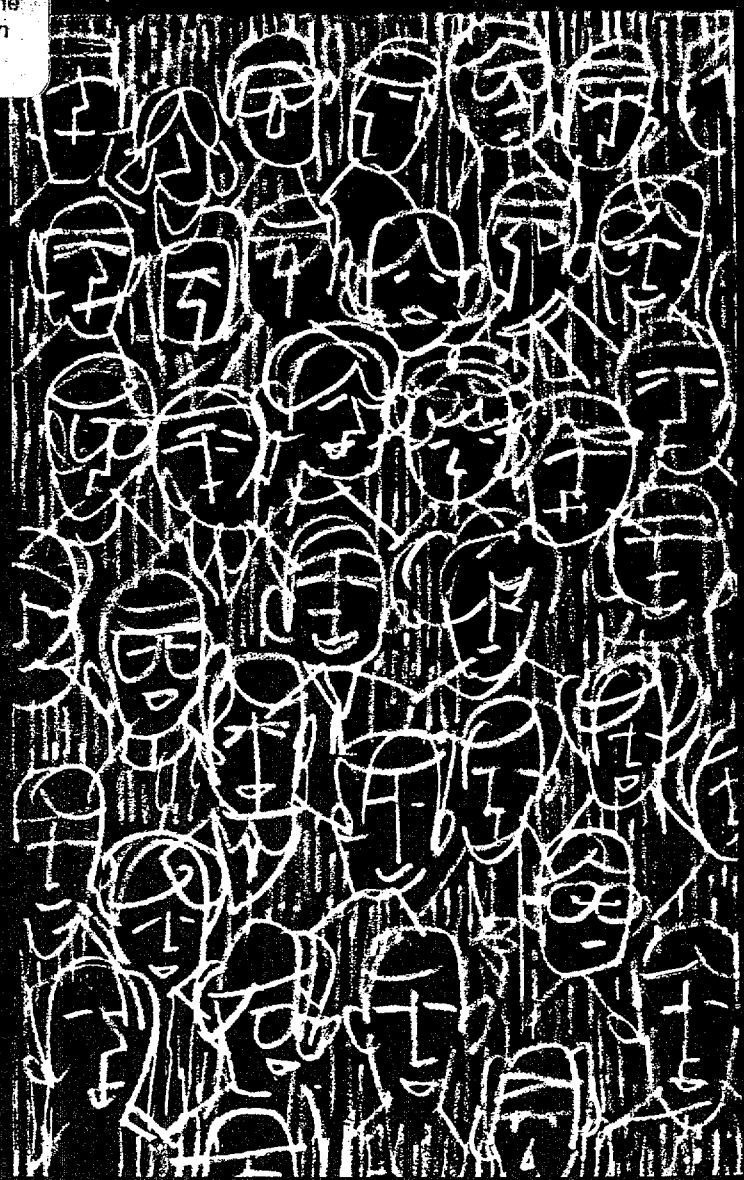

APCC's GROWTH REPORT

Options

FOR CAPE COD'S FUTURE

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APCC'S GROWTH REPORT
OPTIONS FOR CAPE COD'S FUTURE

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PREFACE

Because of mounting concern regarding the intense growth on Cape Cod, the Association for the Preservation of Cape Cod has produced this report for the citizens of Barnstable County. The study includes recommendations for individual town bylaws, health regulations, regional programs and legislative measures to insure caring management and conservation of our natural resources.

APCC has recognized that the use of Cape Cod's finite resources must be coordinated with the rising population, so has framed a series of questions for major study.

Will growth continue? How fast? For how long? What powers the growth? What will eventually limit it? To answer these questions, the APCC Board of Directors asked Philip B. Herr & Associates to develop demographic and economic growth analyses and forecasts to the year 2000, building on and updating work done in 1976 by Herr for the CCPEDC 208 study. While APCC's work made use of published sources such as the census, a great deal of critical information was gathered in painstaking door-to-door surveys, collection of unpublished town records, and lot by lot analysis of assessor's records, all carried out by APCC volunteers who contributed enormous energies to making this effort uniquely well-informed about current Cape Cod realities.

What are the consequences of the forecast growth for our resources, environment, and quality of life and what can be done to make impacts more favorable? To answer that, APCC enlisted the aid of Cape Cod experts on a whole array of topics of concern. Those experts contributed their time and expertise, and provided working papers on how growth as forecast should be linked to policy on natural resource protection, land use planning, and regional coordination. Based on those contributions, the APCC Board of Directors and Science Advisors developed recommendations for public and private action to enhance the living and environmental qualities of Cape Cod. The final results comprise a comprehensive data resource on Cape Cod and its towns, a technical report, and a citizen's checklist for action geared to official, civic and educational groups.

I. GROWING WITH CARE

For two years APCC has studied Cape Cod's growth, drawing on staff, consultants, experts in many fields, and the efforts of many volunteers. The result is a careful delineation of the Cape's present situation and future growth prospects, an assessment of the consequences of that growth, and exploration of how community effort could help shape a better future for Cape Cod.

The dimensions of probable growth over the next 16 years are enormous. The Cape is likely to add half again to its winter population and a third again to its summer population by the end of the '90's. For every two homes existing in 1980 there will be three homes shortly after the year 2000. In fewer than 20 years it is likely that there will be more people on Cape Cod in the summer than live in the city of Boston. The Cape's year-round population is forecast to swell from under 150,000 people in 1980 to nearly 220,000 people in 2000, while summer peak population booms from 370,000 in 1980 to 500,000 in 2000.

Along with growth will come functional change. Increasingly, Cape Cod will function more like a suburb than like a rural region. The components of Cape Cod's growth which are growing fastest, commuting and retirement, mean support for a population which resides one place, Cape Cod, but whose earnings come from a different place, off-Cape, which is exactly the suburban formula. If the Cape looks more like a suburb in the future it will be because it <u>is</u> more like a suburb. The social and political ramifications of that reality, as well as the developmental ones, are profound.

Current zoning and environmental controls won't stop that growth. With current zoning, all the projected growth can be accommodated and still leave land for at least another generation of development. Furthermore, the market has demonstrated a robust ability to find customers willing to buy or rent despite any limitations or costs which current development controls may impose. Inadequate water supply won't stop growth either, although as consumption demand rises and potential clean supplies dwindle, the cost of keeping supply up with demand is likely to escalate.

Even the Cape's celebrated traffic problems won't stop growth, though if it were not for worsening congestion, growth would be even greater than we have forecast. Nor will other deteriorating conditions stop growth, but those conditions <u>will</u> be worsened by it. Problems of sewage disposal, solid waste disposal, overtaxed harbor facilities, crowded beaches, loss of wildlife habitats, and destruction of Cape Cod's character and charm will all grow with further development.

There is no assurance that growth will balance that by helping to resolve social and economic problems. On the contrary, growth may make them worse. Without special efforts, even more Cape Codders in the future may find the housing the market produces too costly to afford. Unemployment disparities versus the rest of the state may grow. Health care problems may grow. The destruction of community cohesion will almost surely be accelerated.

However, it is in that very superabundance of growth pressure that the ability to make a better Cape Cod lies. Growth pressure on Cape Cod is so great that it creates the possibility of choice: the possibility of choosing for the Cape only that growth which is caring in its environmental consequences and caring in serving the Cape's social and economic needs. An appropriate policy is not "no-growth", but "caring growth", growth which is equitable to property owners, environmentally supportable, and socially constructive. That choice is available on Cape Cod precisely because growth demand is so strong.

In considering growth policy for Cape Cod, it is important to consider that not only does the Cape have available choice in its growth, but so too does the vast majority of the people whose coming to the Cape powers its growth. Second-home buyers and in-migrating retirees are making discretionary choices about leisure living, not just meeting basic shelter needs constrained by such things as job location, schooling and income. The obligation to provide unfettered access for those presently choosing among the Cape, eastern Long Island and Maine is far different from the metropolitan imperative to provide suburban housing, and different from the necessity of serving the housing needs of Cape Cod's service population. The appropriateness of intervention to protect the interests of future generations is especially clear under these conditions.

The population to which the Cape might ultimately grow depends upon zoning-controlled density and open space reservation. That saturation limit is many years away: our year 2000 forecast is for 216,000 year-round residents, while at least 250,000 year-round residents, and perhaps more, can be accommodated at saturation, a level which won't be reached until the year 2020 or later. It is premature to debate policy on ultimate population, or to use that issue as a basis for current actions. It <u>is</u> important that low-density sprawl and its excessive land consumption be controlled so that future choices about growth aren't preempted. Open space acquisition, growth rate control, and sensible density regulations can all contribute to avoiding sprawl.

It is <u>not</u> premature to set policy on growth <u>rate</u>. Years ago CCPEDC advocated managing the Cape's growth to achieve 2,500 new housing units per year, a rate exceeded every year since 1976, with nearly 4,000 units added in 1983. The benefits of legislatively controlled growth rate are now apparent in Bourne and Sandwich, which adopted such controls in the '70s, and corroborated by experience on Martha's Vineyard and Nantucket. The current rate of change on Cape Cod is destructively fast, and is without either social necessity or public benefit. "Caring growth" for the eighties and nineties should include care to avoid excessive rates such as those of the past two years.

A. Achieving Caring Growth

Throughout this report an array of suggestions is made for managing growth, including private actions, actions for local government, and actions at the regional level. In summary, three things are needed: strengthened organizational capacity, improved regulatory authority, and adequate financial resources. All are achievable.

ORGANIZATIONAL CAPACITY

Being able to choose beneficial growth requires organizational capabilities which are now generally lacking. For one thing, questions which cross local boundaries such as environmental management, water quality, and transportation continue to elude effective resolution, despite efforts of CCPEDC and the Cape's many formal and informal regional organizations. Only with a real Cape Cod government will there be an appropriate mechanism for choice where the major considerations in that choice overspill local boundaries, as they commonly do. A real government has a legislature and has taxation authority. County government in Massachusetts has neither. For Cape Cod the county is a sound geographic basis for governance, and construction of real government at that level is a key step in building necessary public capacity, regardless of directions other regions may take.

While the establishment of a real county government is moving through the legislature, much could be done at the regional level. For one thing, CCPEDC's work in water quality management has earned national attention, and deserves stronger budgeted financial support so that efforts now spent on grant-chasing can instead be spent on problem-solving.

Both formal and informal regional associations promote intertown communication, but again more could be done. An array of groups ranging from the long-established Selectmen's Association through the newer Cape Cod Council of Conservation Commissions, to an ad hoc organization of the Cape's few professional planners contributes to improving communication and dialogue among towns. Such organizations should be strongly supported, and their efforts supplemented with such things as occasional joint meetings between planning boards in adjacent towns, now a rare but not unheard of event.

At the local level there needs to be an earlier, stronger, and more positive voice in government advocating careful natural resource management. Conservation Commissions too often are confined to the role of policing the last stop in the development control process, earning them the stigma of nay-sayers. There are many ways of giving more effective voice to resource concerns, with different approaches appropriate to different towns. A development cabinet, such as Barnstable has established, can give that voice an early forum. Interagency plan review committees, somewhat like that just created in Orleans, can get environmental review interacting with, rather than following, other reviews. A full-time conservation agent or even part-time professional assistance on conservation matters can help by creating a real presence for day-to-day interactions in Town Hall, strengthening reviews, and freeing Commission energies for more creative efforts than reactive plan reviews.

Similarly, the value of professional planners in town government has only recently been demonstrated on Cape Cod. Barnstable, Dennis, Falmouth, Mashpee and Yarmouth now employ full-time professional planners whose training, time availability, and role greatly strengthen

local capacities. More communities should make more extensive use of professional help, if not through full-time staff then through shared staff, "circuit-riders", regular consultant arrangements, or other means.

REGULATORY AUTHORITY

Growth on Cape Cod is regulated under statutes and state regulations drafted for the whole of Massachusetts in a legislative process often dominated by the homebuilding industry. The result is a set of tools which are far short of ideal for this region, given its rapid growth and fragile resources. However, with skill and creativity an adequate Cape Cod regulatory framework can be developed.

Concern over excessive growth rate can and should be directly addressed through explicit growth rate controls which allow reasonable growth, which respond to market and financing fluctuations, but which constrain the destructive peaks of growth currently being experienced. Legal precedent and adequate models exist and with careful drafting, effective and equitable rate limiting systems can be shaped to each community's peculiar circumstance for local adoption. Given that control, other choices in the regulatory system, such as allowable density and type of housing, can be shaped to respond more precisely to other environmental and social objectives, without being limited by a second role as a control to slow down growth.

With growth rate controlled the next need is to be able to choose development which is caring about its consequences. That means choosing growth which contributes to the year-round economy, not just the seasonal one; growth which helps resolve housing problems rather than making them worse; growth which is considerate in fitting into the visual context; and growth which carefully avoids or mitigates harmful effects on the natural environment.

There is an array of tools available to do that, such as incentive systems, which reward rather than punish, and development rights transfers, which allow preservation without penalty. Just emerging in current work is an approach which enables local planning boards to choose among alternatives for development, rather than being obliged to accept just any proposal whose technical details meet regulatory standards. Criteria for that choice again would be based on caring: caring for environmental, social, and visual consequences. Such a system of choice places both developers and communities in the position of benefiting from development which serves community concerns, explicitly joining interests which too often have been adversaries.

Wetlands control is a crucial function on the Cape, but is exercised through a defective system. Each town should have its own wetlands bylaw tailored to its circumstance, affording a local means of control supplementing the state-created Wetlands Protection Act, whose implementation and appeals procedures don't always serve the Cape well. Given such a local law, procedures and authorities can be clarified by placing essentially all wetlands control in the Conservation Commission, eliminating the dual-track confusion of also having Board of Appeals wetland control under zoning.

Similarly, Title V of the state Environmental Code inadequately protects Cape Cod's special circumstance of geology and hydrology, so it should be supplemented with strict but fair health regulations adopted by each local Board of Health.

Visual resource management is still at a crude level compared with, say, groundwater management. Historic districts and sign controls have prompted controversy and displayed inability to deal with the major questions of community character, yet those questions are as important to Cape Cod's future as any. Better, more objective tools are possible, but require an effort comparable to the 1970's EPA-funded "208" effort on groundwater to develop a comparable level of competence. Somehow that effort should be made.

Regulations are worse than useless unless enforced, and enforcement has often been the weakest link in Cape Cod's resource management. Enforcement is commonly deficient not because of lack of personnel but because of lack of leadership support for that personnel. It is crucial that enforcement agents be capable, well trained, and given adequate staff. It is also important that they be given adequate political and legal backup to assure that laws, once adopted, are enforced.

FINANCIAL RESOURCES

The only appropriate use for many land parcels is to be retained in a natural state, and often the only way of assuring that is through purchase either of the land or of the development rights to the land. Either requires substantial up front financial resources, while the benefits will accrue only over many years. Even regulation has public costs: costs for competent drafting, and costs for careful administration, which means not only enforcement, but also assisting developers to meet community expectations. Resource protection sometimes also calls for funding of public construction, such as public sewers to abate pollution. Resource management, as discussed before, calls for planners, conservation agents, and other professional support, all requiring financial resources.

Proposition 2 1/2 is no less severe for towns on Cape Cod than for those elsewhere, sharply curtailing community ability to finance vital resource management efforts. For that reason adoption of a land transfer tax for Barnstable County is crucial to expanding the public capacity for resource protection. If state enabling legislation is passed, such a tax would apply to land sales over $50,000 in those towns which choose to apply it. At suggested rates, such a tax could raise from $1 million to $5 million dollars per year for all of Cape Cod, dedicated to open space preservation. That isn't a huge sum in relation to the cost of land, but by borrowing against future revenues from that source and using it to gain state and federal assistance, the potential for early action becomes large. Coupled with a carefully designed plan for strategic use of those financial resources, a land transfer tax could allow timely acquisition <u>now</u> while key parcels

are still there to be acquired. In addition, existence of that funding would probably be catalytic in spurring communities to do realistic action-oriented planning to make sound use of those resources.

Public costs of regulation are actually relatively small, but politically vulnerable. An adequate system of fees, however, can assure that those costs are borne by the development which occasions them. By national norms, building and development fees on Cape Cod are miniscule. Raised to a level reflecting real costs, including the costs of professional staff, fees can readily support a fully competent development management program.

Similarly, there is no reason why present residents need subsidize utility services for new development, but that is the current practice, with connection fees which fail to recover each development's fair share of capital investment in system facilities. Again, fee reform could equitably redistribute costs and help assure financial adequacy.

Finally, users should support the full costs of resources they use. That practice is not only equitable, it also improves resource allocation. Water use fees ought to cover all costs, including system capital costs and the costs of protecting aquifer zones through acquisition of protective areas. Those increased use charges would help constrain profligate use of a limited resource, as well as put costs where they belong.

B. An APCC Action Agenda

The dangers of growth controlled only as at present are finally being widely recognized across the Cape, and this report will both help clarify the nature of the Cape's growth and help spread that recognition. Beyond that, there is a need for explicit action.

Action is needed by the state and by the towns. APCC will press for needed state legislation, especially that authorizing a land transfer tax and that creating a real Barnstable County government. APCC will monitor and continue to oppose state actions, often proposed, which would limit local freedom to adopt locally designed health, wetland, and other controls more effective for Cape Cod than statewide "minimum" regulations.

A community checklist has been designed for evaluating the adequacy of local efforts to manage growth. We will seek to help community leaders in each of the Cape's 15 towns to hold "Growth Workshops". At those workshops, participants will review each town's status on that checklist, and press for remedial actions, with the promise of full support from APCC for carrying out needed efforts.

Finally, APCC will seek every available forum to publicize the central message of this study. Massive growth will continue but can be managed for the benefit of Cape Codders if we will muster the effort

to make difficult choices which reject indiscriminate growth powered only by profit, and if we consistently select a caring development future which serves community needs as well as private ones.

II. NATURAL RESOURCE PROTECTION ON CAPE COD

INTRODUCTION

A map in the Coastal Zone Management (CZM) office in Barnstable shows us that the entire Cape is designated a Coastal Zone. In the continental sense, it most certainly is. But in order to understand the Cape's current problems along its shoreline, the processes at work, why the Cape looks and acts the way it does, and presents us with joys and frustrations, it is necessary to go back to the beginning.

That was a very long time ago, and the end of the story is not yet in sight. The characters in this long and fascinating story have names such as Pleistocene Epoch and Wisconsin Stage, glacial till, glacial erratics, moraines, and many more. The vibrancy and excitement of this story belie the millions of years in the making of it.

What is Cape Cod? You will get one answer from the bird watcher, another from the summer tourist stuck in the car bumper-to-bumper on Route 6, still another from the wind surfer, the artist, the baker, the candlestick maker.

But it is the geologist's answer we are seeking here. What is the Cape made of and how did it get here? For the geologist the clues are everywhere: in front and back of the dunes, in the tidal creeks, ponds, in the pebbles, sand, and rocks. Measured by geological time, Cape Cod is very young indeed; in the geological drama, the curtain has only just gone up. For the rest of us who count our time somewhere between the butterfly's moment and the geologist's epochs, we can (loosely speaking) skip many years and begin our story about fifty thousand years ago, at the time of the final Ice Age, commonly known as the Wisconsin Stage. By that time the vast ice sheet which had originated in Labrador covered much of the North American continent. By then, these ice sheets had, so to speak, "gone as far as they could go." Thousands of years in the making, they remained for thousands more, concealing under their icy sheets what they had dislodged and brought with them on their journey from the North. Once they began to spread and move, these great ice sheets acted as a vast continental sculptor.

Before the ice invasions of the Wisconsin Stage, between fifty and seventy thousand years ago, Cape Cod did not exist, for the present Cape Cod is the top of one of several large piles of sand, gravel, and clay that were dumped along the East Coast more than ten thousand years ago by the last Ice Age. After the last of the ice melted away, the mineral debris that had been plucked and gorged and wrenched free by the glacier as it moved along revealed that the ancient sculptor had created a most impressive piece of work -- the string of rolling hills along the Cape's backbone, which the geologist calls a moraine.

Building, moving, dredging, and melting are all part of the glacier's story -- the building up of ice and its melting down. The ice sheets would not have formed as they did had it not been for the ocean; large

amounts of ocean water were held in storage by them. This borrowing of ocean water by the glacier meant that during the Ice Ages there was a lowering of sea level.

Rather abruptly (if we adopt the geologist's time frame), about fifteen thousand years ago, there was a global warming trend. The melting outpaced glacial construction and, in the end, the ocean received back the water taken by the glaciers. Pond water filled the depressions formed by giant blocks of ice that had been buried deep in the mineral debris. These are the Cape's kettle ponds, almost five hundred of them -- "enough, Cape Codders say, to drown every gossip in," as Dorothy Sterling reports in her book, The Outer Lands.

What the glaciers took from the ocean during their building boom, they returned. Ever since the end of the last Ice Age the sea level has been rising; Cape Cod, composed of what the glacier brought with it, is being gradually but steadily submerged by the rising sea level. Records produced by the tide recorders located at east coast harbors show that during the twentieth century the relative sea level has been rising at an average rate of about one foot each century. How does this translate into land loss along the coasts? We can put it this way: A one foot rise in sea level results in approximately a one percent decrease in the land area of Cape Cod. This does not sound too alarming, not much to worry about, but this arithmetic is only part of the story. This estimate does not take into account the additional losses resulting from erosion of exposed coastal land by wave action. Wave erosion produces an average coastal retreat of three feet each year along the cliffed section of the Cape's most exposed east coast, and lesser but still significant retreat along the Cape Cod Bay, Buzzards Bay, Vineyard Sound, and Nantucket Sound shores.

All is not lost, of course, when the coastal banks and dunes are eroded by wave action. Some of the sediment supplied by the erosive process joins the littoral system (sediment transported along the shore by waves) and is deposited again in the form of other beaches and dunes. Shakespeare surely did not have the ocean in mind when he wrote, "Neither a borrower nor a lender be," for at almost any given moment, like some giant financier, it is both.

The beaches, themselves, the product of erosion, are constantly created and recreated, doing the ocean's bidding; the work of the ocean, in turn, takes its instruction from the wind that forms the waves.

The beach, its sands always shifting by this orchestration of wind and wave, so delightful to the beachcomber, the swimmer, to the eye and heart, serves a purpose: the beach buffers the zones behind it from wave action, and some beaches, the barrier beaches, are especially prized by Cape Codders because of the waters, wetlands, shellfish and wildlife habitats that they protect.

Despite the moodiness and caprices of the wind and sea, nature's zoning laws work remarkably well, and it is helpful to think of the Cape divided into several ecological zones. On the outer, ocean-

facing coast, the first such zone is the beach itself, vital to the natural protection of all that lies behind it. The beach's sloping contour and slight angle to the surf makes it uniquely suited to absorb and dissipate the energy of the incoming waves. Coastal ecologist Tom Cross points out that with the dunes behind, "the beach constitutes an intricate sand-sharing system: The dunes provide a reservoir of sand to replenish and sustain the beach's natural contour as sand and nutrient material move to offshore sandbars." Aided by the littoral drift, the beaches have established a remarkable modus vivendi with the sea. In case the sea acts up (and it frequently does), the seaside vegetation stands ready. The salt tolerant plants simply bend their heads when the sea, following its own laws, washes over them. This overwash, Cross writes, is nature's way of "rolling with the punches" to avoid the head-on force of the storm. An added advantage is that this overwash allows sand to accumulate in areas it does not ordinarily reach, and it provides nutrients for the plant life.

All of the forces that result in the shifting of sand, the tearing away of the dune's face, the winter storm waves that reach beyond the beaches -- this seeming willy-nilly accommodation of one force to another, have managed to establish ecological zones that work well. Equally important, nature's efforts to maintain these zones are vital to the food chain itself.

The zone that borders on the bay is the baybeach zone. The baybeach is also one of sloping elevation; at the top the upland with its pitch pines, beach plum, and other low lying bushes, slopes gradually downward to the marsh grasses, the marsh itself, and the tidal flats, twice daily flooded over by the sea. Here an incredible variety of marine life lives and breeds and is protected.

All who live and work and visit on Cape Cod do so at the sufferance of the sea. We might be wise to look to the plant and animal life whose accommodation to each other and the sea is nothing short of a natural marvel. This accommodation was hundreds of millions of years in the making. How are we doing? <u>What</u> are we doing (or <u>not</u> doing) to accommodate ourselves to the natural forces and rhythms already so long established and upon whose continuation the Cape's life and our own depend?

A. COASTAL ZONE MANAGEMENT

The Coastal Zone Management Act became public law on October 27, 1972 (PL 92-583). It is presently administered by the U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Ocean and Coastal Resource Management. Through the Act, Congress made it national policy to "...preserve, protect, develop and where possible to restore or enhance, the resources of the nation's coastal zone for this and succeeding generations".

It further encouraged states to establish management programs that would: protect the nation's natural resources, properly manage coastal development, give priority to coastally dependent uses, provide for public access to the shore, improve ports and harbors, coordinate and simplify procedures for coastal resource management decision making, support comprehensive environmental planning, encourage the preparation of special area management plans for significant natural resources and encourage the participation of state, regional and local governments and citizens in managing the nation's 95,429 miles of shoreline.

Initiated as a voluntary program, Coastal Zone Management (CZM) offered coastal states two incentives for preparing and implementing their own plans in order to carry out the Act on the state level. The first was direct federal financial assistance in the form of grants, one-third of which were to be directed to coastal cities and towns.

The second incentive was the federal consistency provision which emphasized state and federal cooperation and coordination of coastal development at all levels. Once a state's CZM program is accepted by the Secretary of Commerce, all federal activities that "directly affect" a state's designated coastal zone must be consistent "to the maximum extent practicable" with the state's approved CZM program. There are presently twenty-four states and five territories with approved programs.

Desiring no new levels of bureaucracy and increased regulations, the Commonwealth of Massachusetts during the 1970s revamped several of its already existing environmental laws and networked its environmental agencies to work in cooperation with a Coastal Zone Management Program within the Executive Office of Environmental Affairs (EOEA). The core of the Massachusetts CZM Program is twenty-seven coastal policies, thirteen of which have their basis in already existing regulatory law. The Massachusetts Coastal Zone Management Plan was accepted by the U.S. Department of Commerce on April 27, 1978.

After five years of successful operation, Governor Michael Dukakis in 1983 signed the Coastal Protection Bill (ch. 589) which, among other things, established the CZM program as a statutory office within EOEA. Thus, regardless of federal funding, Massachusetts is guaranteed a permanent ability to review federal activities directly affecting the Commonwealth's coastal zone.

The challenges facing Coastal Zone Management, as the nation prepares for reauthorization of the Act in 1985, are critical. Vital on the federal level is federal financial participation in the CZM Program. A priority for those who desire a strong CZM program is to preserve the integrity of the Outer Continental Shelf Revenue Sharing bill, which allots a percentage of all OCS revenues paid to the U.S. Treasury by the oil and gas industry to coastal states in the form of block grants, subject to the appropriations process. The present Administration is opposed to the legislation and all federal funding for the national CZM Program, so eventual enactment of an OCS revenue sharing law to fund ocean and coastal resource management efforts is in question.

The other major hurdle for CZM on the federal level is the preservation of the consistency review as the federal government seeks to exempt offshore oil and gas leasing from CZM regulations. Protection of the consistency provisions will be part of the battle for reauthorization of the CZM Act in 1985.

On the state level, the Massachusetts CZM office is concentrating its efforts on the identification of and cleaning up of polluted marine waters in the commercial and industrial ports of Boston and New Bedford, and the acquisition and improvement of public access to the coast. The Coastal Facilities Improvement Program makes matching funds available to local communities for purchase or improvement of piers and harbor facilities and for open space.

Nowhere is CZM's role in protecting Georges Bank more important than on the Cape and Islands. This one-half billion dollar a year fishery has been continually threatened by U.S. Department of the Interior's attempts to lease the fertile fishing grounds to allow for the exploration of uncertain amounts of oil and gas. The Government and industry in partnership remain committed to drilling in the North Atlantic as the Interior Department prepares its new Five Year Plan and Lease Sale No. 96, scheduled for February 1986.

Although state and federal law have significantly increased protection over the nation's environment since the early 1970s, towns on the Cape should not come to rely completely on the law, regulations and technical assistance offered by outside agencies. State and federal law offer communities minimum standards of protection over their environment. It is up to towns themselves to take that protection a step further and mold it to the Cape's own unique circumstances.

Although the Department of Environmental Quality Engineering (DEQE) and CZM are frequently cited as the important state and federal regulatory agencies for the Cape, the Massachusetts Environmental Protection Agency (MEPA), the U.S. Army Corps of Engineers and the State Department of Environmental Management (DEM) also serve as protective overseers.

MEPA acts as an informational coordinator between state agencies whenever state monies or state (DEQE) permits are involved. The MEPA unit reviews specified projects for the Secretary of Environmental Affairs, identifying the environmental concerns and recommending

information which should be required of the project proponent in an Environmental Impact Report. Project review/on-site inspection by this agency is most frequently triggered by DEQE wetland appeals, applications to the state DPW for curb cuts to state highways, DEQE Water Pollution Control Permits, and state-funded projects such as housing or septage facilities design.

The U.S. Army Corps of Engineers under the Clean Waters Act and Navigable Waters Act issues license permits for dredging or filling activities for tidal and great pond waters of the Commonwealth. Corps jurisdiction extends to such coastal activities as piers, floats, revetments and bulkheads.

The Department of Environmental Management previously controlled the coastal areas identified under the Wetlands Restriction program. That program is now administered by DEQE, while DEM still participates in the designation and administration of Areas of Critical Environmental Concern.

Since late 1983 the DEQE has taken over the administration and regulation of many of the federal Environmental Protection Agency (EPA) programs such as point source discharge permits and sewer permits. The recent designation of the Cape as a Sole Source Aquifer may once again increase the EPA's role.

All of these agencies have the potential to regulate or control any project of significant size or impact. It is up to the local citizenry to alert those agencies so the proper safeguards for environmental protection will be imposed.

B. COASTAL EROSION

Increasingly in the twentieth century, the rush for waterfront property and the sheer pressure of an expanding population have resulted in the development of our coastal areas and disturbance of our coastal ecosystems.

The lovely and fragile environment the Cape affords, so wondrously balanced, is threatened by the building boom of recent years. The zoning laws nature has instituted are critically threatened by the haphazard and inadequate human ones which have allowed construction on the edges of both sea and marsh. As houses are built on the edges of dunes and fragile wetlands, natural ecosystems are disturbed.

When houses are threatened by eroding beaches, their owners want to take measures to hold back the force of the sea. For some the answer is: build seawalls, groins, revetments, breakwaters; sometimes combinations of these various man-make devices. Coastal engineering firms have developed designs intended to be effective and appropriate for the various dune and beach conditions: zig-zag vertical structures, rip-rap (the use of loose stones instead of cement) and other designs whose purpose is to stop or alter the force of the waves.

Rising sea level and wave action are indeed powerful forces shaping the coast, but the rapid increase in the building of these man-made structures is disturbing to physical oceanographer Graham Giese. The walls lead to major disruption; adjusting one small part of the shoreline by building a wall or groin throws other parts of the coastline out of balance. Seawalls may slow down the erosion problems at a particular place - but only in the short run. Eventually they spell trouble. The structures prohibit the waves from taking their natural course, from digging into the dunes and distributing sand along the coast; often such structures cause waves to increase their scour. Thrown against a seawall for example, the waves are reflected and returning seaward, collide with incoming waves. The resulting turbulence scours the shallow ocean floor at the base of the structure, digging in at the sand and carrying it off. To make matters worse, the beaches, banks and dunes at either end of the wall bear part of the brunt of the waves' accommodation. An accelerated erosion sets in on the adjacent beaches. One seawall tends to beget another and another.

Coastal ecologists advise people who contemplate buying water front property and protecting it with seawalls to consider other alternatives. An obvious alternative is to buy inland; another is to plant beach grass or erect snow fences, or a combination of the two. Vegetation can be an effective and inexpensive way to deal with the work of the waves, to stabilize dunes and protect marshes. There are added benefits. A vegetated dune, unlike a seawall, is pleasing to the eye and attracts birds and small animals. While vegetation alone cannot handle an angry winter storm, neither can a seawall over many winters and many storms.

New regulations written in 1978 to implement the state's Wetlands Protection Act reflect the thinking of coastal ecologists. These regulations prohibit the placement of man-made erosion control devices to protect shorelines where building has occurred after 1978. And it is tougher now to gain permits for seawalls and other kinds of structures for houses built before 1978. Permits are supposed to be granted only after other measures, such as vegetation, have been tried and have failed.

Some homeowners who have a front row seat, not only on the sea but over the eroding process as well, are frustrated. So are some members of local conservation commissions. Commission members, charged to uphold the Wetland statutes and other conservation regulations on the one hand, and property owners' interests on the other, find themselves caught "between the devil and the deep blue sea."

Does all this mean that man-made devices to hold back the sea are never justified? The same coastal ecologists who urge alternatives to these man-made structures concede that there are situations that call for their construction. Examples include safe navigation in certain waters, access to certain wetland areas and beaches, and harbor protection. The important thing, say coastal ecologists, is to plan such structures according to the natural coastal processes at work and make adjustments to fit these natural processes. When disturbances must be made, careful study of the systems involved can go far to minimize the environmental impacts.

In order to do just that, coastal engineers have come up with design systems custom tailored for the particular situation and site. Yet no structure, ecologically suitable as it might be, is problem free. Seawalls and revetments which separate land from water interfere with the natural erosive process and are subject to scouring. Groins, those finger-like structures extending perpendicularly from the shore, interrupt the transport of littoral sediment (the material moved along the shoreline under the influence of waves and currents) when they are built to prevent erosion at one site. Breakwaters, placed offshore, will interfere with shoreline process if built too high; built too low, they will be ineffective. In addition, the material that fills in behind the breakwater, might, without that intervention, have ended up on someone else's beach where nature intended it to be.

Those who oppose the construction of seawalls and other structures do not do so out of disregard for reasonable measures taken to protect property built on the edges of coastal banks. But it must be emphasized that anyone who does build on the edge of the sea implicitly accepts the known risks to that property caused by nature's forces, wind and wave.

On the Cape, politics begins (not ends) at the water's edge. Understanding the natural processes at work here is every Cape Codder's responsibility, not just a matter for the geologist, the oceanographer, the coastal ecologist or the naturalist. Every property owner, vacationer - every citizen who serves on a local board or

commission must assume responsibility for learning (and understanding) these natural forces so that our human laws, regulations and codes can reflect them.

No matter how sound or unsound our own human environmental laws and policies are, the natural laws will continue to operate. No law or regulation or land use policy can ignore forever the natural facts of the matter: Cape Cod is diminishing as more people rush to come here. The sea continues to rise; the Cape to submerge. Nature, aggrieved just so long, seeks her own redress; not in hearings, or law courts, but her voices are heard, nonetheless - in the wind and wave, and in the end these voices will triumph.

> Surely your waste and your
> desolate places
> and your devastated land --
> surely now you will be too narrow
> for your inhabitants
> and those who swallowed you up
> will be far away...
>
> Isaiah

Perhaps we ought to listen more carefully to the words of the prophet Isaiah; they may have a special meaning for us on the Cape. All of us who inhabit this narrow land are charged with the responsibility of answering the question: When does growth and development cease work for the common good and, instead, promote the devastation Isaiah speaks of?

The Tragedy of the Commons teaches us that we cannot be sure which particular sheep added to the grazing herds spelled the end of the common pasture. Until the limit was reached, each man's profit was swelled by adding one more sheep to his herd. Until one day there was no grass. No grass, no commons, no living sheep, no profit. No one could say what particular sheep added to the common grazing ground caused the demise of all. In order to avoid the fate of the Commons, we must arm ourselves with the knowledge to determine just how many bulkheads, groins and revetments will one day be too much here for the delicate balance to sustain?

The geomorphologist, Arthur N. Strahler writes: "Through its whole extent, Cape Cod consists almost entirely of sand, gravel, silt, clay and boulders, with no solid bedrock whatsoever showing anywhere or even to be found at depths of many feet below the surface."

Those of us who want to share this Cape with nature will have to form our own "bedrock" - sound management of growth.

C. HARBORS

This was the most completely maritime town that we were ever in. It was merely a good harbor, surrounded by land, dry if not firm, - an inhabited beach, whereon fishermen cured and stored their fish, without any back country.

- Henry Thoreau on Provincetown

Harbors are carved by nature and they assume definition only as they are discovered and used by mariners. They are to the seafaring world what depots and stations are to trains, what terminals are to truckers and busses, what parking lots are to downtown. Harbors are natural resources and their early character, to the extent character can be preserved, is an inherited resource. What we have to decide is what they shall become, because already their past is in conflict with the present.

Thoreau described Provincetown as a harbor surrounded by an inhabited beach. Considering the hundreds of fishing vessels that once sailed from that town and the shoreside employment that industry provided, it is little wonder that Provincetown then had the highest per capita income in the state. There was work for everyone in the middle of the last century and every dollar came first from the sea and was then multiplied in the town's economy. At one time there were more than fifty long wharfs to accommodate the fish business and today there are two. The character of the harbor has been altered. Forty or so powered trawlers have displaced the hundreds of sailboats and their modern efficiency has contributed to the decline of the fish stocks and the vast employment that industry once insured. This will forever be a fishing port, but we have to focus now on the rest of the harbor and ask what might become of it. Provincetown is asking itself that question right now. Other towns are now showing concern and need encouragement to do the same.

A harbor is first of all a place for boats to safely anchor and to conduct maritime commerce. Other than commercial fishing and support facilities, commerce in rural harbors today is limited mainly to recreational fishing and tourist excursions. We have substantial charter fleets, a number of head boats and whale watching vessels, and a few ferry terminals. It is hard to see the day when these needs and services will not exist, and yet it is easy to visualize a scenario in which the waterfront land needed to support these activities is bought by developers for high cost condominiums and other lucrative adventures. New England farmers sold to developers as the value of their land soared above the returns from agriculture. There is no reason to believe these same pressures will not be brought to bear upon those who do business along our harbors. When the harbor and the beach no longer nourish one another, harbors will lose their traditional character. They will be something else and the past will not be retrievable.

Part of our planning assignment is to guarantee that a sufficient segment of each harbor shoreline is preserved to support a myriad of recreational and commercial marine activities. Boatyards and off-loading piers, boat slips, launching ramps and supply stores - these are the kinds of indigenous harbor facilities that require protection forever. Both our resident and visiting public deserve walking access where they can come close to enjoy their fascination with boats and harbor activity, where they can come at dusk to appreciate a sense of quiet beauty before a setting sun.

Webster defines harbor as "a protected inlet, or branch of a sea, lake, etc., esp. one with port facilities." In other words, harbors come in all sizes. A river, the Bass River for example, may be a harbor and so also might the inlet of a tidal creek, such as Rock Harbor. It could be an estuary like Nauset Inlet. It is in these smaller places that traditional uses have been most severely tested and the challenges come from neighbors, homeowners, some of whom have harrassed or successfully curtailed certain activities that commercial fishermen consider essential to their livelihood. Maybe their trucks are found objectionable, or their use of the beach. Maybe they are denied the right to have a loading dock, even on public property. Actions against rural fishermen have increased substantially in the past decade as more and more neighborhood associations organize. Protecting the ancient and traditional rights of fishermen in these places will require careful zoning and/or legislation, thoughtful enough also to protect towns against frequent and excessive court costs. Slowly and painfully the character and first purposes of these harbors and anchorages are changing under pressure. Our most ancient native industry is threatened.

But its major threat, recreational boating, is also important to a growing number of Cape Codders and to the tourist trade essential to the livelihood of other Cape Codders. The pressure for dock and mooring space of all kinds continues to rise, and responses come from both towns and individuals developing marinas, service docks and mooring systems. Each permitted wharf from a harbor shore may encroach upon open mooring space. Too many moorings may make entering and leaving a harbor difficult and dangerous. Excessive fees for slip rentals and moorings tend inevitably to favor a boating elite who can afford the fees.

It is clear that the orderly further evolution of our harbors must be regulated and controlled in a manner fair to all; - pleasure boats, fishermen and other commercial boating. Each harbor has unique characteristics, however, and where one may be ideally suited for marine development, another may preferably encourage launching areas, skiff docks and moorings, or a third may warrant unique protection of fishermen's docks and processing areas. The necessary controls must come through local harbor zoning ordinances, guided by State and Federal statutes and responsive to them. We are opposed to any Cape-wide blanket harbor zoning provisions and believe that town Planning Boards should be the major focus of harbor zoning control, giving balanced consideration to the conflicting desires of their various local users.

The development and management of marinas by the Towns themselves may be a reasonable approach to providing harbor boating facilities. These must be managed, however, in such a way as to provide well maintained and protected docking space equitably allotted and at fair prices. It is reasonable in such cases to have the users bear the costs rather than the non-using taxpayers.

Adequate dredging of shallow harbor entrances is an important factor in the safe and convenient use of our harbors. Towns should ensure that this is carried out on a regular and cost effective basis, using

State and Federal aid wherever possible. Advance planning and careful contract procedures are necessary, however, in order to avoid problems such as the present impasse over dredging the entrance to Bass River.

Pollution is always a threat to our waterways and especially to shellfish beds. The Commonwealth appointed its first coastal warden in 1929 and he was assigned to Cape Cod. Our major harbors were badly contaminated and regulation of shellfishing was essential. In those days, household septage flowing directly into the harbors was the unquestioned cause. Over the years the harbors became cleaner, but again we are witnessing the closure of one bed after another. The reversal is sometimes blamed on domesticated waterfowl, sometimes it is septic saturation of surrounding land where overbuilding has occurred, and often the fault lies with run-off from storm drains and nearby asphalt areas. The problem of too much asphalt is causing major crises throughout the Northeast. Cape Cod is not immune. Even we have too much asphalt. Our zoning codes require more parking than is sometimes necessary. Developers are encouraged to use asphalt. Large asphalt parking areas at public beaches and town landings and next to our harbors are all contributors to the pollution problem. We need alternative areas that do not resist natural drainage.

Boats can be a source of pollution. Automatic bilge pumps and minor fueling spills can put an oily sheen on the water's surface. Boat toilets do not always have holding tanks. But significant progress has been made. Owners have become better educated and rarely would they knowingly foul their own nest. Outboards no longer require as much oil in the fuel mix as they once did. New Coast Guard regulations dealing with oil pollution and marine toilets have helped measurably. Perhaps the most serious problem with boats today comes simply from the multiplication of their numbers.

There is no end to the demand for more boat slips in all harbors. Recreational boating is big business in this country and there are thousands of potential boat buyers who can do nothing but wait until they have a slip. We could cover every square inch of water surface in our harbors with boat slips and the demand might still be as great for more. It may be that we have to think of an end to expansion of such facilities. The discussion should at least take place.

Each of our harbors is unique in its natural design and its historic character. Our examination of protective possibilities must be approached with a sensitive commitment to preserve the individuality of each.

D. Freshwater and Saltwater Bodies

Often the objectives of lake eutrophication control are framed in technical terms such as algae control, reduction of nutrient concentrations and aquatic nuisance weed control. Socioeconomic factors such as maintenance of shoreline property values and recreational attractiveness, however, are likely to be the principal factors in motivating policies to insure the water quality of Cape Cod's salt and fresh ponds. The following case history exemplifies the existing and potential problems.

In the mid-1970s, a typical retirement couple decided to move to Cape Cod, intent upon purchasing a retirement home on a quiet 30 acre kettle pond in a secluded cove suitable for launching a small dinghy or sailboat to putter around the shore. The selected house was somewhat in want of minor repairs, so they launched into a major upgrading of the house, enlarging the dining room, installing bay windows and large sliding glass doors and a pretty patio to improve the view of the pond, also improving the outside landscaping by creating a long, bricked entryway highlighted by ground-hugging junipers in woodchip enclaves. During the warm summer months they enjoyed pushing their dinghy off the driveway launch area across the shallow sandy beach spit, created by a nearby stream, into the pond and rowing around the northern basin, occasionally going sailing in the central large southern basin which enjoyed a strong sea breeze in the afternoon.

In 1978, events outside their control began to impinge on the retirement paradise. A 40-acre parcel of land across from the property was sold to a developer, who planned to construct 91 clustered condominium units on the area. After extensive hearings and negotiations, the number was reduced to 62 units. The developer agreed to provide a 100-foot buffer along the border of the pond, hired a well-recognized engineering firm to design and supervise installation of septic disposal systems which strictly complied with the state's Title V environmental code, and made sure that erosion control through hay bale lines was used during construction. Construction began in 1979 and occupancy in 1980. The developer had no difficulty in selling the accommodations and considered the project to be a very successful venture.

During 1980, scattered regions of macrophytic vegetation (pond weeds) were present, usually comprised of *Ceratophylum demersium* (coontail), *Potamogeton crispus* (pond weed), *P. foliosus* (leafy pondweed), with the attached algae *Microsystis marina*, *Anabena sp.* and *Oscillatoria sp.* The patches did not interfere with rowing or sailing, but would break away from the bottom and drift through the basin.

However, in 1981 and 1982 a substantial increase in thickness and coverage occurred. Roughly one-third of the northern basin contained attached macrophytes which reached to the near-surface, often from depths of two meters or more. The thickness of the patches presented a noticeable obstruction to rowing, the weight of the vegetation mass clinging to the oars and interfering with forward progress. Similarly, centerboards had to be withdrawn to allow sailboats to pass through the masses of pond weeds. Fishing lures also required weedguards to avoid becoming snarled in the shoreline masses of vegetation.

Although the couple did not understand that the increased nutrient loading induced by the development had caused the changes, they did complain that the previously clear beach area now contained pond weeds, which stretched out over fifty feet into the pond, and would not allow them easily to launch the boat. In addition, during the late hot summer months, the water would turn a milky white color and emit a distinct septic odor if the wind suddenly churned the surface.

hearing in March, 1982, complaining about the continually deteriorating situation. To their dismay, even more property near the house was being considered for development, despite the existing condition of the waterfront. In 1983, fearing the loss of value of their property and feeling that the cost of remedies would be high and take a long time, they decided to sell their property and relocate.

Town planners, conservation commissions, developers, environmental engineers and scientists should reflect momentarily on what went wrong and why lake management is worthwhile. Traditionally, impacts of pond aging or eutrophication have been assessed on the basis of limnological considerations. Because of its technical and often complex nature, the limnology of a water body may be difficult - or unintelligible - to the public. The Cape Cod shoreline owner's perception of the benefits of water quality and eutrophication control is far more likely to focus on the water body as an extension of property ownership. The surface water body and its condition become an extension of the personal self-image, much like the model of car a person drives. Loss of control of the condition of the shoreline carries a psychological impact as well as a monetary one. The average shoreline owner, while vaguely appreciating the technical aspects of water pollution, probably assesses water quality most often on its aesthetic value (Gregor and Rast, 1980)[1].

On Cape Cod, the aesthetic benefits may be very tangible. The benefits of eutrophication control on kettle ponds would include:

1. Enhanced shorefront property values.
2. Enhanced recreational values.
3. Reduced need for costly last-resort control (sewering).

Omerod (1970)[2] considered the impact of algae-fouled beaches on property values along the Canadian shorefront of Lake Erie. He compared the real estate values (average value per foot of water frontage) for three classes of algae-fouling: 1) no algal cover; 2) light algal cover; and 3) heavy algal cover. Omerod found that combined light and heavy algal covered properties exhibited a 15 to 20 percent lower value than those on the shorefront areas with no algal cover.

Cape Cod has enjoyed a continuing climb in shoreline property values, particularly since the late 1970s when valuable property could be used as a hedge against inflation. Cape-wide an acre lot could be purchased for $1,000 in the 1940s, $2,000 in the 1950s, $7,000 in the 1960s, $15,000 in the 1970s and over $30,000 in the early 1980s. Market values for inland parcels have failed to show a similar increase. Interior land values have continued to increase, but at about half the value of shoreline property. An acre of land in the interior in the 1970s would have sold for about $7,500, around $15,000 in the early 1980s.

Cape Cod contains over 350 freshwater ponds, with 209 of those being Great Ponds of ten acres or more (CCPEDC/EPA, 1978). The classification of a pond as a Great Pond has many significant legal implications. All standing water bodies having an acreage in excess of 10 acres are classified as Great Ponds (Section 35 of Chapter 91 of the

General Laws) and are open to general public use unless restricted by special acts or considerations of the Legislature (McCann, 1969)[3]. The water of these ponds constitutes about 8 percent of the surface area of Cape Cod.

Generally, the enhanced value of property due to a water body is not limited to the shoreline lots, but extends to at least 1,000 feet from its shoreline. Residents within this region have convenient access, i.e. walking distance to the water or a water view. Their benefit is not as great as the immediate property owner's, but their dwellings or property command a price above that of interior land regions. If we take the total shoreline miles of the freshwater ponds (an estimated 0.6 miles for every 10 acre lake; 240 total miles of shoreline) times a 1,000 foot strip around the pond as the economic area of influence of the pond, about 45 square miles (approximately 30,000 acres) or about 12 percent of the Cape's land is economically influenced by shorelines, without even counting its traditionally valued saltwater areas.

If towns and homeowners neglect their pond areas, the prognosis will not be good. On Long Island the lakes and ponds in Nassau County, which has undergone urbanization, are presently eutrophic. This undesirable state is due chiefly to a large nutrient load compared to the small assimilative capacity (carrying capacity) of the lakes (LMS, 1982)[4]. Bringing a lake that has gone hyper-eutrophic back to mesotrophic (a level which can sustain sport fish and recreational uses) can be expensive:

Estimated costs of dredging:	$20,000 - $45,000/lake acre
Aeration systems:	
equipment	$790/lake acre
operating:	$1,500/year
Sewering recharge area:	$700,000/mile shoreline

The total cost of recuperation of the Cape Cod Great Ponds could run beyond 500 million dollars. The control of sources of nutrients which cause eutrophication represents an institutional problem as well as a scientific one. As has been pointed out by Peters and Krause (1979)[5], "Health departments rarely monitor the operation and effects of onsite systems. They normally address existing problems on a complaint basis only."

To maintain the property values which the ponds bring with them, it is going to be necessary to understand the factors which combine to determine their condition. A municipal management plan should include the following objectives:

1. Identify the "carrying capacity" of the water body. Each pond has a "carrying capacity" for development based upon its flushing rate and the nutrient loading from the adjacent land use.

2. Define the recharge area and runoff watershed for each water body. Understand the source and flow rate of the water which flows up into the pond through its lake bottom and into it during storm runoff events.

3. Through a sampling program, identify the current condition of the water body. This includes mapping the extent of shoreline vegetation, defining the clarity of the water, determining the concentrations of algae and nutrients in the water column.

4. Develop planning guidelines which estimate the ultimate amount of nutrients generated with different densities of land use and road drainage and their cumulative loading on the receiving waters.

5. Monitor the hydraulic and water quality condition of the pond at defined intervals, perhaps at least once every 5 years. As development occurs around a pond, increased vegetation, erosion and runoff causes plugging of the lake bottom, altering the carrying capacity of the pond. The initial guidelines may have to be revised at periodic intervals to correct for reduced flushing.

6. Identify the extent of breakthrough of phosphorus and nitrogen from septic systems at different distances from the shoreline. Recognizing that some regions in the recharge zones may have more rapid groundwater flow into the pond than others recommend changes in spetic system design and location to reduce groundwater loadings.

7. Avoid direct storm water drainage into surface waters. Where possible, plan to divert runoff into dry kettle holes outside recharge regions. Use multiple recharge catch basins to reduce direct runoff, silt and nutrient loadings to the pond.

The two largest towns on Cape Cod, Barnstable and Falmouth, have both begun to develop programs for pond management. The Barnstable Conservation Commission, with the aid of its conservation planner, progressively began to define the carrying capacities of its freshwater ponds, starting with Wequaquet Lake and working down in size. Falmouth has developed its own program for salt ponds and fresh ponds. In 1984 Falmouth's Town Meeting voted bylaws and the Planning Board adopted subdivison regulations which define guidelines for nutrient loading and require developers to adjust proposed plans if they exceed those guidelines.

Other towns on Cape Cod should follow the examples of Barnstable and Falmouth. The Cape Cod Planning and Economic Development Commission should develop a model bylaw for pond management, such as the ones done for groundwater protection. Towns should authorize matching funds to supplement the state's 301 monies for pond restoration.

Notes

[1] McGregor, D.J. & Rast, W., 1980. Benefits and Problems of Eutrophication Control. In: Restoration of Lakes and Inland Waters, EPA 440/5-81-010, U.S. EPA Office of Water Regulations and Standards.

[2] Omerod, T.K. 1970. Relationship Between Real Estate Values, Algae and Water Levels. Lake Erie Task Force, Department of Public Works, Ottawa, Ontario.

[3] McCann, James, 1969. Inventory of Ponds, Lakes and Reservoirs, Barnstable County, Mass. Water Resource Research Center, University of Massachusetts.

[4] LMS, 1982. Stream Flow Augmentation Study Within Nassau County Disposal District No. 2 and No. 3. Nassau County Department of Public Works, Mineola, New York.

[5] Peters and Krause, 1979. Decentralized Approaches to Rural Lake Wastewater Planning - Seven Case Studies - Individual Wastewater Systems, Ann Arbor Science, Ann Arbor, Michigan.

E. FRESHWATER WETLANDS, SALT MARSHES AND ESTUARIES

INTRODUCTION

There are many terms (none with much aesthetic appeal) in use to describe wetlands, including marsh, swamp, bog, pothole and wet meadow. Generally speaking, these are lowland areas which are covered to some degree with water during a good part of the year. Due to, and according to, the degree of wetness, the soils and vegetation are distinctive. Wetland plants must adapt to difficult growing conditions in order to survive.

Coastal wetlands are generally tidal, e.g. salt marshes, and may be described as estuarine if located in a region where fresh water meets salt water, e.g. rivers with a tidal pulse. Inland wetlands are generally freshwater in nature, and fed by flowing water or groundwater.

Although saltwater wetlands and freshwater wetlands perform many similar roles in their respective ecosystems, they are distinct enough to be described separately.

FRESHWATER WETLANDS

During recent years, coastal scientists have had some success in convincing citizens and policy-makers of the importance of salt marshes and estuaries. Their success in making a similar case for the freshwater wetlands has been markedly lower, the effort far more difficult.

Freshwater wetlands have for many generations been perceived as undesirable areas - stagnant, mucky, insect-infected, and unpleasant - places best used for filling or dumping. Their wildlife, including birds, turtles and fish, often go unappreciated.

Even less appreciated, invisible, and complex is the biochemistry which goes on in these waters. This chemistry is responsible for purifying the water which flows through these lands. One of the most important examples of this cleaning action is the breakdown or removal of nitrates, now known to be harmful to infants in concentrations as low as 20-30 ppm (EPA standard is 10 ppm.). Nitrates in our drinking water supplies pose a rapidly increasing problem since they are such an important component of the fertilizers which we tend to apply so liberally. Septic system leachate from on-site disposal systems is another source of nitrate contamination. In sandy soils such as those on the Cape, these dissolved salts tend to percolate rapidly away from the reach of plant roots and into the groundwater. We shall be depending upon our wetlands in ever greater measure to help to mitigate rising levels of nitrates in our drinking water. In wetlands, the water tends to move slowly through its heavy organic soils, gaining the time necessary for chemical reactions to occur as the groundwater is recharged.

Anaerobic wetlands soils (lacking oxygen) are also coming to be associated with effective absorption (withholding) of toxic heavy metals, phosphates, and some pesticides, thus removing or reducing their circulation and furthering the wetland's role of improving water quality. Clean water is a product of healthy wetland areas, a most important point to consider as we read daily of contaminated groundwater in a growing number of communities.

Cape Cod is not as subject to inland flooding as many areas of the country, but even here the freshwater wetlands play a very important role in holding and preserving excessive rainfall and ensuring its gradual release into the groundwater. In this way, water loss via excessive runoff is checked, retention enhanced, and the maintenance of a high water table made more likely.

Like their coastal counterparts, inland wetlands serve as critical wildlife habitats for which there is no substitute. There is no replacement for the food, nesting sites, and shelter provided by these areas. The stability and protection afforded in wetlands is crucial to the survival of many species, including waterfowl, many of which depend upon wetlands as a stop on their migration routes.

As we sacrifice our wetlands to other uses, we must expect to see diminished the roles and functions described here. Perhaps we may take heart in the fact that - at long last - the losses are beginning to be noticed. A recent report in Congress from the Office of Technology Assessment raises the alert that we are destroying more than 400,000 acres of freshwater wetlands nationwide each year.

Gradually, the word is getting out that these wetlands are not wastelands. As we learn more about the complexities of these important ecosystems, we hope we can produce better laws and regulations to preserve them. We had better not lose too much more time.

SALT MARSHES AND ESTUARIES

Salt marshes and estuaries are coastal features: they feel the pulse of the tides and mediate between the land and the sea. They represent that portion of the marine world closest to man's activities and are first to absorb the effects of those activities.

During most of the year on Cape Cod, salt marshes appear quite brown and dreary; to the casual observer, they would seem of dubious value. It is therefore not surprising that people have sought to replace them with what they have perceived to be more useful features, like buildings, harbors, marinas. Since World War II such efforts have cost the East Coast approximately 50% of its functional saltmarsh acreage. Only recently have biologists and other coastal scientists been able to make convincing arguments as to the importance of these ecosystems.

A Cape Cod salt marsh is a delicately balanced, productive, and protective ecosystem which is in turn dependent upon the protection of other coastal features. Marshes cannot by themselves sustain the assault of the open ocean, and are thus found tucked behind barrier

beaches, e.g. Sandy Neck, or along river banks of estuaries. They are noted for their remarkable Spartina grasses which dominate the stable habitat and support a complex and highly productive food web. An excerpt from Life and Death of the Salt Marsh by John and Mildred Teal (1969) best describes one aspect of this biological productivity:

> "Two thirds of the value of the commercial catch of fish and shellfish landed on the East Coast of the United States comes from species that live at least part of their life cycles in marshy estuaries."

What the salt marshes provide is the food and protection necessary for larval and juvenile marine organisms to reach a degree of maturity. The grasses prevent these tiny animals and their food supply (smaller plants and animals) being swept out to sea.

More than 25 years ago the Annual Report of the Atlantic States Marine Fisheries Commission (1958) stated, "As our knowledge of the biology of our major commercial and sport fishery resources grows, we are becoming more and more impressed with the significance of estuaries and inshore waters, from Maine to Florida, as breeding and nursery grounds for many of the most important species". It is now apparent that we must do much more than "become impressed". The plight of one of the most extraordinary marsh-estuaries in the world, the Chesapeake, has received wide publicity during the past year. Its condition is a clear warning to all of us that our coastal systems cannot be expected to continue to produce under the growing pressures which we are imposing upon them. The decline of striped bass and contamination of bluefish are merely the most obvious of the symptoms.

Salt marshes perform other functions important to coastal dwellers: they attenuate and absorb billions of gallons of water brought ashore by high tides, storm surges, winds, and related meteorological events. To see a salt marsh at work during a good storm is a sight to behold. In combination with a barrier beach (which intercepts heavy wave action) a salt marsh provides one of the most protective coastal systems known to man. It appears that salt marshes provide a significant barrier to water moving from the opposite direction as well, the groundwater emerging from our aquifer under the Cape. By virtue of the elevated salinity (density) and saturation of salt marsh peats, the seaward flow (loss) of our fresh water from the aquifer is impeded.

Salt marshes take up and accommodate significant contributions of domestic pollutants found in coastal runoff. Some of these, e.g. nitrates and phosphates, can act as fertilizers in reasonable concentrations, and bolster the overall productivity of the marsh. Others, such as potentially toxic heavy metals and some pesticides, appear to be sequestered to varying degrees by soils and plants (as in freshwater wetlands), and less is known about their cycling within the ecosystem. There is strong agreement, however, that salt marshes play a powerful role in maintaining the cleanliness of our coastal waters. Unfortunately, the evidence is growing that we are not doing well in looking after these waters. Fishermen report increasing percentages of foul-smelling, tumor-ridden fishes in their catches. Coastal com-

munities, in order to release more sewage into our coastal waters, are appealing for exemptions to the Massachusetts Ocean Sanctuary Act. Concerns have finally risen to the point where offshore dumping grounds (off Massachusetts and other New England states) are coming under increased scrutiny by the National Oceanic and Atmospheric Administration.

There is no question about the value of our salt marshes. We need them more than we have ever needed them before. To promote a caring attitude about them, our citizens need to understand the roles of these marvelous coastal systems. On Cape Cod, we are fortunate to have an especially fine coastal endowment which includes some 13,000 acres of salt marshes. But every year in every town, this acreage is being relentlessly reduced - bit by bit, acre by acre. We must find ways to preserve and protect what we have left.

SUMMARY AND RECOMMENDATIONS

In 1968 William Niering, Director of the Connecticut Arboretum, wrote, "Although the nation's marshes, swamps, and bogs are among the most productive landscapes in the world, these liquid assets have suffered greater destruction and abuse than any other natural habitat manipulated by man". Access to open water through wetlands should be strictly limited. Only one or two well-elevated walkways should be permitted for each subdivision.

Paradoxically, wetlands are at once both resilient and vulnerable. They can recover quite successfully from most natural disturbances, but their ability to survive man-made impacts is less certain. Draining, dredging, filling, and chemical pollution have proven overwhelming in their consequences. Wetlands are receiving increasingly toxic levels of sewage, pavement run-off, solid waste leachate, pesticides, and fertilizers. They are being constantly nibbled away by cumulative encroachments. It is estimated that we have reduced our wetland assets nationwide (not including Alaska) from more than 125 million acres to fewer than 70 million acres, and that this destruction continues at a rate of at least 1% per year. Towns should adopt bylaws of greater protective stringency than those of the Commonwealth, especially with regard to run-off and to distances from septic systems.

Recent data for Cape Cod (MacConnell, February 1984) show a heartwarming decrease in the acreage of wetlands being lost to development. The author credits the Wetlands Protection Act and the work of conservation commissions with this encouraging trend. However, we may not complacently assume that the pressures are deterred. While large tracts of wetland are thankfully more untouchable than they were 20 years ago, the nibbling at the edges continues as conservation commissions are required constantly to evaluate "significance" of impact. The cumulative effect of dozens of small projects deemed less than significant seems never to be assessed. Conservation commissions should keep records of losses from wetland acreage, regardless of size.

Another concern under the recently revised wetlands regulations, is the acceptance of compensatory wetlands as a substitute for established wetlands slated for sacrifice. Such contrived wetlands may store flood waters to an acceptable degree, but we should not naively assume that we can recreate the complex and productive ecosystem of a wetland which has developed over hundreds, perhaps thousands of years. In addition to sound drainage design, any compensatory wetlands proposal must be carefully evaluated for nutrient potential.

Although wildlife exists in all areas of the Cape, it is most abundant in estuaries, marshes and wetlands areas. Strengthening the protection of all state-listed endangered or threatened flora and fauna is a top priority. (See list on following page.) State-listed species should, within the Commonwealth, have the same status as federally-listed species. Another essential element is aggressive land management to assure that wildlife habitats are preserved. Finally, a thorough examination should be made of all open space or conservation land purchases to assure that critical habitat is protected.

As Cape Cod tries to accommodate more human beings than it has ever served before, we can expect the pressures to accelerate. Based upon our understanding of wetlands and their capacity to carry out particular physical, chemical, and biological functions, we must take effective action to save them -- in the long-term best interests of everyone. Damage to wetlands from man's activities can be prevented -- if we have the will to do so.

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RARE AND ENDANGERED SPECIES

Federally-listed Endangered Species

Reptiles: Atlantic Leatherback (*Dermochelys coriacia*) - Marine; migrant
Kemp's Ridley (*Lepidochelys kempi*) - Marine; migrant; summer resident
Atlantic Hawksbill (*Eretmochelys imbricata*) - Marine; migrant

Birds: Bald Eagle (*Haliaeetus leucocephalus*) - Coastal; migrant
Peregrine Falcon (*Falco peregrinus*) - Coastal; migrant
Eskimo Curlew (*Nunenius borealis*) - Coastal; migrant

Mammals: Right Whale (*Eubalaena glacialis*) - Marine; migrant (spring, fall); resident (winter)
Sei Whale (*Balaenoptera borealis*) - Marine
Blue Whale (*Balaenoptera musculus*) - Marine
Fin Whale (*Balaenoptera physalus*) - Marine; migrant; seasonal resident
Humpback Whale (*Megaptera novaeangliae*) - Marine; migrant; summer resident
Sperm Whale (*Physeter macroephalus*) - Marine

Federally-listed Threatened Species

Reptiles: Green Turtle (*Chelonia mydas mydas*) - Marine; migrant; summer resident
Loggerhead (*Caretta caretta caretta*) - Marine; migrant; summer resident

State-listed Rare Species

Fish: Atlantic Sturgeon (*Acipenser oxyrhynchus*) - Migratory marine populations; freshwater breeding populations undocumented for many years and probably extirpated.

Reptiles: Eastern Box Turtle (*Terrapene carolina carolina*) - Woodland
Northern Diamondback Terrapin (*Malaclemys terrapin terrapin*) - Saltmarsh; upland nester

Birds: Arctic Tern (*Sterna paradisaea*) - Migrant; barrier beach nester
Roseate Tern (*Sterna dougallii*) - Migrant; barrier beach nester
Northern Parula (*Parula americana*) - Migrant; remnant breeding population

Mammals: Gray Seal (*Halichoerus grypus*) - Migrant; winter resident

Plants: Slender Arrowhead (*Sagittaria teres*) - Freshwater beaches
Sea Lime Grass (*Elymus arenarius*) - Saltmarsh borders
Panic Grass (*Panicum commonsianum*) - Dry sandy clearings
Spike Rush (*Eleocharia melanocarpa*) - Freshwater beaches
Dwarf Umbrella Grass (*Fuirena pumila*) - Freshwater beaches
Golden Club (*Orontium aquiticum*) - Pond edge
Blue-eyed Grass (*Sisyrinchium arenicola*) - Sandy soil
Swamp Pink (*Arethusa bulbosa*) - Swamps
Post Oak (*Quercus stellata*) - Sandy barrens
Seabeach Knotweed (*Polygonum glaucum*) - Sandy beaches
Rich's Sea Blight (*Sueda richii*) - Saltmarshes
Thread-leaved Sundew (*Drosera filiformis*) - Sandy pond shores
Broom Crowberry (*Corema conradii*) - Moors and barrens

State-listed Rare Species (cont'd)

Common Persimmon (*Diospyros virginiana*) - Dry woods
Plymouth Gentian (*Sabatia kennedyana*) - Freshwater beaches
Butterfly-weed (*Asclepias tuberosa* - Sandy barrens
Two-flowered Bladderwort (*Utricularia biflora*) - Ponds

State-listed Local Species

Amphibians: Spotted Salamander (*Ambystoma maculatum*) - Temporary ponds; woodlands
Four-toed Salamander (*Hemidactylum scutatum*) - Bogs
Turtles: Spotted Turtle (*Clemmys guttata*) - Ponds
Birds: American Bittern (*Botaurus lentiginosus*) - Marsh; nester
Marsh Hawk (*Circus cyaneus*) - Migrant; grasslands; nester
Osprey (*Pandion haliaetus*) - Migrant; coastal nester
American Oystercatcher (*Haematopus palliatus*) - Migrant; barrier beach nester
Upland Sandpiper (*Bartramia longicauda*) - Migrant; grassland nester
Willet (*Catoptrophorus semipalmatus*) - Migrant; saltmarsh edge nester
Red Knot (*Calidris canutus*) - Migrant
Laughing Gull (*Larus atricilla*) - Migrant; barrier beach nester
Common Tern (*Sterna hirundo*) - Migrant; barrier beach nester
Barn Owl (*Tyto alba*) - Nester
Short-eared Owl (*Asio flammeus*) - Grassland nester
Purple Martin (*Progne subis*) - Migrant; nester
Grasshopper Sparrow (*Ammodramus savannarum*) - Grassland nester
Vesper Sparrow (*Pooecetes gramineus*) - Grassland nester

Of Special Concern - Cape Cod Breeding Birds Which Are Declining (in addition to state-listed species)

Black-crowned Night Heron (*Nycticorax nycticorax*) - Coastal thickets
Piping Plover (*Charadrius melodus*) - Barrier beach; may soon be federally-listed as endangered
Whip-poor-will (*Caprimulgus vociferus*) - Pine barren woodland nester
Eastern Bluebird (*Sialia sialia*) - Open field/grassland nester
Eastern Meadowlark (*Sturnella magna*) - Grassland nester

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F. The Wetlands Protection Act and Town Bylaws

The first significant step towards the conservation of wetlands in Massachusetts was the enactment of the Conservation Commission Act (MGL. Chapter 40 Section 8c) in 1957. This Act authorized the formation of conservation commissions in each state or city. The major emphasis of the Act was on the development of techniques for the acquisition of land that was deemed, for whatever reason, valuable to preserve in its natural state. Initially the regulation of land use was not a function of the conservation commissions. This function was yet to come. Later, two pieces of legislation, the Jones Act (MGL 130 section 27A 1963) entitled "An Act Providing for the Protection of the Coastal Wetlands of the Commonwealth", and the Hatch Act (MGL Chapter 131 Section 40 (1965) entitled "Protection of Floodplains, Seacoasts and Other Wetlands", were passed. Their main function was to alert a number of town agencies and the Department of Natural Resources (DNR) to projected development or other activities in coastal and inland wetland areas. Later this function of the DNR was taken over by the Department of Environmental Quality Engineering (DEQE), a division of the Office of Environmental Affairs. The Massachusetts Legislature initially believed that these statutes would protect an unsuspecting public from unscrupulous or unknowledgeable developers and likewise. ignorant home-owners from their own ignorance. These statutes became known as dry basement laws. Rarely, however, did they protect wetlands, contrary to the implication of their titles.

Inadequacies of this legislation led in 1972 to the combination of the two statutes into a single act, entitled "An Act Relative to the Protection of Wetlands", or more succinctly the Wetlands Act (MGL Chapter 131, Section 40 (1972). At the same time, the Jones Act was repealed. The primary administrative responsibility for the new Act was put into the hands of the municipalities, with conservation commissions chosen as the local vehicles for implementation.

On Cape Cod, because a state senator had been the primary sponsor of one of the original statutes (the Jones Act) and because of an awakening of public consciousness of the need to protect the Cape's water resources, the enforcement of the Wetlands Act was pursued with vigor and often with little regard to the actual working of the statute. In a relatively short time, shortcomings of the Wetlands Act became apparent. As a result, thanks to the efforts of the Massachusetts Association of Conservation Commissions in cooperation with various state agencies, regulations were devised and adopted. These regulations essentially changed a statute which initially was designed to protect people, into a statute for the protection of the environment. This change reflected a slow and steady realization that the protection of wetlands was more important than the protection of dry basements; the environment became more important than the people occupying it.

Reflecting an increased concern for the protection of wetlands, two acts, the Inland Wetlands Restriction Act (MGL. Chapter 131, Section 40A) (1976) and the Coastal Wetlands Restriction Act (MGL. Chapter 130, Section 105) (1976) were passed. Under the Department of Environmental Management both of these acts resulted in mapping of and

deed restrictions to a number of critical wetland areas. Generally the project was ineffective, partly due to bad mapping practices (lines on some maps were thick enough to represent 16 feet of land) and partly due to the fact that the existence of the restrictions was forgotten or ignored.

Both wetlands restriction programs are now administered by the Department of Environmental Quality Engineering (DEQE). When the coastal program was first implemented, only salt marshes were restricted, using the USGS topo maps. The methodology has now been updated with the use of ortho photographs, at a scale of 1:5000. In addition to salt marsh acreage, dunes and barrier beaches are now restricted. Those Cape towns that have had only salt marsh acreage restricted are Eastham, Orleans, and Truro. Those towns that have had salt marsh, dunes and their barrier beaches restricted are Barnstable, Bourne, Brewster, Chatham, Dennis, Falmouth, Harwich, Provincetown, Sandwich, Wellfleet, and Yarmouth. Bourne is the only Cape town to have both its coastal and inland wetlands restricted, using ortho photos. Mashpee has not had any wetland acreage restricted. All towns, with the exception of Mashpee, have been flown and ortho photos have been produced for them. Each restricted town has a set of maps delineating the restricted wetlands.

Many wetlands areas are not protected by the Wetlands Act. There are a dozen ways in which bordering wetlands can be altered, despite the Act and despite newer, tougher regulations: exemptions under the Act (agricultural, cranberry operations, mosquito control, aquaculture), emergencies, limited projects, 5,000 square feet (with replication), 500 square feet of finger-like projections, variances, overcoming the presumptions of significance, a special act of the legislature and areas not subject to jurisdiction under the new regulations, such as isolated depressions and intermittent streams. Many of these loopholes could be closed for critical resource areas through the restriction process.

The wetlands restriction program is an important land-use tool for Cape towns. Mashpee should petition to have its wetlands, both coastal and inland, restricted, and Eastham, Truro and Wellfleet should be re-restricted, using the ortho-photos. In addition, all the towns should consider having their inland wetlands restricted.

In 1981 an Executive Order was issued for the protection of barrier beaches. However, the Executive Order really serves only as an economic barrier. For instance, if the barrier beach/uplands dune area is wide enough to satisfy Board of Health sewage disposal requirements, and if certain assurances are supplied (technical and environmental information required for development, engineering design and construction practices to be followed), then development can take place under the present law and regulations. Money, patience and time are all that is necessary, and most developers have plenty of all these commodities.

From 1972 on, frequent minor amendments to the Wetlands Act were made, but substantive changes in the interpretation of the Act took place through the regulations which were designed to clarify and sharpen the

application of the Act. Regulations, once promulgated by the state environmental agency, became existing law. In 1978 fairly comprehensive regulations, largely prompted by the formation and funding of the CZM programs, were published by the DEQE, but these regulations still had inadequacies leading to a thorough review in 1983. Since the late 1970s Cape Cod conservation commissions have shown increasing concern for the importance of wetland protection, and recent records indicate that losses to wetland acreage have been sharply reduced during the past 8-10 years (MacConnell, Land Use Update for Cape Cod, February 1984).

One concern, however, which accompanies the 1983 revisions to the wetlands regulations, is that non-bordering wetlands and small inland ponds (less than 10,000 square feet) and their borders no longer fall under the jurisdiction of the Act (unless subject to flooding). This change is a part of a compromise which resulted in the removal of most of the Commonwealth's significant wetlands areas from the potential for development, while significantly reducing the regulation of upland adjacent to wetland areas.

In spite of the apparently extensive nature of the various state wetlands protection acts, there are continued problems with the protection of areas deemed valuable. For example, wildlife, wildlife habitats, recreation areas and areas that should be preserved for aesthetic reasons are not subject to protection under the existing state Wetlands Act and its regulations. Any attempts to do so would probably be promptly over-ruled by the DEQE. This has led municipalities to search for alternatives. The answer appears to be in the form of local wetlands-protection bylaws. Through these bylaws, clear authority can be created for the protection of these additional interests. Although local bylaws vary from town to town, their overall effect is to increase the regulatory power of a community beyond the limits of the statutes of the Commonwealth.

This brief overview gives some perspective for a more detailed examination of both the legislation and the regulations now in place, so that concrete recommendations for the improved protection of wetlands, open space, habitat areas and areas of aesthetic value can be made.

The Wetlands Protection Act, as interpreted by current regulations, addresses seven (7) specific interests: private or public water supply, groundwater supply, flood control, storm damage prevention, prevention of pollution, land containing shellfish, and fisheries. Regulated activities are dredging, filling, removing, or altering. The resource areas to be protected are any bank, freshwater wetland, coastal wetland, beach, dune, flat, marsh, or swamp bordering on the ocean, and any estuary, creek, river, stream, pond, or lake. Also subject to protection are any water bodies listed above, land subject to tidal action, land subject to coastal storm flowage and land subject to flooding.

The revised regulations in 1978 addressed only the sections dealing with coastal wetlands but they served as the model format for the subsequent 1983 revisions. These revisions clarified set standards and assisted local conservation commissions by providing valuable

working guidelines. The CZM program provided funding for such technical personnel as a coastal geologist and a coastal wetland specialist. These additional staff personnel were responsible for the advances to coastal wetland protection that have taken place since 1978.

In 1983 (general) regulations which contained details of procedures, presumptions, jurisdiction and purposes were revised to be more explicit, and the Freshwater or Inland Wetland Regulations, Section III, were rewritten. In addition, these revisions to the regulations were accompanied by improved forms for filing, both with the state and with the local conservation commission, for permits or determination requests for proposed work. The intent of these revisions was to detail the performance standards for work and the jurisdiction of the conservation commissions for freshwater wetlands in the same manner as had been done for the coastal wetlands in the 1978 revisions. Some modifications, particularly with regard to performance standards for work in or near a bordering vegetated wetland, became more strict in terms of enforcement, while some of the regulations relative to the 100 foot buffer zone became less restrictive. It should be recognized clearly that these modifications were made to "appease" specific interest groups. First, the most valuable wetland resource areas could be clearly identified and were to be protected "to the hilt". At the same time, project proponents were given some relief from what were perceived to be potentially "over-regulating" conservation commissions.

Other provisions of the revised regulations allow a property owner to construct or maintain reasonable access to his/her property. On the Cape this may have serious consequences. Before the new regulations were adopted, an access road across a salt marsh or bog to an upland parcel of land might have been successfully denied. However, now if it can be shown that the ONLY reasonable access is provided by such a road and other requirements can be met, e.g. compensatory provisions elsewhere on the property for lost wetland areas, then it may be possible to obtain the desired access and to develop the land. In any event, since a commission is still obligated to protect the interests of the Wetlands Act and the resource areas, it has the right to require enough detailed information on a project to evaluate and document its projected impact. It also has the right to demand that any proposed project within any resource area be supported by information derived from the best available technology. Orders of Conditions for the project by the conservation commission can be drafted without regard to the cost to the community as long as the commission's actions, policies and concerns are reasonable and authorized by statute. In summary, there is divided opinion about the 1983 regulations.

On Cape Cod, wetlands protection could be significantly improved by the drafting of reasonable and comprehensive application guidelines or regulations to be used in conjunction with the local laws. These guidelines should be as uniform as possible, and they should put the onus on the applicant for providing good baseline data.

Data provided to commissions should include:

1. Complete resource identification done on the basis of local and state definitions. This should include the labelling and mapping of vegetated and geomorphic resource areas, a written description of how the decisions about location and labelling were made, and a vegetative species list.

2. Topographic mapping by a registered land surveyor using as a base National Geodetic vertical datum, not an assumed datum. This is especially important in mapped flood zones where an assumed datum may show an area which actually floods as being above the flood elevation.

3. Relationship of the project to interests to be protected. This means supplying locus maps of the project on SCS soils maps, MacConnell's maps, DMF/CZM or local shellfish and fisheries maps, and maps supplied by the Massachusetts Natural Heritage Group showing habitat of rare and endangered species.

4. Engineering plans prepared by certified professionals, showing both existing and proposed features, especially final grading, which is commonly left off plans.

5. Other relevant studies prepared by qualified professionals, depending upon the specific project, such as drift studies by a coastal geologist for shoreline work.

Commissions also need to decide what it is they are protecting under the interests of wildlife habitat, recreation and aesthetics, if these interests appear in their bylaw.

A second type of decision that is problematic for wetlands regulators is how to take into account the pollution attenuation capability of wetlands. For example, siting septic systems far from an unvegetated pond edge is more important than locating them far from one with a wetlands edge, but this difference is often not recognized in decisions. Wetlands can also serve to buffer surface waters from the harmful effects of "urban" drainage flows but only within limits. A policy of making appropriate use of this cleansing capability could be beneficial but it is much more difficult to implement than a policy of blanket prohibition of drainage into wetlands because greater technical expertise and judgment is required.

The role of the local conservation commission is not an easy one. Gaining a thorough grasp of the detailed working of state and local laws pertaining to the protection of wetlands is a demanding requirement in itself. Then, there has to be understanding of how wetlands regulations mesh with other federal, state and local regulations. Large amounts of time, energy and knowledge are necessary to prepare adequate documentation for decisions that will be tight enough to withstand appeal to the DEOE or the courts. It is a regrettable fact that a developer with time, money, legal counsel and persistence can usually nullify the conservation commission's difficult decisions.

Conservation commissions' problems could be alleviated by having access to the advice of knowledgeable environmental experts and lawyers but most conservation commission budgets are hopelessly inadequate. There is no money to hire experts or even significant administrative help. Some local conservation commissions do not even have the ability to monitor work projects that they have approved. Regrettably the setting of Orders of Conditions is too commonly the end of the involvement in development projects by this key local body.

A lack of financial support is intimately tied to the attitude of local town officials and finance committees. In some towns these bodies not only do not supply any support, they are positively antagonistic to the work of their commission. A reversal of this attitude is a top priority if continued vigorous protection of wetlands is to be guaranteed. It is ironic that improving support for the commissions would probably be easier if commissions had assistance. Part-time commissioners who are struggling to meet decision deadlines do not have much opportunity to cultivate the support of other town officials or the general public.

G. WASTE DISPOSAL - SEWAGE AND SEPTAGE

ON-SITE SEWAGE DISPOSAL

Over 90 percent of Cape Cod's population disposes of its sewage through on-site disposal systems. Such systems include older cesspools and more current septic systems comprising separation tanks and leaching facilities.

The primary functions of the on-site disposal system are to preclude public health hazards (systems backing up to the surface of the ground) and to allow for the percolation of waste water through the system in a manner that results in as little contamination as possible to ground and/or surface waters. Although no passive on-site sewage disposal system completely removes all threats to water quality, it is widely recognized that the effectiveness of these on-site systems is directly proportional to the distance between the leaching facility and the groundwater, the types of soils through which the leachate is flowing and the capacity of the disposal system to separate liquids and solids.

The first and second criteria, the distance between the leaching facility and the groundwater and the types of soils in which the leaching facility is located, are obviously independent of the type of disposal system. However, the capacity of systems to separate solids and liquids is vastly different.

Cesspools (Figure 1) typically consist of nothing more than a perforated pit, located below existing grade, into which household sewage directly flows. Since there is no separation of liquids and solids, except by normal gravity, frequently the perforations become plugged with solids and the system fails. The cesspool becomes filled, and the system backs up, causing raw sewage to flow to the ground surface where it becomes a direct threat to public health. Once plugged, strong acids and organic solvents, both serious groundwater contaminants, are frequently used to clean out the facility.

Cesspools are characteristically associated with older structures as installation of this type of system has been prohibited since adoption of the State Environmental Code, Title V, in 1977. Before that date, there were no established criteria for the siting of cesspools, so many of them were, and are presently, installed too close to or actually into the water table. Such placement provides an easy path for the movement of many sewage contaminants into the groundwater.

Since 1977 new on-site sewage disposal systems must be designed at a minimum to the specifications of Title V. (Individual towns can enforce even stricter standards). The newer Title V systems include a primary separation tank to promote the separation of solids from the effluent prior to the flow of the wastewater to the leaching facility. (Figure 2.). Another requirement of Title V is a minimum of a four foot vertical distance between the bottom of the leaching facility and the highest observed groundwater elevation. The State Code also sets specified setback distances for septic systems from wetland resource areas.

While the past Title V systems provide for improved operation and more effective microbiological breakdown than cesspools, both types of systems fail to remove appreciable amounts of nitrate-nitrogen, a major by-product of human sewage and a prime threat to the quality of Cape Cod's aquifer. Nitrate-nitrogen moves readily from the system into and through the groundwater and is not removed as the effluent plume passes through soils. Long Island is now requiring in some instances denitrifying on-site sewage disposal systems, but it would appear that, to date, the most effective control of nitrate-nitrogen (and other contaminants that are not removed by percolation) comes through regulating population density, i.e., a strategy of prevention, not treatment.

Although it is important to recognize the limitations of even the best conventional on-site systems and plan accordingly, Title V systems are a distinct advance over the old cesspools.

EXISTING MUNICIPAL SEPTAGE DISPOSAL METHODS

Septage refers to those solids which accumulate in cesspools and septic systems and are periodically removed through pumping. With cesspools the pumping occurs as necessary; for septic systems preventive maintenance pumping once every 2 to 4 years is recommended depending upon the annual rate of dwelling occupancy. Septage haulers transport this material to municipal disposal facilities. On Cape Cod three types of facilities are currently used: 1) septage pits; 2) septage lagoons; and 3) septage treatment plants (see Figure 3).

Septage pits and lagoons offer little or no treatment of septic waste. These facilities basically consist of open unlined holes or series of holes dug into the ground. Both pits and lagoons operate by allowing the septage to settle for a period of time, causing the liquid and solid material to separate. The liquid effluent percolates through the soil, while the solids are retained.

Pits have a limited life span and once their capacity has been reached they are simply covered over and buried. Lagoons are somewhat more sophisticated than pits in that they incorporate sand filter beds to facilitate the percolation of the liquid effluent. Theoretically a larger volume of septage can be treated with a lagoon. Once the solids have dewatered sufficiently they may be physically removed and composted or buried in the landfill.

Water quality treatment provided by the lagoon system is not substantially different from that received in an open pit. Some anaerobic digestion occurs in the settling of septage, but generally very little treatment is provided. Some removal of bacteria, viruses, suspended and dissolved solids occurs after the effluent has percolated down through the sand beds, but many pollutants are not absorbed and are therefore a significant source of groundwater contamination.

Major drawbacks of septage pits and lagoons include: 1) uncertainty of groundwater quality protection; 2) odor problems; 3) possible vector problem (e.g. flies, rodents); 4) soil clogging from grease of

unsettled solids overflowing to percolation beds, which may prevent infiltration; and 5) poor stabilization of septage; (anaerobic digestion can only occur if bacteria have optimal environmental conditions). Low temperatures, grease, chemicals or detergents may upset the biological equilibrium, allowing little or no breakdown of solids to occur. Finally, poor settling and dewatering characteristics of septage may make lagoons difficult to dry out, rendering the resulting residue difficult to handle.

EXISTING MUNICIPAL WASTEWATER COLLECTION AND TREATMENT FACILITIES

Barnstable, Chatham and Falmouth have limited wastewater collection and treatment facilities. These facilities consist of sewers which transport wastewater from individual homes and businesses to central locations for secondary treatment. Secondary treatment consists of the removal of solids and biological digestion. These treatment plants do not remove appreciable amounts of nitrogen.

Barnstable and Chatham treated waters are discharged to the ground, whereas Falmouth currently uses an ocean outfall. Due to a state law (the Ocean Sanctuaries Act) it is unlikely that future outfalls will be permitted.

The discharges at Barnstable and Chatham have caused nitrogen contamination of groundwater at those sites. In the case of Chatham the disposal site is near and upgradient to an estuary, Cockle Cove Creek. Hence the groundwater discharges directly to the estuary and is not a source of drinking water. Estuarine ecosystems generally are able to utilize nutrients such as nitrogen without detrimental effects; however, coliform contamination of shellfish resources frequently occurs resulting in closure of these resource areas.

In Barnstable, however, the disposal site is inland and upgradient from lakes, ponds and possible drinking water supplies. Contaminated groundwater at this site flows southerly toward these freshwater resources and eventually discharges to Nantucket Sound. Hydrogeologic studies are currently underway to determine the extent of this groundwater contamination.

PRESENT AND FUTURE MUNICIPAL FUNDING PROGRAMS FOR 201 FACILITIES PLANNING

The Federal Clean Waters Act authorizes grants for the planning, design and construction of public wastewater treatment facilities under Section 201. To date, grants have been awarded to Barnstable, Bourne, Chatham, Falmouth, Orleans, Sandwich, Wellfleet and Yarmouth. Only three towns (Barnstable, Chatham and Falmouth) have proceeded to the construction phase. The town of Orleans is presently in the design phase, along with Brewster and Eastham. The three towns plan to share a septage treatment facility, which has been planned for a coastal site adjacent to a salt marsh. The town of Bourne is also currently in the design phase.

Actions at the federal level to reauthorize Section 201 funding indicate that the federal share of these projects, currently at 75 percent. is likely to drop to 55 percent. This will put a greater financial burden on municipalities to plan, design and construct treatment and disposal facilities. This fact. coupled with an apparent lack of support on the part of Cape Codders for capital intensive. technological solutions such as wastewater collection systems. indicates an increased need for preventive actions.

CONCLUSIONS AND RECOMMENDATIONS

The fifteen towns of Cape Cod need to address existing problems with sewage/septage disposal. Effective action will include the development of adequate septage treatment and disposal facilities for Bourne. Brewster, Dennis, Eastham, Harwich, Mashpee, Orleans, Sandwich, Truro, Wellfleet and Yarmouth. Proper on-site treatment programs including mandatory maintenance pumping, enforcement of existing regulations and standardization of health regulations on a Cape-wide basis are needed to insure the proper protection of water supplies and water resources.

Equally important is the prevention of future sewage disposal problems. Strict enforcement of regulations which require existing cesspool systems to be brought into compliance with Title V before any building or plumbing permits are issued for additions, remodeling or conversions is strongly recommended. Growth controls and careful planning may preclude the need for future sewers, as sewers become necessary only when the waste from development exceeds the carrying (or more correctly, disposal) capacity of the land. Sensitive areas where such capacities are low include recharge areas or zones of contribution to public supply wells, private wells and future water supplies, poorly flushed lakes, ponds and coastal embayments, and areas where existing soil characteristics inhibit adequate percolation. Appropriate bylaws and regulations must be developed, adopted and enforced to protect these areas. This will require the availability of more personnel, with greater expertise. to the Boards of Health, Conservation Commissions, Planning Boards and/or Natural Resource Departments.

If Cape Cod continues to be developed without the emplacement of adequate planning, zoning and health regulations and without adequate enforcement of these regulations, additional water resource contamination will occur. Elevated nitrate-nitrogen levels will force abandonment of drinking water supplies; lakes and ponds will experience accelerated rates of eutrophication; and coastal embayments will be closed for shellfishing, fishing and possibly swimming. Individuals with enough foresight, knowledge and perseverance must act now, while the opportunity still exists, to guide Cape Cod's growth so as not to exceed its natural capacity to assimilate wastes. The no action alternative is not attractive. It will mean either irreversible changes in environmental quality or painfully expensive future solutions.

Figure 1

TYPICAL CESSPOOL

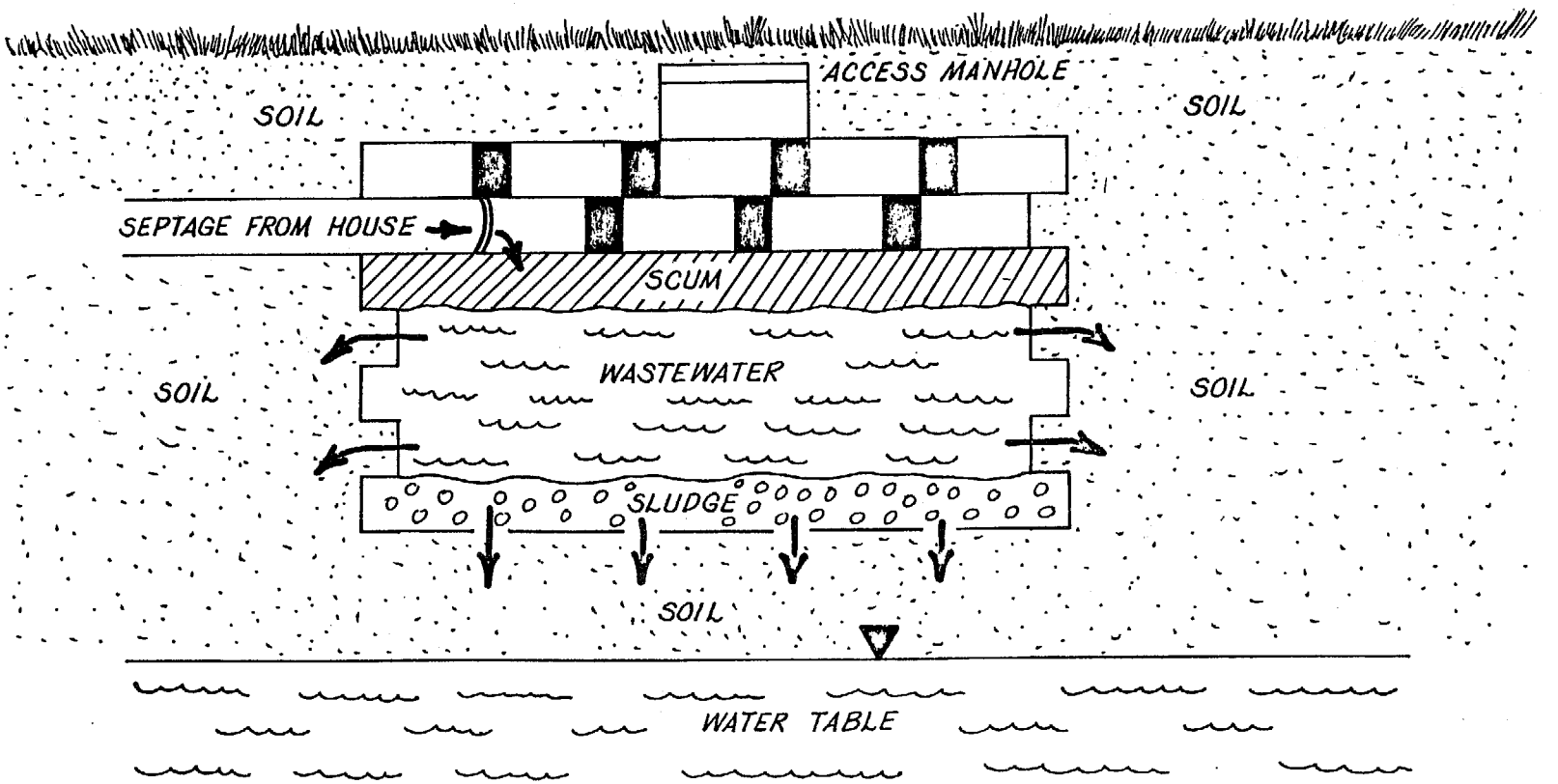


Figure 2

TYPICAL SEPTIC TANK & LEACHING FACILITY

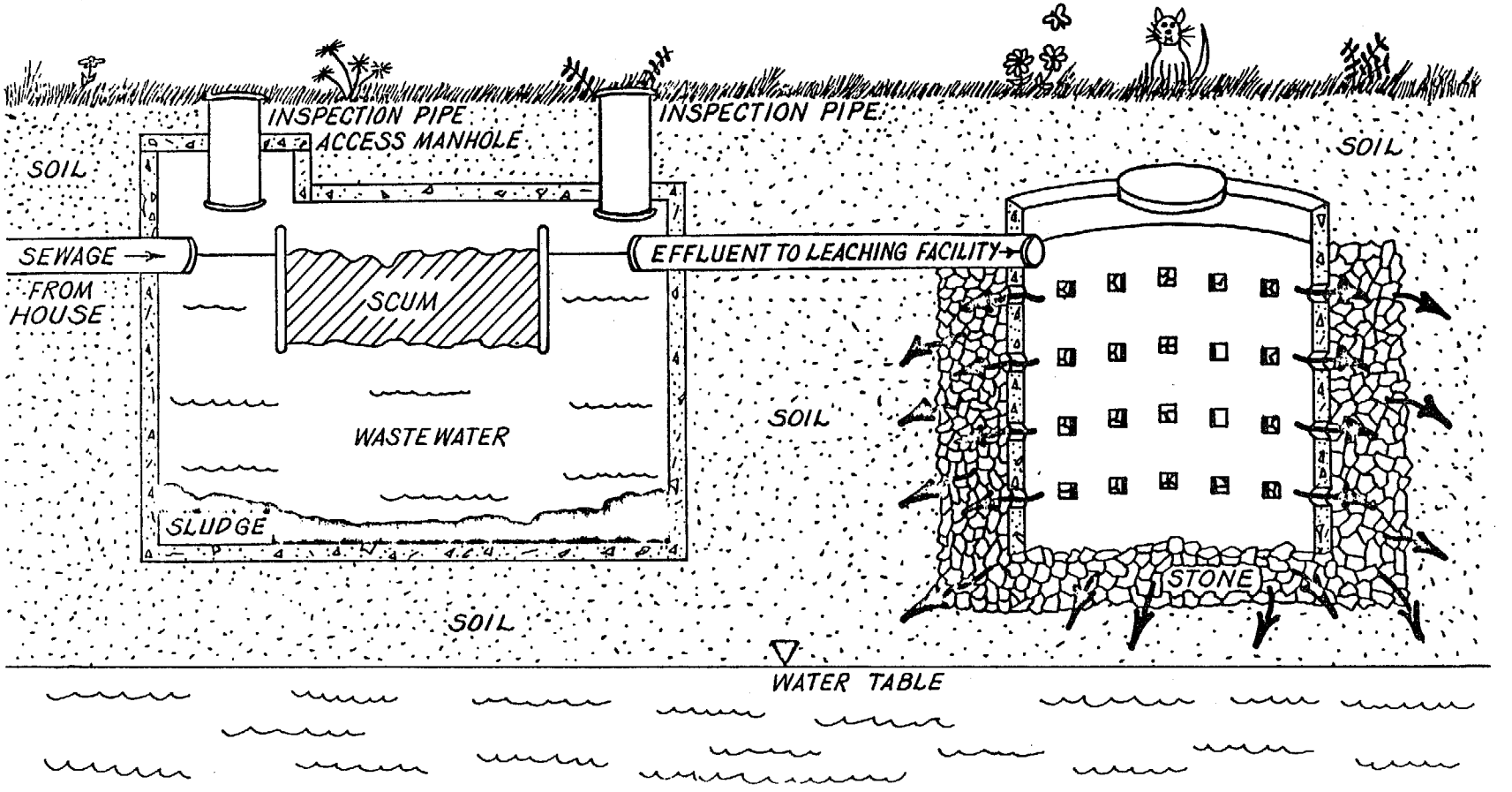
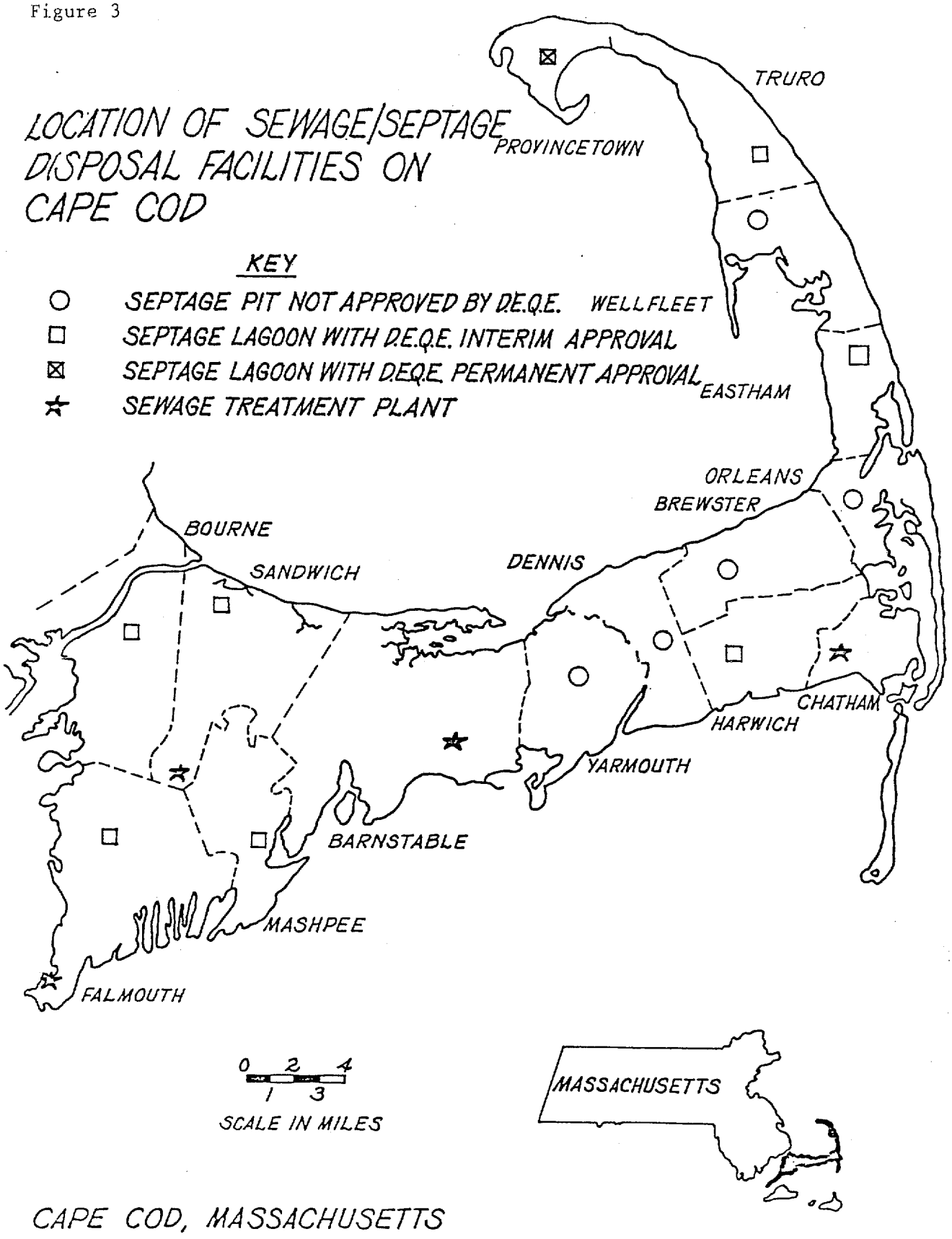


Figure 3



CAPE COD, MASSACHUSETTS

TABLE 1 SUMMARY OF ADOPTIONS OF 208 RECOMMENDATIONS

"208" Recommendations	Barnstable	Bourne	Brewster	Chatham	Dennis	Eastham	Falmouth	Harwich	Mashpee	Orleans	Provincetown	Sandwich	Truro	Wellfleet	Yarmouth
Health agent employed	x	x	x	x	x	(x)	x	(x)	x	x	x	(x)		(x)	x
Title V amendments enacted	x	x	x	x	x	x	x	x	x		x	x		x	x
Septage hauler regulations	x	x		x		x			x	x	x	x	x	x	x
On-site system files developed	x		x		x		x					x			x
Sanitary surveys conducted through 201's or other studies	x	x		x		x	x	x		x		x		x	x
Chemical cleaning agents banned	x	x			x		x		x					x	
Upgrading required: of failed systems:	x		x	x	x	x					x			x	x
of cesspools:	x		x		x	x				x	x				x
for alterations:	x	x	x		x	x			x	x	x			x	x
Financial aid available to low income residents															

(x) town building inspector serves as health agent.

Source: Cape Cod Planning and Economic Development Commission

H. HEALTH REGULATIONS TO PROTECT GROUND WATER

Groundwater contamination is a public health concern for many reasons. To begin with, since the drinking water supply on Cape Cod is essentially from ground water, large segments of the population can be exposed to harmful constituents present in the aquifer system. Infinitesimally small amounts of certain chemicals in groundwater, on the order of parts per billion, are considered to be a health threat. Unless comprehensive water quality monitoring is provided for or undertaken by communities, serious contamination can be present but remain undetected indefinitely. The public health effects of dissolved or dispersed pollutants in drinking water range from short-term acute response, such as blue baby syndrome (the result of ingesting elevated levels of nitrates) to development of chronic conditions, particularly cancer. Many chemicals identified in groundwater contamination incidents nationwide are known or suspected carcinogens.

Once groundwater contamination occurs, rehabilitation of the resource is extremely costly and frequently less effective than desired. By far the most advantageous method of dealing with groundwater degradation is to prevent it from occurring at all. The preventive approach is currently being exercised by local officials on Cape Cod.

While zoning has been a useful tool to govern land use and subsequent effects on the environment, its value is limited.[1] First, existing land uses are unaffected by zoning. Second, political problems can arise when upgraded zoning affects extensive areas of town and individuals perceive regulation of land use as a taking without just compensation. Finally, special permit granting authorities set up to pass judgment on variance applications may grant permits by subjective determinations based on political pressure or legal loopholes, rather than sound scientific and/or engineering documentation.

To augment the benefits of zoning, towns have turned to enactment of health requaltions on the local level. The health regulation approach avoids many of the problems of zoning while accomplishing some of the same goals. However, great care should be exercised in the adoption of these regulations to try to standardize them throughout the Cape and to make sure of their legal validity. Chapter 111, Section 31 of the Massachusetts General Laws confers tremendous authority on local boards of health to pass regulations deemed necessary to protect public health. Using this delegation of power, each of the 15 boards of health on Cape Cod has adopted various ordinances dealing with environmental protection for public health purposes. There follows a general summary of these laws, a discussion of their effectiveness, and an outline of future needs.

TOXIC AND HAZARDOUS MATERIALS HEALTH REGULATION

The 208 Water Quality Management Plan/EIS for Cape Cod recommended development of local health regulations aimed at groundwater protection. One of the model ordinances developed by the Cape Cod Planning and Economic Development Commission regulates toxic and hazardous materials at the local level. Over half of the Cape towns adopted the ordinance as either a bylaw or a health regulation. The two forms of

the law are similar and provide for management of virgin materials, an area generally ignored by state and federal regulations which deal primarily with large amounts of hazardous waste. While local ordinances can apply to large quantity waste disposal, they are usually concerned more with use, storage and disposal of amounts of toxic and hazardous materials not subject to state and federal regulations. The activities of smaller businesses which handle seemingly insignificant volumes of hazardous materials present a greater threat to Cape Cod's groundwater quality than the slim possibility of large-scale hazardous waste dumping. It should be noted, however, that most local regulations deal only with underground storage. Local regulations should be revised to include hazardous waste inventories and process discharges to septic systems.

Those local ordinances which do govern toxic and hazardous materials have two unique components: a registration requirement and an inspection process. All firms storing over threshold quantities of toxic and hazardous materials must file specific information with the Board of Health concerning handling of the compounds. The term "toxic and hazardous materials" has a broad definition so that listings are comprehensive. Once the Board of Health obtains registration forms, inspections of firms are conducted on a priority basis. The visits are meant not only to observe how materials are used, stored and disposed of, but also to answer questions and offer suggestions on optimal means of handling.

To date the most successful program has been conducted in Barnstable, where a staffed health department is adequate to the task of implementation. It is clear from that town's experience that other towns need resources in addition to public education about the threat of small quantities of toxic and hazardous materials to drinking water supplies. Most other towns that have adopted a toxic and hazardous ordinance lack the staff in their health departments to carry out meaningful implementation. Enforcement of groundwater protection strategies will require greater funding. One point of view is that inspection of and education about toxic and hazardous materials may best be handled on a county-wide basis through expertise hired as staff or consultants to the Barnstable County Health Department.

UNDERGROUND FUEL STORAGE TANK REGULATIONS

The leaking tank incident in Truro during 1978 provided effective impetus for almost all Cape towns to adopt health regulations for underground fuel storage tanks. Recognizing the threat of gross water supply contamination from hydrocarbon fuels and the exorbitant cost of clean-up, boards of health and/or local fire departments acted between 1979 and 1983 to devise storage and inspection regulations for hydrocarbon fuels. Three facets of the health regulation help minimize the potential of groundwater contamination from leaking tanks: 1) registration of underground storage tanks with the board of health and/or fire department; 2) inventory control and leak testing; and 3) regulation of new tank installations.

Table 2

SUMMARY OF LOCAL HEALTH REGULATIONS SUPPLEMENTING TITLE V

Parameters Governed By Title V	Minimum Distances From: a. well b. surface water supply c. water course d. drain e. downhill slope		Period of Year for Soil Test	Disposal Works Construction Permit Validity Period	Minimum Leaching Area-Design Flow Calculations	Septage Haulers Regulations
Title V Requirements	Septic Tank a. 50' b. 50' c. 25' d. 25' e. 150'x slope	Leaching Facility a. 100' b. 100' c. 50' d. 25' e. 150'x slope	Any time of year	2 years	Required area varies with percolation rate-110 gal/bedrm/day design flow	Not specified
Barnstable 5~17~83	c. 100'	a. 150' c. 100'	Any time of year USGS Guideline*		400 sq.ft. minimum leaching area.	Licensed hauler required to use septage treatment facility and are prohibited from using septic system cleaners
Bourne 10~27~82	c. 100'	c. 100'				Licensed septage haulers shall report name, address, date and type of system service prior to disposal
Brewster 7~28~81		c. 100' d. 100'				Septage hauler must submit special septage coupons to Town Engineer at time of disposal providing name, address, date, type of system services and volume pumped for each customer.
Chatham 12~82	b. 100' c. 50'	c. 100'	When ground water is at highest elevation	1 year	1 or 2 bedrms-285 ^{2} 3 bedrooms - 385' ^{2} 4 bedrooms - 485' ^{2} 5 bedrooms - 585' ^{2}	
Dennis 12~7~76	b. 100'	c. 75' single family c. 100' multiply family e. 50'	High water time of year (no dates specified)	1 year	125 gal/bedroom when leaching field utilized	Haulers must submit coupons at gate house with name, address and total gallons on reverse side.
Eastham	a. 100' b. 100' c. 100' d. 100'	c. 100' d. 100'	anytime			Septage haulers must submit septage coupons to Board of Health at time of disposal
Falmouth 8~19~82	c. 50'	c. 100'				Monthly septage pumping report containing name, address, date and volume pumped is required.
Harwich 10~1~78	b. 100'	c. 100'			140/gal/bdrm/day	Septage hauler shall provide town with information required on septage coupons
Mashpee 7~27~77	a. 100' b. 100'	c. 75' single family c. 100' multiply family e. 50'	Any time of year USGS Guideline*	1 year	125 gal/bedroom when leaching field utilized	
Orleans						(Same as Bourne)
Provincetown 2~8~83		c. 75' for accrued land				(Same as Bourne)
Sandwich 9~15~72		c. 100' d. 100'				(Same as Bourne)
Truro 4~4~79						(Same as Bourne)
Wellfleet 6~25~84	c. 50'	c. 100'				(Same as Bourne)
Yarmouth 8~25~78	a. 100' b. 100' c. 50' d. 50'	a. 150' c. 100' d. 100'	Nov.-June otherwise: water table must be 10' below ground USGS Guideline*	6 months		

*Frimpter, Michael H., 1980, "Probable High Ground-Water Levels on Cape Cod, MA" U.S. Geological Survey Open File Report #80-1008

Cape Cod Planning and Economic Development Commission

Under this Cape-wide program dozens of leaking tanks have been discovered, many in public supply well recharge areas. These tanks have been removed and replaced with state-of-the-art facilities in all instances. While most town health and/or fire regulations apply to both commercial and residential tanks, the hesitancy of homeowners to register fuel storage facilities has caused the ordinance to focus primarily upon commercially owned tanks. However. local officials are concerned about residential tanks with 1,000 to 2,000 gallon capacities which are increasing in number almost as fast as new homes. Even though commercial tanks are more likely to leak, due to dipsticking practices and greater outward pressure in the larger tanks. the necessity for monitoring residential installations is clear. Towns may need to consider revising their regulations and educational efforts to transfer greater initiative and awareness onto the homeowner for registering and monitoring individual tanks. For example. records of new domestic installations should be registered with the Building Department.

Developing technology in the area of underground leak detection may also necessitate revision of local ordinances as more accurate methods become available. Towns may also want to consider more frequent testing requirements on underground storage of unleaded fuel since its composition makes it extremely soluble in ground water and therefore even more difficult and costly to clean up than other fuel types.[2]

HERBICIDE REGULATION

Two recent developments, EPA designation of Cape Cod as a Sole Source Aquifer and state legistation requiring utilities to notify towns of their intent to spray herbicides, led in 1982 to region-wide action controlling the use of herbicide chemicals. Through the work of the U.S. Environmental Protection Agency Office of Pesticide Programs, local officials became aware that the Cape Cod aquifer is extremely susceptible to contamination by pesticides with certain characteristics. ("Pesticides" in this context refers to all herbicides, insecticides, fungicides and rodenticides). Fourteen of the fifteen Cape towns (Provincetown being the exception) passed health regulations during 1982 to prohibit or restrict herbicide use along powerline and railroad track easements. Recognizing that this genre of regulations dealt only with a small area of pesticide use, a comprehensive model health regulation was developed for protecting groundwater resources from contamination by any type of pesticide application. The model. being much more extensive than the original right-of-way restriction, was received cautiously by local boards of health despite having been reviewed for legal appropriateness by the consultant staff of CCPEDC. However. Brewster. Dennis, Bourne. Falmouth and potentially Orleans have adopted all or part of the CCPEDC model.

The area of pesticide management is extremely complex and controversial. Local officials are concerned about incidents of pesticide contamination elsewhere in the country and implications for the fragile Cape Cod aquifer. However, evaluating the threat to groundwater of pesticide application requires technical expertise often beyond the expertise of most local decision-makers. Clear, concise, factual information is needed to allow boards of health to develop justifiable

regulations on pesticide use. Once again, the suggestion has been made that appropriate staff expertise be made available to the Towns through the County Health Department.

SUPPLEMENTS TO TITLE V, STATE SANITARY CODE FOR INSTALLATION OF WASTEWATER DISPOSAL SYSTEM

The state of Massachusetts in 1977 developed a minimum code governing design and installation of wastewater disposal systems, particularly septic systems. On Cape Cod many health officials felt the state code was inadequate for proper protection of private wells and wetlands or surface water bodies, given the generally permeable nature of area soils. Further, the state code does not regulate septage haulers. Eleven towns increased minimum distance requirements between the septic tank and leaching area and private wells, surface water supplies, water courses, drains and downhill slopes. Eleven towns also require septage haulers to report information to the town on each system serviced. Barnstable (one of two Cape towns with a municipal wastewater treatment facility) requires all haulers to use the facility and prohibits commercial use of septic system cleaners. The town of Bourne also prohibits certain cleaners and requires special permits for use of all cleaners, rejuvenators, etc. Other local additions to Title V include limitations of the time of year a soil test can be performed, decreases in the period of validity for a disposal works construction permit, standardization for the design flow calculations, and increases in minimum requirements for leaching areas. Although no towns have formally adopted them as a regulation, most Cape towns require as policy groundwater elevation corrections to the USGS high groundwater calculation standards.

The purpose of the Title V supplements is both to increase protection of water resources and to allow boards of health tighter control over wastewater disposal since contact with wastewater is one of the most insidious modes of pathogen transmittal. However, a significant misconception about Title V systems is that they prevent <u>any</u> sort of contamination from entering the groundwater system, which is simply not true. Standard septic systems do nothing to remove the most ubiquitous contaminant of groundwater; nitrate-nitrogen. The only way nitrate concentrations can be kept to an acceptable level in groundwater without tertiary treatment of wastewater is by limiting the density of wastewater disposal systems.

Controlling nitrate levels in drinking water is critical since high levels of the chemical can cause blue baby syndrome (methemoglobenemia) in infants under three months of age by depriving cells of oxygen. Furthermore, nitrate has been implicated as a contributor to the development of gastro-intestinal cancers. A maximum allowable concentration of nitrate-nitrogen in drinking water has been set at 10 parts per million by both state and federal governments to guard against adverse public health effects.

Many towns on Cape Cod have augmented the benefits of local wastewater disposal standards by adopting zoning which limits housing density. But in areas where zoning is ineffectual, some towns are developing health regulations that limit nutrient (nitrogen and phosphorous)

loading to groundwater based on carrying capacities of nearby surface water bodies and wetlands. When zoning is inappropriate, boards of health might also consider limiting septic densities on the basis of public health concerns for groundwater contamination. The town of Brewster's proposal limiting volume of wastewater discharge per year might be reviewed for future consideration in all towns.

REGULATION PROHIBITING ADDITION OF SEPTIC SYSTEM CLEANERS

Only two towns on Cape Cod, Dennis and Falmouth, have adopted health regulations banning the sale or use of certain septic system additives. The actions came as the result of experience on Long Island where gross contamination of the aquifer by organic solvents was traced to widespread homeowner use of septic system cleaners. In 1979 a number of products containing petroleum distillates were available in hardward and department stores. So concentrated were these formulas that one gallon had the potential to contaminate 20 million gallons of groundwater at the parts per billion level. Since that time legislative action on Long Island and public concern have prompted many companies to reformulate their products without such recognized groundwater contaminants as methylene chloride and 1, 1, 1 trichloroethane. However, the effects on groundwater quality from chemicals found in the new concoctions are unclear at this time. Manufacturers claim there are none.

Additives should be unnecessary if a septic system is properly sited and maintained. When a system is functioning properly, solids are prevented from spilling over into the leaching area and impairing the ability of the proximal soils to leach liquids. System pumping every three to five years is recommended. Some health departments are considering mandatory pumping requirements as a ground water protection measure.

Reviewing these groundwater protection strategies, it is clear that no single measure is adequate by itself. Rather a multi-faceted framework is necessary that includes all levels of government, and a strong public education program.

Current State and Federal guidelines and regulations provide communities with a broad basis of groundwater management, but local decision makers must implement specific groundwater protection measures which consider the unique environmental conditions of Cape Cod. Both local and regional agencies should develop citizen support for groundwater protection strategies through public education. But of even greater significance is the degree of enforcement of existing and/or proposed regulations. Local regulations exist, but in many instances for either political reasons or lack of agent expertise, they go unnoticed or unenforced. Both of these factors should be addressed and corrected promptly. Other areas of concern such as those noted previously for toxic and hazardous materials would probably be best dealt with through expertise available or to be contracted by the Barnstable County Health Department staff and lab facilities, since the problems facing the Cape in relation to these materials are common throughout the region.

Recently (October 1983) the state Department of Environmental Quality Engineering has become more directly involved in protecting the Commonwealth's groundwater resources through the promulgation and adoption of strict groundwater discharge regulations. This new program sets drinking water standards for all permit-requiring discharges to the ground unless sufficient technical information is provided to prove that the localized groundwater is previously contaminated and so defined as Class III water. Discharges requiring permits include such categories as all industrial waste and all discharges over 15,000 gallons per day. Strict enforcement of this regulation could be a tool in slowing the process of use conversions (such as motel/condo, etc.).

The problems of surface water contamination should also receive strong consideration. Each year more shellfish areas are being closed due to contamination, especially from contaminated groundwater reaching the bays, rivers, etc.. At present, towns do not have adequate financial resources to document pollution sources properly, let alone pay for the engineering design and facilities construction to deal with possible methods of eliminating the pollutant sources once they are identified. Outside sources of funding - state and federal - are needed so that proper baseline data can be gathered and corrective measures initiated to deal with these problems.

Notes

[1] Horsley, Scott W. 1982 Beyond Zoning: Municipal Ordinances to Protect Groundwater. Proceedings of the Sixth National Groundwater Symposium, Atlanta, Georgia, Sept. 22 - 24.

[2] Entropy Ltd. 1984. Lecture at CCPEDC workshop on Underground Fuel Storage, Cape Cod Community College, W. Barnstable, Massachusetts.

I. ENVIRONMENTAL RESOURCE ADMINISTRATOR: A PROPOSAL

Environmentalists are expressing concern over the effectiveness of local zoning Boards of Appeals to deal with land use issues. The concern is well founded. The criticism, however, should not be directed at Board of Appeals members. The problem with the system is more fundamental as the regulatory structure does not provide for an advocate for the environmental interests of the town as a whole.

The Board of Appeals has been chartered in our General Laws as a judicial-administrative body. Its role is not to advocate any position. It is not even charged with the duty to preserve the Master Plan as it dispenses variances and special permits.

We pay for building inspectors and master plans. We pay in the long run dearly for imprudent development. It is time to pay for a spokesperson to represent the overall best interests of the towns in which we live.

What is needed is a professional advocate for the town - a champion of the Master Plan - an ombudsman, so to speak.

The need for each town to have a full time professional Environmental Resource Administrator (as presently represented in Barnstable by the Conservation Agent) is as imperative as the need for a Town Planner, a post which has been funded in five Cape Cod towns in recent years. In Barnstable the position has been basically responsible for technical and administrative assistance to the conservation commission, natural resources commission or water quality advisory board. It could also encompass the responsibility of appearing before the Planning Board and the Board of Appeals as an advocate to the town's natural resources. Both boards listen to arguments of legal and technical experts on behalf of the developer. It is indeed time for these boards to have the benefit of adversarial argument on behalf of all the citizens of the community - for the common good.

There is no single best place for such a position on a town's organization chart. Ideally the Environmental Resource Administrator would have a broad mandate and would not be seen as expressing the interests of any one board.

III. CAPE COD GROWTH FORECASTS

In the short decade and a half separating us from the year 2000, the transformation of Cape Cod will be profound. This report describes the economic, demographic, and land use dimensions of that change as a basis for judging impacts, setting policy, and taking action.

By the year 2000. Cape Cod's winter population is likely to be nearly half again as large as it was in 1980, and peak summer population is likely to be about one third again as large as in 1980, growing to 500,000 persons, perhaps as many people as by then will reside in Boston.

That growth will be driven by increases in commuting, retirement population, and seasonal visitors. More and more, Cape residents' income will not depend on the Cape economy, but rather on jobs off-Cape or on retirement income independent of current employment. In that sense the Cape will be functioning more like a suburb than like a rural region.

Growth of a third in peak population. 40% in jobs, and nearly 50% in winter population will place heavy demand on the Cape's resources, most visibly on its land. While the rate of building is projected to turn downward as land supply and policy tighten, the rate will continue to be rapid, close to 2.000 dwelling units per year in the last decade of the century. Developed land, only 24% of the Cape's total in 1980, will swell to 35% of the Cape's total in 2000, while vacant buildable land will drop from 35% of the total in 1980 to 18% in 2000, approaching but not yet reaching virtual land saturation.

Growth, of course, will be uneven among towns. Winter population growth will range from under 25% in land-shy Provincetown to over 125% in booming and land-rich Mashpee, peak summer growth from 9% in Chatham to nearly 100% in Truro.

All these forecasts are predicated on continuation of the trend of past efforts to control local growth. Increasingly, Cape towns have used zoning and land acquisition to intervene in growth. These forecasts anticipate still tighter regulation and more open land acquisition. If that doesn't happen, growth could easily be even more rapid than projected.

A. INCOME

It is striking that in 1980 work earnings from jobs on Cape Cod were less than half the income Cape Cod residents received (see Table 1). The rest came from investments (bank dividends, stocks and bonds, and real estate, of which 25% was imputed income from owner-occupied homes*, etc.), transfers (social security, unemployment compensation), and net out-commuting. To predict the future of Cape Cod it is necessary to understand the future of those "unearned" and "outside" sources of income, as well as the future of jobs on Cape Cod.

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*That is, the net annual value of their rent-free accommodations.

Table 1
TYPES OF INCOME, CAPE COD, 1980

	Dollars	Percent
WORK EARNINGS		
On Cape Cod	$668,000,000	44%
Commuting	157,000,000	10
PROPERTY	397,000,000	26
TRANSFER	293,000,000	19
TOTAL	$1,515,000,000	100%

Source: Bureau of Economic Analysis, 1981.

Of particular importance is the way income, here termed "basic" income, is brought onto Cape Cod from outside. That income is brought to the Cape by retirees, summer (and other leisure) visitors, commuters, the military, and a variety of others. The extent to which each contributes to the Cape economy was estimated through an analysis of specific types of income and earnings. The rest of the income on the Cape, the difference between total income and "basic" income, comes from internal re-spending, "taking in each other's laundry", which is an important part of the economy, but not the source of growth (see Table 2).

The largest percentage changes over the past decade are the relative decline of military income and the rise of commuter income. In 1970 retirement was already a major but relatively unrecognized component of basic income. Leisure as a source of income has provided a steadily declining share of the Cape's economic base until in 1980 it represented barely one-quarter of all basic or "import" income.

Over the 30 years 1970 to 2000, a profound change in the Cape economy is expected, as illustrated in Figure 1. From a position of equivalence with the leisure industry, retirement is likely to grow rapidly to a position of dominance. Commuting off-Cape is also expected to grow rapidly, becoming the third largest "industry". Taken together, growth in all those sources is expected to be robust right through the

Figure 1

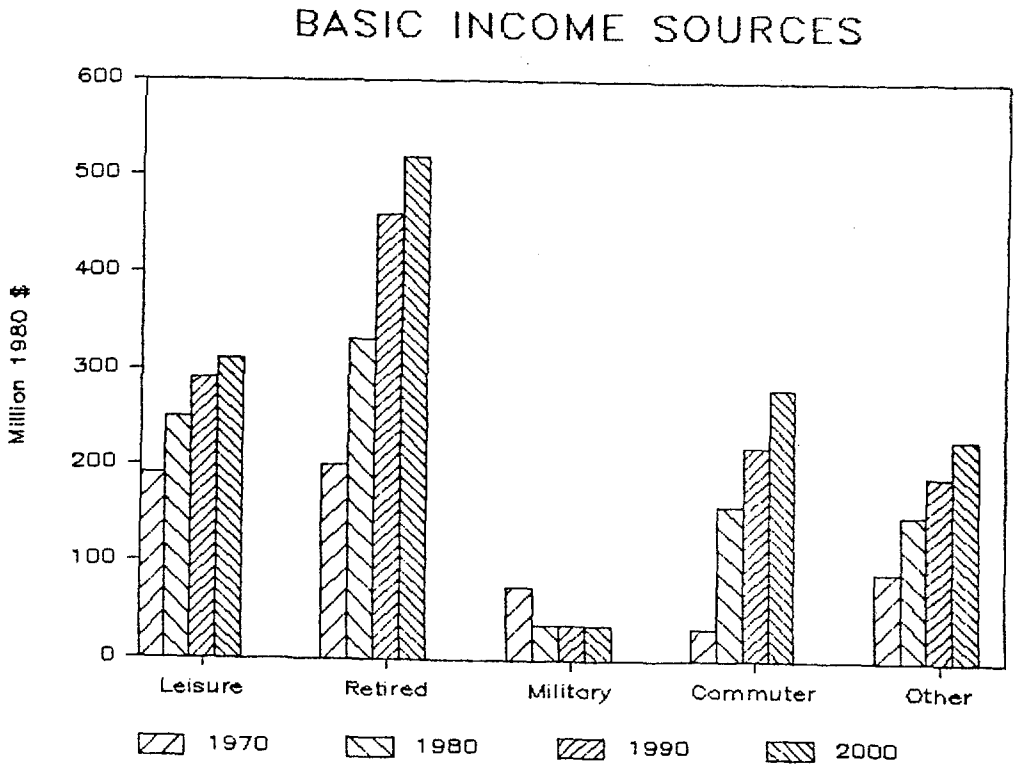
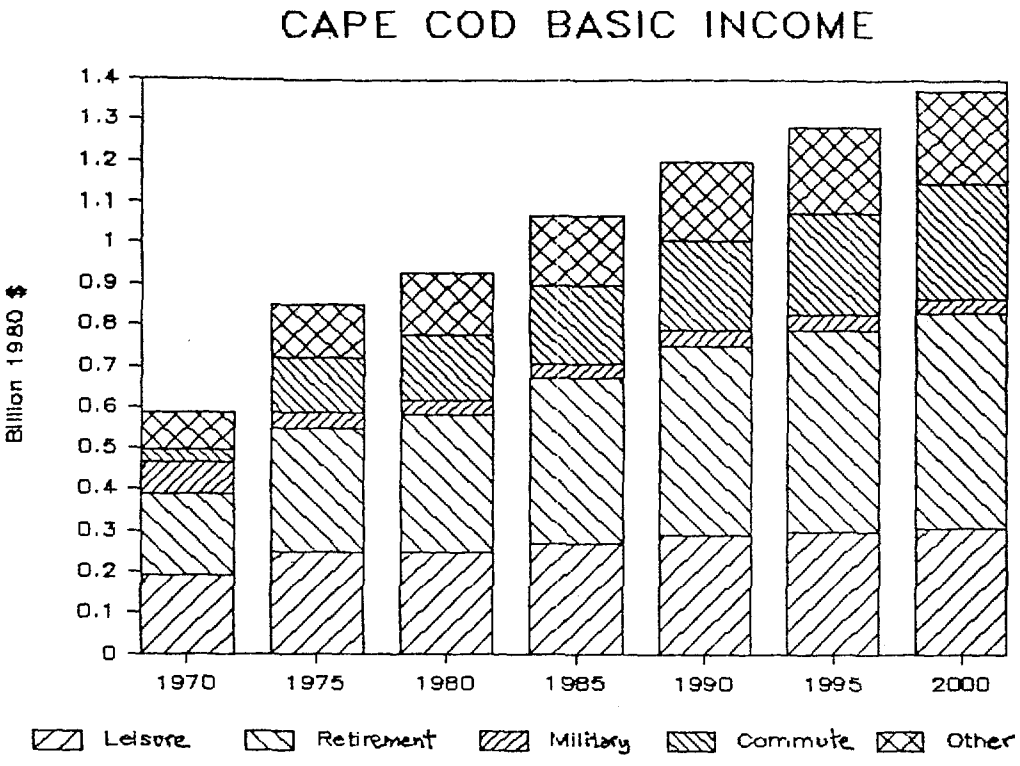


Figure 2



year 2000, as illustrated in Figure 2, though the rate of growth is likely to slow as land supply dwindles, the Cape's urbanization impacts its tourism appeal, and the demographics supporting in-migration of the retired gradually shift.

Table 2
INCOME SOURCES, CAPE COD, 1980

	Dollars	Percent
Retirees	$331,000,000	36%
Leisure	247,000,000	27
Commuters	157,000,000	17
Military	36,000,000	4
Other outside	145,000,000	16
Total outside	$916,000,000	100%
Respending	597,000,000	
Total income	$1,513,000,000	

Source: Herr Associates analysis of BEA data

Table 3
INCOME SOURCES 1970-1980

	1970	1975	1980
Retirees	34%	35%	36%
Leisure	32	30	27
Commuters	5	15	17
Military	13	5	4
All Other	15	15	16
Total	100%	100%	100%

Source: Herr Associates analysis of BEA data

RETIREMENT CONTRIBUTION

Forecasting the income contribution of the retirement population involves forecasting how many retirees there will be, and what their income contribution per capita will be.

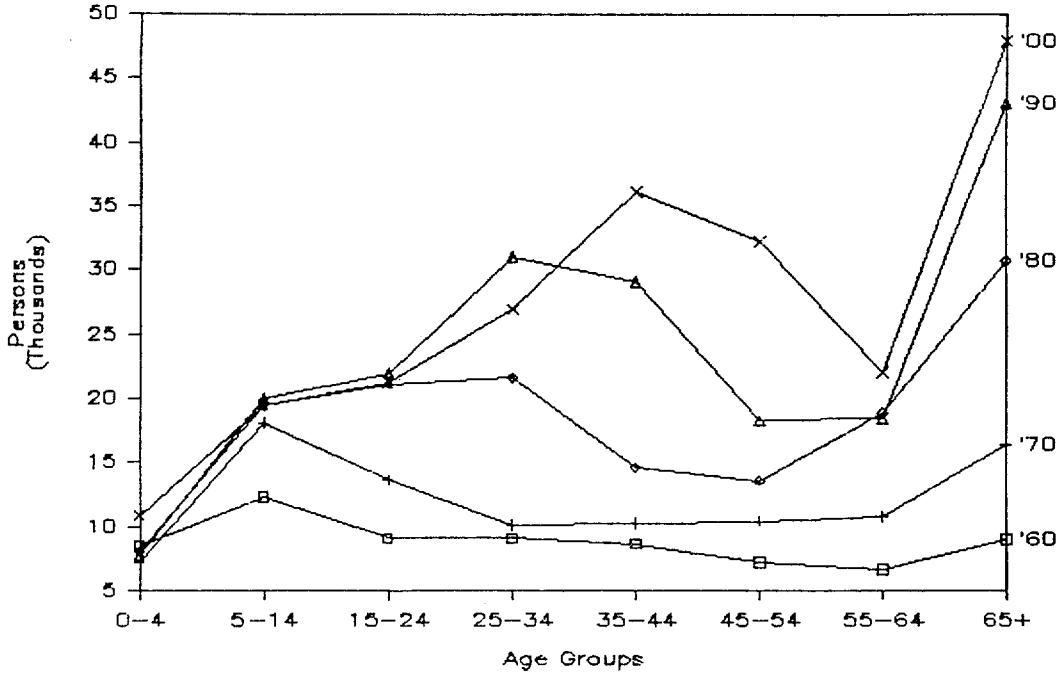
Table 4
YEAR ROUND POPULATION AGED 65+

Year	Number	Annual % Increase Cape Cod	Annual % Increase Massachusetts
1970	16,300		
		8.3%	1.0%
1975	24,300		
		4.9	1.1
1980	30,700		
		3.7	0.8
1985	37,000		
		3.1	0.0
1990	43,100		
		1.1	0.0
1995	45,500		
		1.0	1.0
2000	47,900		

Source: 1970-1980 and Massachusetts projection: U.S. Census Cape Cod projection: Herr Associates

Figure 3

CAPE POPULATION AGE STRUCTURE



The Cape has a powerful attraction for retirees. Between 1970 and 1980 the Cape population of persons over sixty-five years of age almost doubled, growing from 16,000 to 30,000, the result of aging, mortality, and net in- migration of 13,000 persons in that age category. In 1970, 16% of the Cape population was over sixty-five years of age, growing to 21% in 1980.

Complex changes are happening to that demographic group, including recent sharp increases in longevity and for a while, projected decreases in the number of persons nationally reaching retirement age (the result of the depression "baby bust"). Growth of that age group on Cape Cod was analyzed both in relation to the statewide number of persons in that age group and in relation to historically experienced in-migration rates.

The extraordinary attraction of the Cape for retirees seems likely to be tempered as growth diminishes rural seaside charm, raises taxes, reduces availability of housing sites, and pushes housing costs upward, and as zoning and other restrictions on growth become more stringent. On the other hand, parallel things are also happening in competitive areas. The results of modelling survival and migration, given our expectations of sharply reduced rates of elderly net in-migration show that the retirement population is still likely to grow far faster on Cape Cod than in Massachusetts as a whole, resulting in about the same proportion of retired to other population in the year 2000 as at present, about 22%. It is worth noting that this is only two-thirds as large a proportion as found in such national retirement centers as Charlotte County, Florida, where 34% of the population is over 65.

Assuming no change in the income supported per retiree, the retirement-supported income increases in parallel with the retirement population, at first more slowly than in the last decade, then markedly slower after 1990.

LEISURE CONTRIBUTION

Summer home owners, renters, house guests, guests of year-round residents, and those staying in motels, campgrounds, and other seasonal accommodations produce the leisure component of "basic" income. They collectively contribute just over $1,000 per visitor accommodation (1980 dollars) to the net personal income received by the Cape's year-round residents. Clearly visitors spend much more than that, but much of what they spend winds up in Saudi Arabia or Boston rather than staying on Cape Cod. That figure changed insignificantly over the '70's, after accounting for inflation. Our expectation is that it also will not substantially change (in constant dollars) through the year 2000.

As can be seen in Figure 4, the seasonal increase in population on Cape Cod is chiefly from second home residents, with commercial accommodations (which in this discussion includes campgrounds, even public ones, as well as hotels and motels) making a far smaller addition. The year-round population is also supplemented by a summer burgeoning of extra houseguests, as well as by recovery from a deep-winter low

Figure 4

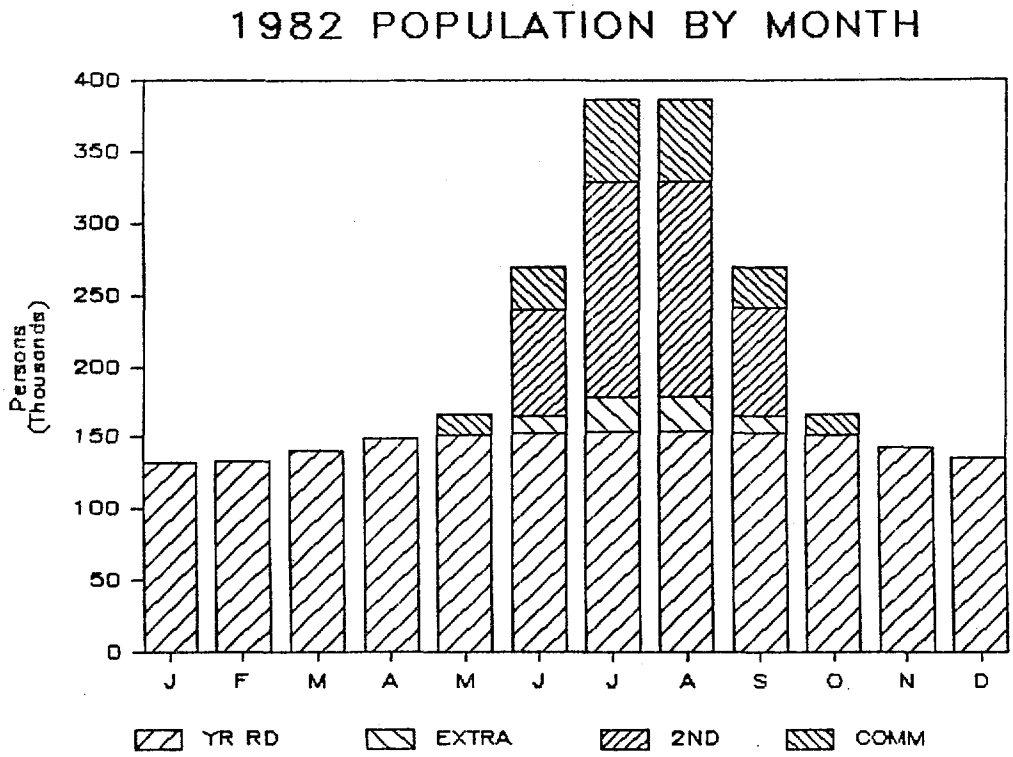


Table 5
CAPE COD SUMMER-ONLY POPULATION

	Number	Annual % increase
1970	175,000	
		2.7
1975	200,000	
		2.4
1980	225,000	
		1.9
1985	247,000	
		1.0
1990	260,000	
		1.1
1995	275,000	
		0.4
2000	281,000	

Source: Herr Associates

In the past. growth in the number of second homes on Cape Cod has apparently been closely related to the nearby population in the mid-years age brackets likeliest to have interest in and capability of supporting such homes, a market approximated by the Massachusetts population aged 35-54. That market population. after a decade of near-stability, is now growing sharply and will continue to do so for a decade as the "baby-boomers" enter that age level. Our forecast of second homes grows accordingly, despite our judgment that the Cape's capture rate of such homes will decline as the region urbanizes. becomes more costly, and more stringently controls growth.

The number of summer guests in year-round homes is expected to grow at the same rate as the number of year-round homes grows. Best estimates are that summer population in motels, campgrounds. and other non-dwelling accommodations has grown more slowly than the seasonal population in dwellings. and our forecasts presume continuation of that trend.

Adding all the components of summer population together yields growth in summer-only population from 225,000 in 1980 to 281,000 in the year 2000, with the rate of increase falling over time (see Figure 5). Assuming no change in income contribution per visitor. the same changes are true for total income contribution as for seasonal population: sharp increases in the near future, then slower growth.

COMMUTERS

The reported number of on-Cape residents commuting to off-Cape jobs nearly tripled from 1970 to 1980, from 2,100 to 5,900. Net out-commuting, the excess of out-commuters over in-commuters, rose even more sharply with the early '70's decline of commuters from off-Cape to Otis Air Force Base.

Given the continued exurbanization of Boston-centered employment and the attractiveness of Cape Cod residence, further growth in out-commuting can be expected. Our forecasts suggest growth in commuter-supported income at a rate slightly lower than the growth from 1975-80 and growing at a steadily declining rate through the year 2000.

MILITARY

Despite its recent resurgence. Otis Air Force Base supports less than half the income it did in 1970. The Base now seems to have a secure set of missions and a future of stability or growth, but is so dependent upon unpredictable governmental circumstance and policy that we are projecting simple continuation of income contribution at the present level, recognizing the large uncertainty involved.

Figure 5

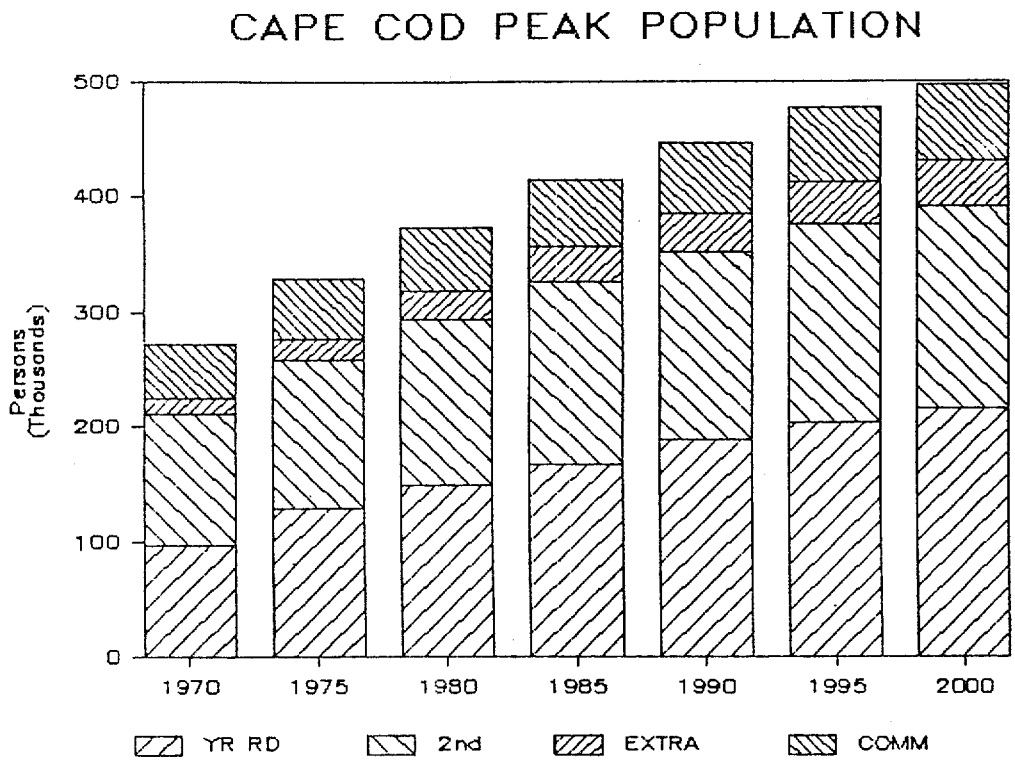


Table 6
INCOME GROWTH, 1980-2000

	1980	2000	Annual % Change
Income ($ millions)			
Retirees	$331	$516	2.2
Leisure	247	309	1.3
Commuters	157	280	2.9
Military	36	36	0.0
Other outside	145	233	2.4
Total "basic"	916	1374	2.1
Re-spending	597	893	2.0
Total income	$1,513	$2,267	2.0

Source: Herr Associates

OTHER "EXPORTS"

Most of the remaining income brought in from outside is unearned: interest and dividends from off-Cape investments and deposits paid to non-elderly residents, unemployment compensation, and other property and transfer income not already accounted for. In 1980 that amounted to over $100 million.

In addition, about $42 million in wages and profits derived from the sale of goods and services for off-Cape consumption, not including tourism (already counted), but including fishing, marine research, and a wide array of other activities.

Such income is sure to grow, but again a rational basis for forecasting is elusive. We have estimated annual growth of about $4 million per year in this "all other" category, faster than growth over the past five years but slower than growth over the past ten years.

RE-SPENDING

Incoming gained by Cape Codders from other Cape Codders constitutes re-spending of income originally gained for the region through "exports" to other regions. Such re-spending has added about two-thirds again to export income over the past decade, and in this study is forecast to remain in that relationship through the year 2000.

B. POPULATION

Summing the income forecasts for each of the income sources yields total income to the year 2000. The winter population which that income would support was next estimated. Total income was divided by income per capita, assumed to be constant in real value, which is consistent with the assumptions behind the income growth forecasts. That results in a 46% increase in winter population over the next two decades. Table 7 shows the results.

It is important to understand that these figures reflect the judgment that local growth controls will likely become more severe over the next two decades. If that is not true, or true to a lesser degree than reflected here, population growth will be higher, possibly <u>much</u> higher.

COMPARISONS

Comparing results of these forecasts with those made earlier by ourselves or by others indicates close agreement. For 1985 year round population there is essentially no difference among these projections and those made by us for the mid-70s 208 program, a post-census CCPEDC staff update using different techniques, and a state Department of Public Health projection using yet different techniques. By 1995 the spread between these projections and those others is under 8%, giving a false sense of precision, since for an area of this size and complexity to be safely within 15% of the real figure 15 years from the base year is about as good as can be claimed.

Table 7

FORECAST POPULATION

	1980	1990	2000	% Increase 1980-2000
WINTER POPULATION				
Elderly	31.000	43.000	48,000	55%
Other	117,000	144,000	168,000	44
Total	148,000	187,000	216.000	46
SUMMER POPULATION				
Summer home	145.000	164.000	175.000	21
House quests	25,000	34,000	40,000	60
Other	55,000	61.000	67,000	22
Total	225,000	260,000	281,000	25
PEAK POPULATION	373.000	447,000	497,000	33

Source: Herr Associates

It should be noted that the mechanics of projection continually suggested results which were higher than these, but by our judgment seemed incredibly high. Our final figures are conservative and reflect some effort to constrain the faster growth indications which the models produced. For example. simple continuation of 1970-80 age-specific migration rates yield an unbelievable year 2000 estimate of 314,000 spring population. It should also be noted that these final forecasts assume no consistent direct public control over regional rates of growth That assumption could prove wrong. Bourne and Sandwich have adopted explicit growth rate limitation bylaws. Falmouth is again discussing one after rejecting an earlier proposal. A major growth management initiative is underway in Barnstable. Those communities collectively accounted for over half of the Cape's year-round population growth 1970-1980. It is clear that public choice will play a large role in what the actual 1990 and 2000 population levels are, though growth will not be halted. Even if the Cape attracts no more tourists and in-migrating retirees than it did in 1980, its winter population would still increase 20% over the next two decades, to 180.000 by year 2000.

C. EMPLOYMENT

In most regions job growth impels population growth but. as we've shown, on Cape Cod it is the reverse. As retirees and second-home occupants choose to reside on Cape Cod, their spending stimulates job growth. In this case, jobs follow population rather than vice versa.

Table 8
COMPARISONS: WINTER POPULATION FORECASTS

	1985	1990	1995	2000
This study	167,000	187,000	203,000	216,000
"208" (Herr), 1976[a]	166,000	180,000	187,000	
CCPEDC, 1982[b]	168,000	190,000	214,000	230,000
Mass. DPH[c]	168,000	190,000		

Table 9
COMPARISONS: PEAK POPULATION FORECASTS

	1985	1990	1995	2000
This study	414,000	447,000	478,000	497,000
"208" (Herr),[a]	490,000	540,000	570,000	
CCPEDC, 1982[b]	494,000	535,000	575,000	603,000

a. Herr Associates, Development Projections for Cape Cod, for CCPEDC, 1976.

b. CCPEDC, "Population Estimates and Projections for Barnstable County, 1980-2000", c. June, 1982.

c. Massachusetts Dept. of Public Health, 1985 and 1990 Population Projections... Mass. DPH, c. 1983.

Figure 6

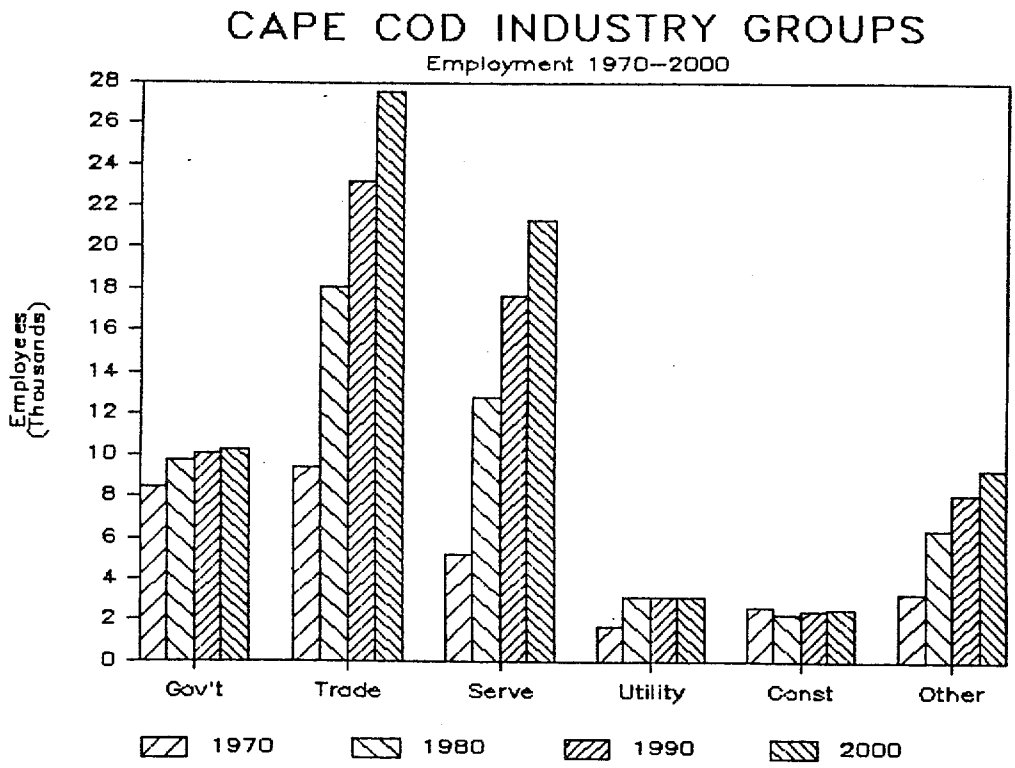
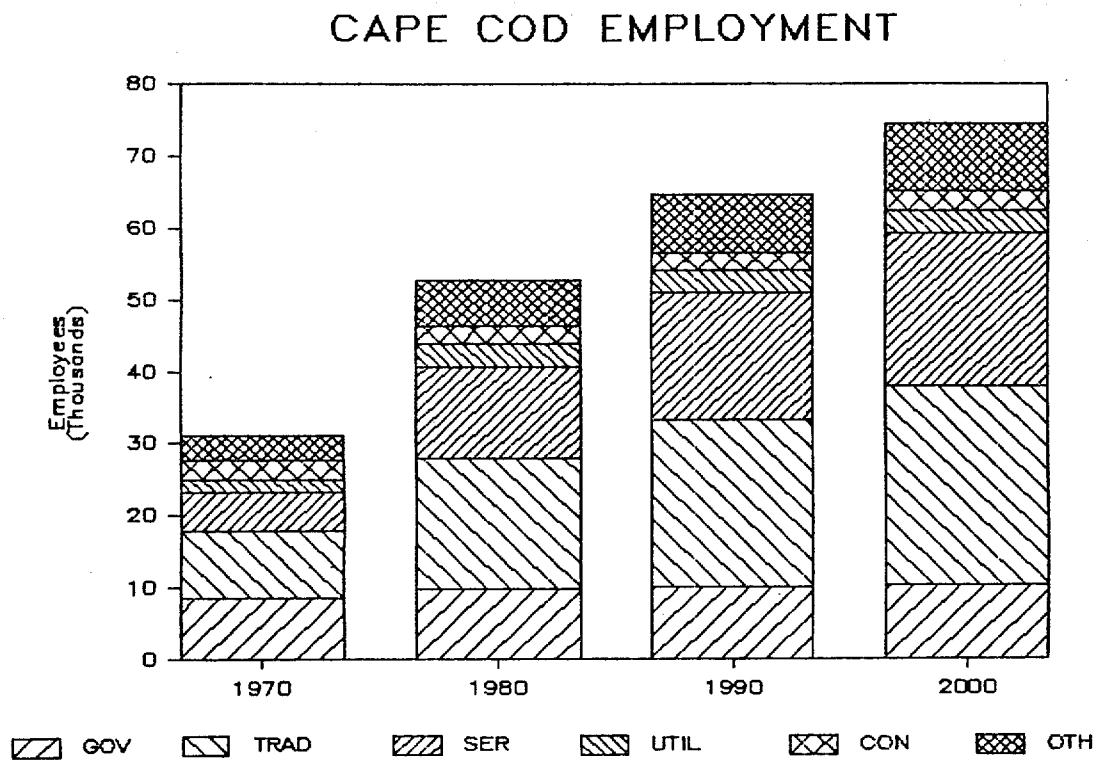


Figure 7



The structure of Cape Cod's economy is little affected by the national shift from goods to services, since it is already services-dominated, and has been for decades. Agriculture and fisheries account for under 2% of the Cape's reported employment, manufacturing for about 6%, while trade is over 35%. services are over 25%, and government over 16% (see Table 10).

Trade and services domination is likely to continue. Employment in services will likely have the most rapid growth, with growth in trade employment starting from a higher level and almost as strong (see Figure 6). Government shows little likelihood of strong growth, nor does the category of utilities, communications, and transportation. Construction employment has declined over the past decade, and seems unlikely to grow more than slightly. based on projected homebuilding rates. The "other" category is over half manufacturing, largely servicing on-Cape customers (e.g. with building components) so likely to grow with the population. Finance, insurance, and real estate, the other major component. is also likely to grow with the population. Agriculture and fishing is much smaller, its growth having little impact even on the "other" category.

Overall. growth in employment is likely to closely parallel growth in population (see Figure 7 and Table 10). Note that these are average annual figures. As such, they reflect the summer surge of employment. much of which goes to off-Cape residents, so does little to support year-round population.

Table 10
CAPE COD EMPLOYMENT

	1970	1980	1990	2000	% increase 1980-2000
Government	8500	9786	10100	10300	5.0
Wholesale. retail trade	9451	18105	23200	27600	52.4
Misc. services	5242	12746	17600	21300	67.1
Trans., commun. utility	1739	3130	3150	3200	2.2
Construction	2681	2331	2500	2600	11.5
Other	3351	6419	8150	9350	45.7
Total	30964	52517	64700	74350	41.6

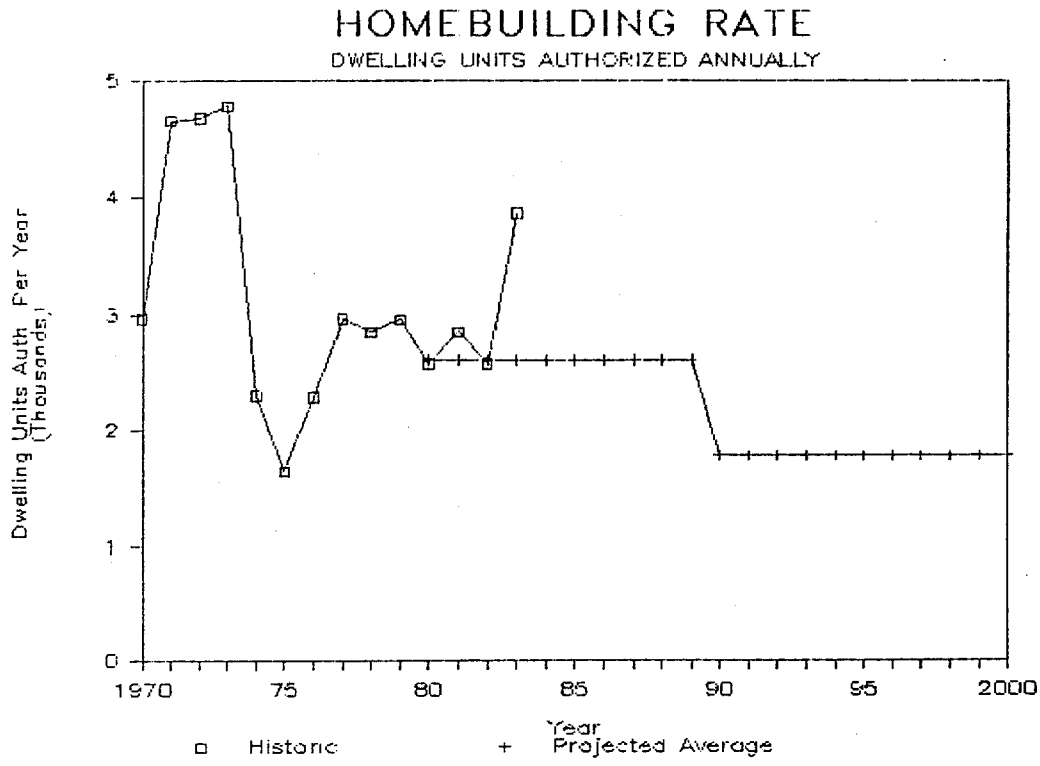
D. CONSTRUCTION

Construction rates are carefully monitored on Cape Cod for good reason. The building industry is of large, though declining, importance to the year-round economy of Cape Cod. Construction rates are an indicator of the rate of environmental change, and they provide evidence of growing population.

Table 11
CAPE COD HOMEBUILDING

	Total Housing units	Added per year
1960	46,800	
1960-70		1910
1970	66,000	
1970-80		3400
1980	100,000	
1980-90		2620
1990	126,000	
1990-2000		1790
2000	144,000	

Figure 8



These forecasts indicate continuation of robust building on Cape Cod, though not at the frenetic pace of the '70s.

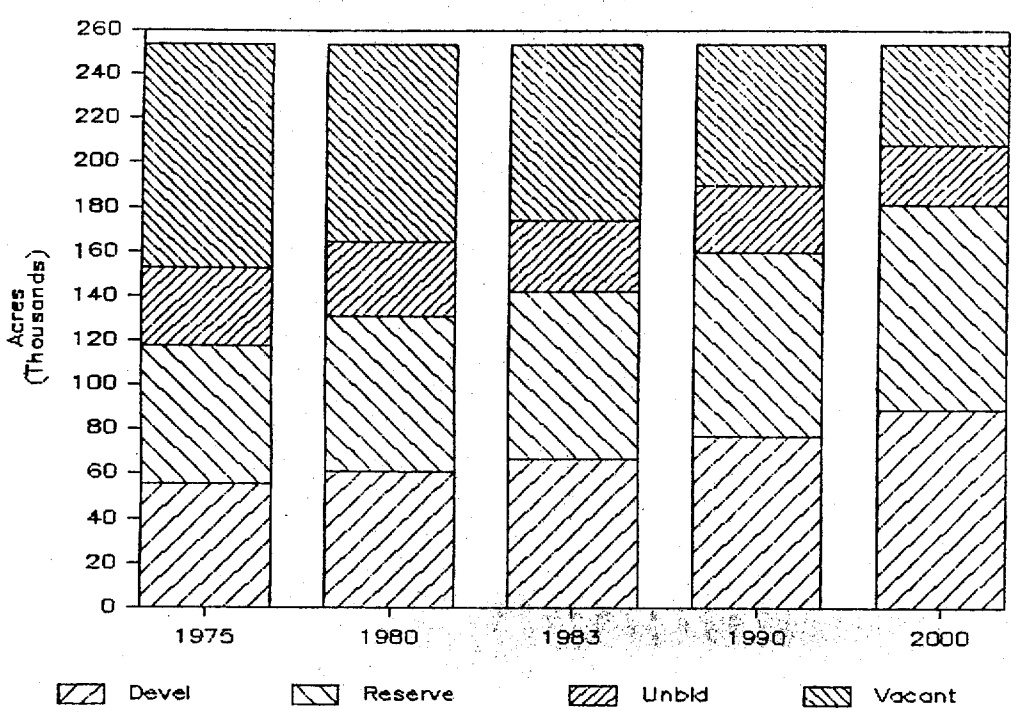
The forecast of homebuilding rates depends basically on forecasts of population growth and change (decline) in average household size. We have assumed the number of summer vacant units to remain unchanged, and no net change through demolition or conversion. Household size is forecast to decline- but much more slowly than in the past decade. Slower decline in household size, coupled with declining rate of population growth, results in substantially reduced construction rates.

E. Land Use

Development actually covers only about a quarter of Cape Cod's land area today, though it seems to occupy more, and certainly impacts more (see Table 12). Reserved open space. such as the National Seashore and conservation commission lands, covers slightly more land than is developed and appears to be expanding about as fast as land is being developed. Thus, a little less than half the land remains susceptible to development, about one-third of which is wetland or dune and cannot, therefore, readily be developed. In sum, then, about one-third of the Cape's land remains available for development.

Figure 9

CAPE COD LAND ANALYSIS



Two opposite forces are pressing on density of development. Town efforts to slow growth, control its quality, and protect water resources have led to steadily increasing lot area requirements, and those efforts are certain to continue, perhaps with even greater intensity. On the other hand, obviously vanishing development opportunities and concern over housing affordability have led to greater acceptance of multifamily housing and its higher densities. That, too, seems likely to continue.

Table 12
CAPE COD LAND USE

	ACRES			
	1975	1980	1990	2000
Developed	55,800	61,500	77,100	88,700
Reserved open	61,700	70,100	82,900	92,200
Unbuildable	35,100	33,400	29,500	27,200
Vacant buildable	100,900	88,600	63,900	45,400
Total land	253,500	253,500	253,500	253,500
	PERCENT			
	1975	1980	1990	2000
Developed	22	24	30	35
Reserved open	24	28	33	36
Unbuildable	14	13	11	11
Vacant buildable	40	35	25	18
Total land	100	100	100	100

On balance, land consumption per dwelling unit has apparently been increasing in recent years. Our 1983-1990 land consumption forecasts are based on a 15 percent increase in added land per added housing unit over the 1980-83 rate, and our 1990-2000 forecasts are based on continuation of the 1983-90 rate. The result is likely to be growth in developed land from 60,000 to 90,000 acres between 1980 and 2000, but it is important to recognize that the figure could be either higher or lower, depending on both population growth and public land policy.

In an average year between 1975 and 1983, open space acquisitions by all levels of government and private conservation groups amounted to about 1 percent of the undeveloped and unreserved land on Cape Cod at the beginning of that period. Perhaps optimistically, we have based

our land forecasts on continuation of that rate, with about one-quarter of the acquired land coming out of unbuildable wetland and dune, the rest out of buildable vacant land.

By the year 2000, development and land reservation will still leave vacant developable land, but only about half the amount now available. By then, twice as much land will have been developed as will remain for future building.

F. TOWN-LEVEL FORECASTS

Forecasts of winter population and peak population have been made for each of the Cape's 15 towns, using four different projection techniques, then making a fifth "best judgment". Results are summarized in Tables 13 and 14.

The "linear extrapolation" figures are what would result if the number of added winter and peak period residents per year were the same in each town in the period 1980-2000 as it had been in the period 1960-1980. The total of those extrapolations is some 6-8% higher than the Cape-wide total population we have forecast, though in some individual towns extrapolation produces projections lower than those produced by other methods.

The "land share" method bases growth on vacant land availability. The projected 1980-1990 Cape-wide construction of new housing units is distributed among the towns in proportion to their share of the Cape's 1980 vacant buildable land, and 1990-2000 construction is distributed based on projected 1990 buildable vacant land. The total resulting housing units in each town are then divided between year-round and seasonal occupancy, and dwelling units converted to population by using estimates of population per dwelling unit. The basic method assures that the town figures sum to the Cape-wide forecast. In most cases this projection provides the figure in which we placed greatest reliance in reaching "best judgment".

"Shift share of population" is another way of distributing the Cape-wide forecast among towns. This method, instead of extrapolating population trends, extrapolates the trends in percentage share each town has of the Cape-wide total population, winter or peak. Those extrapolated shares, applied to the Cape-wide forecast, give town-by-town projections.

Similarly, "shift share of dwelling units" extrapolates each town's share of the Cape-wide total of dwelling units, uses that share to project the number of dwelling units in each town, splits those units between year-round and seasonal occupancy, then converts units to population.

All those projections (120 in all) were graphed, and "best judgments" made for each town. For example, linear extrapolation is clearly too low in Mashpee because of past events unlikely to be repeated, but is unsustainably high in Falmouth. Land share is plummeting so fast in Yarmouth that projections based on it are probably low, while Bourne's land resources are so vast that projections based on them seem clearly

too high. On the other hand, Bourne's share of Cape population has steadily dropped, attributable in part to the influence of Otis. Extrapolation of that share is unreasonably low. Dennis' share of Cape-wide population grew sharply over the past decade, but land availability won't allow that to continue.

On the average, the highest projections for year 2000 town peak populations exceed the lowest projections by 22 percent, excluding Provincetown (which has a 96 percent range). That is a fair indication of the sort of uncertainty involved. At the town level (especially the smaller towns), town forecasts which fall within 10 percent of the actual figure within a decade from the base year would be fairly good, and forecasts averaging within 5 percent of the actual figures would simply be fortuitous.

Table 13
TOWN WINTER TOTAL POPULATION

	1960	1970	1980	1990	2000
BOURNE	7430	8770	11830	14100	16200
FALMOUTH	13040	15820	23635	29000	33000
MASHPEE	870	1290	3700	6200	8400
SANDWICH	2080	3630	8730	12600	15500
OTIS	6590	5600	2045	2000	2000
BARNSTABLE	13470	19840	30900	39000	45000
DENNIS	3730	6450	12360	15500	17000
YARMOUTH	5500	12030	18450	22000	24300
BREWSTER	1240	1800	5230	8000	10000
CHATHAM	3270	4550	6010	7500	8200
EASTHAM	1200	2040	3470	4700	5700
HARWICH	3750	5900	8970	11200	13000
ORLEANS	2340	3060	5300	6900	8000
PROVINCETOWN	3390	3700	3540	4200	4400
TRURO	1000	1230	1490	1800	2000
WELLFLEET	1400	1740	2200	2700	3200
TOTAL	70300	97450	147860	187400	215900

Source: 1960-1980: US Census of Population
1990-2000: "Best Judgment" forecasts

Table 14
TOWN PEAK TOTAL POPULATION

	1960	1970	1980	1990	2000
BOURNE	17380	21480	26300	30000	32500
FALMOUTH	25750	37510	51090	61000	67500
MASHPEE	5260	7950	12840	17600	22000
SANDWICH	10020	11640	18570	23000	27000
OTIS	6590	5600	2050	2000	2000
BARNSTABLE	26920	37290	54450	68400	78200
DENNIS	24490	29510	46530	54000	57000
YARMOUTH	17630	30690	43000	52000	56400
BREWSTER	7060	9280	15830	20500	25000
CHATHAM	10840	14040	17410	20000	21000
EASTHAM	8360	10110	13990	16500	18500
HARWICH	12020	16290	21930	26500	29000
ORLEANS	5360	7990	11800	15000	17000
PROVINCETOWN	13370	13480	13370	14000	15000
TRURO	7980	9090	10560	11500	13000
WELLFLEET	9390	10800	13310	15000	16000
TOTAL	208420	272750	373030	447000	497100

Source: 1960-1980: APCC analysis
1990-2000: "Best Judgement" forecasts

IV. MANAGING GROWTH RATES ON CAPE COD

Of all the characteristics of growth, its rate is the most fundamental. By influencing growth rate, all the consequences of growth, good and bad, are also influenced. Influencing other characteristics of growth, such as its pattern or location. while important, is less universal in its effect.

Intervening in growth rates is an old American practice. Until relatively recently, that intervention has almost universally been aimed at speeding growth through devices such as public land sales. speculatively extending roads and services at public cost. and granting favorable tax treatment. Now, however. many communities and regions and a few states are acting to deliberately slow growth in order to protect existing qualities of life. chiefly using regulatory devices not labelled "growth control" but instead called such things as "two-acre zoning" and "agricultural protection", and using fiscal devices. such as huge fees for new development's share of schools and other public services.

It is only in the past 10 or 15 years that communities have directly controlled or limited growth and called it that, producing a storm of litigation which firmly established the community right reasonably and frontally to intervene to slow growth rates.[1]

The rationale for intervening in growth is different in leisure areas such as Cape Cod than it is in suburban areas, where the imperative for accommodating growth is clearer. There is no strong reason why this decade's second-home buyers and retirees must have untrammelled access to Cape Cod's limited resources, since there are later decades for which that land must also serve, and there are many alternatives to Cape Cod for that leisure population. both in the Northeast and elsewhere.

The consequences of growth intervention are also different in leisure areas than in suburban areas. Cape Cod's "product" is not goods such as autos or computer chips or even such services as education or medicine. Its "product" is living accommodation for visitors and retirees, so slowing residential growth is also slowing growth in the region's basic industry. That isn't true on Route 128.

Intervening in growth has impacts on the Cape's complex dual housing market. To the degree that growth management either uses increased housing costs as a control device or has increased housing costs as a consequence, a major segment of the non-leisure population is hurt. That segment then finds it harder than ever to compete for housing against vacationers who are either wealthy or able to pay stratospheric costs by staying only a short while or against retirees who bring accumulated home equity and enjoy a tax treatment that encourages its reinvestment in housing.

Finally, one town intervening in growth is very different from a regional policy of intervening in growth. Given their size and proximity, Cape Cod towns individually enjoy no monopoly position, so the market effects of growth restraint in any one of them are tiny, other

towns readily absorbing any growth "pushed away". However, Plymouth County and the Islands couldn't readily offset the consequence of an effective Cape-wide action to slow growth; the results of which would clearly impact on the Cape's housing costs and social stratification.

In summary, growth rate control is not new, is clearly legal, can ethically be applied and probably should be; but to avoid negative secondary consequences, should be sensitively designed to protect both the region's economy and the housing needs of the non-leisure community. The remainder of this chapter outlines techniques which can be woven into such a design, with the hope that with better understanding of available methods, sound public policy can be better implemented.

Techniques fall into three categories: direct, indirect, and caps. All three types are in common use.

A. Direct Rate Techniques

This family of techniques controls growth rate more or less directly. Four common direct devices are moratoria, quotas, phasing, and stretchout.

MORATORIA

Moratoria proliferated in Massachusetts in the early '70s. Typically, they impose a zero growth rate for some class of development for a limited time while the community makes efforts to deal better with the development on a regular basis. Moratoria are timing controls in the sense that they don't change what you can do, only when you can do it. Probably half the towns on Cape Cod have used or debated using moratoria in the past decade, with current moratorium issues in Brewster, Barnstable, Orleans, Mashpee, and probably elsewhere. Although limited in time, the categorical prohibitions of moratoria make them extreme devices. They have possible severe consequences for some developers, but probably have little lasting consequence for the general population other than the intended effect of gaining time for the town to develop better controls or put infrastructure in place.

QUOTA SYSTEMS

Quota systems are "pure" rate controls. Under them, the community adopts a rule limiting annual growth to a stated rate: 400 dwelling units a year, perhaps, or 40,000 gallons per year of added daily waste disposal. No such "pure" system exists on Cape Cod: one was proposed for Falmouth in 1978 but not adopted, and Brewster recently debated but didn't accept a variant on such a system. Nationally, however, quota systems are fairly common, the most famous being that adopted in Petaluma, California. Nantucket recently adopted such a system for seasonal dwellings.

The key to the design of quota systems is the method of allocating permits in the event that the limit is reached. "First-come first-served" is clearly unreasonable, though often used (e.g. in Nantucket and in southern New Hampshire). Petaluma used and Falmouth proposed a point system to rank-order applicants, highest-scoring getting per-

mits, others put back in the pool. That requires delaying approvals until a pool is assembled for comparison, which means delays of several months if permits are acted on quarterly, or longer if Petaluma's annual actions were to be followed. If absolute growth rates are low, say under 100 dwelling units per year, it is difficult to make that competitive system work fairly and quickly.

Marin County, California, has adopted such a system countywide, with an annual county quota broken down by sub-county regions, then divided among towns in each region to establish responsible town-level quotas. That is one way of avoiding the evident danger of an inappropriate collective result from town actions which may individually seem reasonable.

PHASING SYSTEMS

Under phasing systems, growth and supporting services are directly linked. Rules are adopted which require some level of water, sewer, and nearby school adequacy as preconditions to eligibility for building permits. At the same time, the community lays out a schedule for extending services so that the level of services at any given location will be adequate to accommodate permits by some certain date. The system allows potential builders to base application for future permits on the present schedule, with the permit to be granted later even if the community falls behind its own schedule.

The key to these systems is the services schedule. The schedule is designed so that the amount of "adequately" serviced land will grow at a rate resulting in a rate of development the community is willing (and presumably able) to accept. Growth rate is controlled by scheduling services and linking development to them.

Few Massachusetts communities and no Cape Cod communities schedule service extensions with enough committed foresight to warrant basing controls on such schedules. The form of government, fiscal uncertainties, and the demands on scarce professional staff effectively preclude such scheduling, desirable though it may be. Ramapo, New York adopted such a phasing system, and was followed by Salem, Massachusetts, whose strong staff and circumstances allowed that approach. Recently, Ramapo dropped its system, citing changed circumstances.

Sometimes part of the phasing approach is adopted, the part requiring adequate services, without connection to a scheduled commitment for improvements. That partial approach is sometimes called "Adequate Public Facilities" (APF) laws. Such laws can raise serious issues of equity, and in the absence of scheduled improvements, aren't direct rate controls.

STRETCHOUT

Stretchout devices oblige developers to stretch out their developments over a fixed period, commonly seven to ten years. Tisbury may have been first in the nation to adopt such a law, and Bourne followed with several key refinements, one providing that such stretchout is necessary only when the townwide building rate exceeds a given level,

and a second refinement providing exemption for small developments. Variants on those models have been adopted in Sandwich, Chilmark, Edgartown, and most recently Falmouth. About a dozen other Massachusetts communities have adopted similar controls.

Popularity of this device is understandable. It doesn't depend on difficult facilities scheduling, and avoids the problems of determining who wins and who loses under strict quota systems. By incorporating a "trigger" or "threshold" rule, in slow years the stretch system imposes no administrative burden or imposition on property owners.

B. INDIRECT TECHNIQUES

More common than direct growth controls are indirect ones, often not explicitly discussed as growth controls but motivated by concern over growth rate, nevertheless. In this category are all the manipulations of either housing supply or housing demand which communities exercise. The classic is large-lot zoning, which lowers growth rate by pricing out a substantial part of the housing market, but there are many others, most carrying less substantial secondary consequences.

The most common techniques operate by either taking land out of available supply, or by creating conditions which encourage landowners to hold onto rather than develop land.

TAKING LAND OUT OF SUPPLY

Intuitively, it seems that by reducing land available for development, development rates should be reduced, and to a degree, that is true. The most obvious way of doing that is through public acquisition, an option widely employed on Cape Cod. Not only is there more reserved open land on Cape Cod than there is developed land (75,000 acres reserved versus 67,000 acres developed), but in the last eight years apparently more land was added to reserved open space than was developed (about 13,000 added acres of open space versus about 11,000 added acres of developed land).

Public land ownership can be supplemented with other supply-management devices. Deeded restrictions, for example, can effectively achieve the same reduction of land availability for development, while leaving the land in question in private ownership, privately maintained, and paying at least some taxes.

Regulations can have a similar effect. For example, a growing number of communities exclude wetlands from the definition of "lot area", in effect removing substantial land from that available to be credited towards meeting development rules. Though rare on Cape Cod, in other regions exclusive industrial zones prohibiting residences have been adopted, aimed as much at excluding land from the residential market as at promoting industrial development.

REDUCING HOLDING COSTS

A more positive approach to managing land availability is to reduce the costs of holding it, thus encouraging more property owners to hold out longer before selling or developing their land. Towns have several means of doing this, chiefly the tax treatment given to undeveloped land. Encouraging and facilitating the use of agricultural or forest use-value assessments for land, and differentiating tax rates among categories of land use (classification) are methods provided for in statutory law, and are supplemented by an array of more informal discretionary actions which together can substantially reduce the owner's annual cost of holding vacant land, thereby reducing the likelihood of it being put onto the development market.

Publicly installed services impact land supply two ways. First, for many builders land simply isn't available unless it is serviced with town water or sewer or both. Even in the absence of a phased growth bylaw, residential growth rate can be influenced by careful planning of the rate and pattern of services extension or, in the case of public sewerage on Cape Cod, system creation.

Second, the way those services are paid for can raise or avoid raising the holding costs for land, and thus impact land availability. The details of the design of betterment charges, user charges, and improvement districts (e.g. water districts) can have major effects on the costs of holding land out of development.

C. LOWERING THE SATURATION CEILING

By the year 2000, there will still be a substantial amount of undeveloped and unreserved but apparently buildable land on Cape Cod, about 45,000 buildable acres based on our projections, or just under 20 percent of the total land area of the Cape. Careful projections haven't been made beyond that date, but rough calculations suggest that by the year 2000 with continuation of recent trends (our Basic scenario) there would <u>still</u> be 19,000 buildable acres left on the Cape, with a winter population of some 250,000 people. Clearly, given continuation of past trends it will be very many years before the Cape's growth is constrained by running out of land, or reaching a "cap".

Many towns increasing required lot sizes would produce a large-lot alternative to the Basic scenario. The Basic scenario involves some increase in average lot sizes. The Large-lot alternative involves <u>much</u> greater increase in lot sizes and a 50 percent increase in average land consumption per dwelling unit over the Basic scenario. This Large-lot scenario probably has no effect on the Cape-wide amount of development, but rather spreads it out. The result is land saturation by 2020, "capping" the Cape's population at about 250,000 persons. That is one kind of growth control: using large lots to lower the "cap" or ceiling.

The same lowered ceiling or cap can be reached in a very different way, through a Focused scenario. This Focused scenario involves not larger lots but smaller ones, or more multifamily units at relatively

high density. This scenario assumes land consumption per added dwelling unit at three-fourths the amount in the Basic scenario, or half the amount consumed in the Large-lot scenario. Alongside that higher-density development would be accelerated open-space acquisition, in fact triple the rate assumed in the Basic scenario (open space acquisition is projected at a percentage of total remaining undeveloped land in each decade, divided between developable land taken out of potential development and unbuildable wetlands and dunes). This, too, results in land saturation in 2020 with the same number of dwelling units and the same 250,000 winter population as in the Basic scenario, but with a very different land use pattern. In the Large-lot scenario, there is about one-fourth more developed land than reserved open space at saturation. In the Focused scenario, there is one-half more open space reserved than there is developed land. That huge gain in open space can be thought of as not being in competition with building, but being in competition with large-lot zoning, since potential to accommodate 250,000 persons in 2020 is consistent with either large-lot zoning or reduced-lot zoning and aggressive open-space acquisition, but not with both.

There is another possibility for building to 2020: a relatively uncaring unfettered approach with both reduced land consumption per dwelling unit and a reduced rate of open space acquisition. In this case, saturation is not reached by 2020 if the rate of building is the same as in the other scenarios, in fact nearly as much vacant land remains in 2020 under this scenario as remained in 2000 under the Basic scenario. The "cap" would still be a generation or two away.

It is clear that there is a wide range of policy choice available regarding "build-out" or saturation. With no concerted intervention, there are far more than another 40 years of land availability left. Alternatively, we could have lower-density building and essentially full development in the year 2020, or higher density building and either a great deal more reserved open space or an even greater reserve of buildable land for yet decades more of building and a higher ultimate population.

BUILDOUT SCENARIOS

	S C E N A R I O S			
	Basic	Large-Lot	Focused	Unfettered
2020 LAND USE - ACRES				
Developed	105,200	124,300	96,600	93,700
Reserved open land	105,100	102,100	144,700	92,200
Vacant unreserved				
Buildable	19,300	3,200	2,500	40,600
Unbuildable	24,000	24,000	10,600	27,000
Total land	253,500	253,500	253,500	253,500
1983-2020				
Acres/year developed	1,100	1,600	800	800
Acres/year reserved	800	700	1,900	500
WINTER POPULATION				
2020	250,000	250,000	250,000	250,000
Saturation	300,000	250,000	250,000	350,000

D. A History Of Policy Choice[1]

In the early '70s, spurred by an unprecedented building boom, CCPEDC and others debated Cape-wide growth intervention.[2] A policy target of 2,500 dwelling units per year was considered and judged by many to be appropriate, allowing continued growth but not allowing this period to preempt all land for future generations. Had that suggestion somehow become law, growth on Cape Cod would have been lower than it was in seven of the ten past years, though until last year not by huge amounts.

In the later '70s Bourne and Sandwich adopted local growth rate controls. Both have had apparently ambiguous effect because of building downturns nationally and Capewide. which would have slowed development anyhow, and building peaks well above bylaw thresholds, chiefly the result of subdivisions which enjoy exemption because of "grandfather rights". However, when examined more closely, those laws have in fact affected the way development takes place. encouraging smaller developments and shielding the towns from even greater year-to-year gyrations.

In Bourne. adoption of growth rate controls provided an "umbrella of protection" against repetition of early '70s runaway development rates. Knowledge of that protection allowed the town greater freedom to implement regulatory changes liberalizing development controls. For example. multifamily development is allowed virtually everywhere in Bourne, a rule which has resulted in, among other things, development of low-density. environmentally sound, but affordable housing units. It is just such interweaving of control over growth rate with concern over housing cost and availability which ought to be encouraged Cape-wide.

The policy concern over growth rate began more than a decade ago. Tight and expensive money produced a building slow-down which lulled many into believing there to be no problem. Current unprecedented growth rates give currency to the policy debate again. This time the tools are known and tested. A responsible program of growth rate management deserves to be high on the regional agenda.

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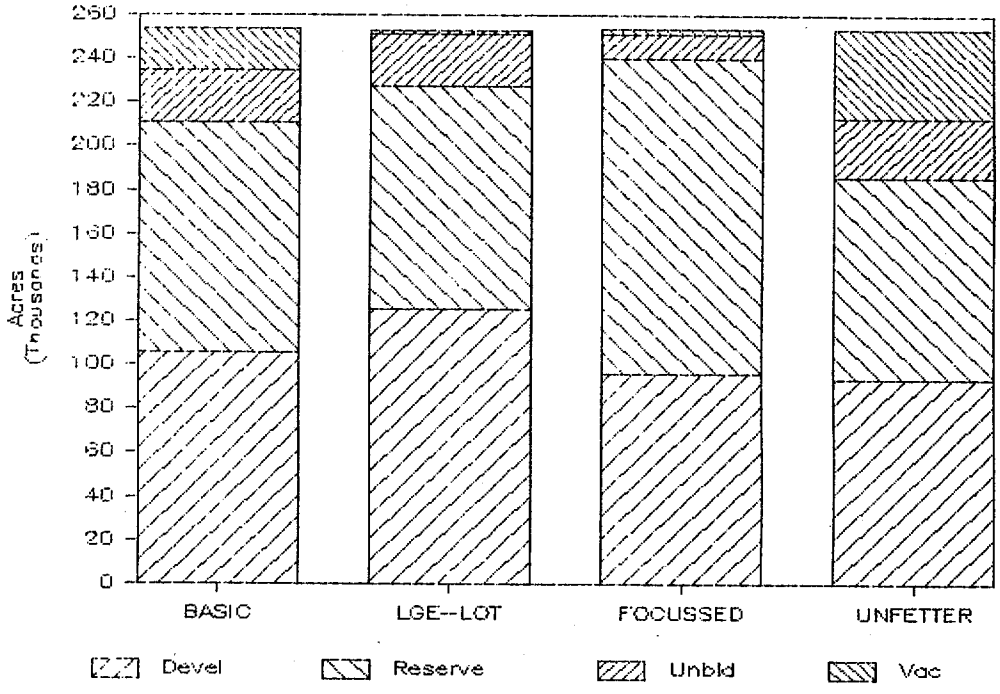
[1] Collura v. Town of Arlington, (Mass) (1975) 329 N.E. 2d, was the first Massachusetts case to validate a timing or rate intervention, a moratorium. Golden v. Planning Board of Ramapo, 30 N.Y. 2d, 1972, N.E. 2d 291, 1972, upheld a growth phasing law in a carefully contested case which is the first national precedent for growth rate controls. Construction Industry Association of Sonoma County v. City of Petaluma 522 F.2d 897 (9th Cir. 1976) certiori derived, 965.Ct. 1148 (1976) provided a test of growth quotas, Petaluma ultimately being upheld by refusal of the Supreme Court to review the case. Sturgis v. Town of Chilmark (1980) 402 N.E. 2d 1346, 380 Mass. 246, is the Massachusetts precedent upholding a growth "stretching" bylaw.

[2] See, for example, the policy statement "Resource Management", approved August 31. 1972 by CCPEDC. and "Land Use Policy and Strategy", by Herr Associates for CCPEDC, December 31, 1974.

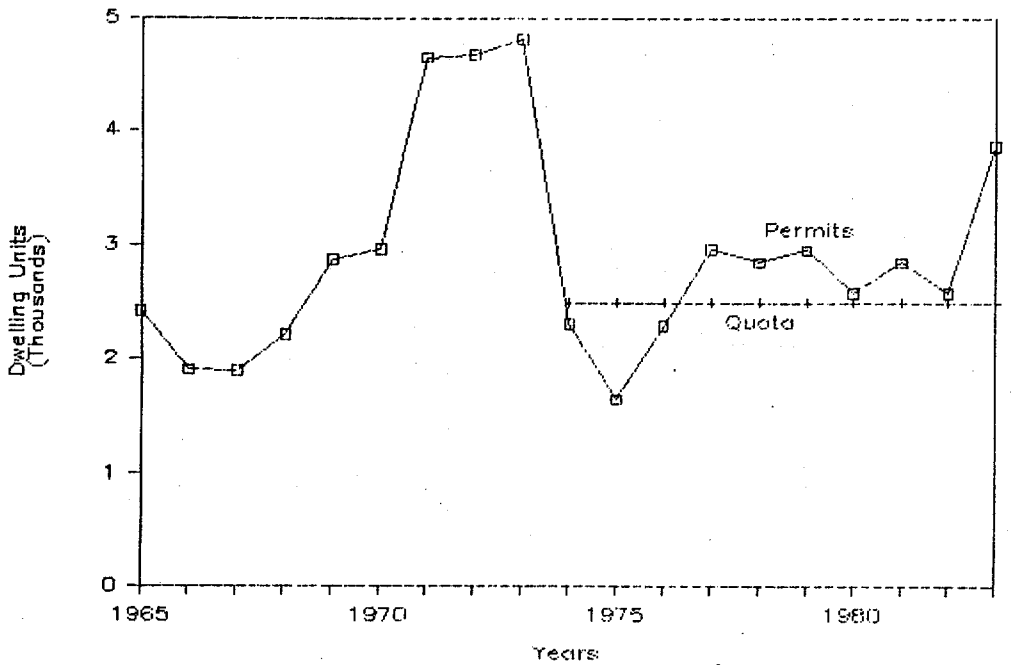
2020 LAND USE

20P0A/2020/APCC-3

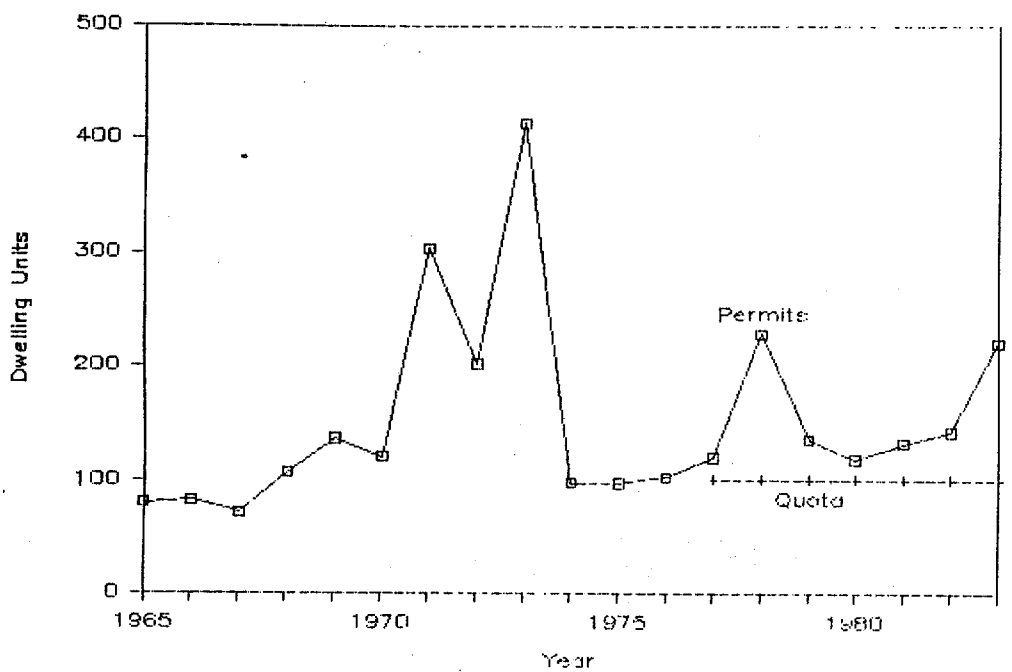
2020 SCENARIOS



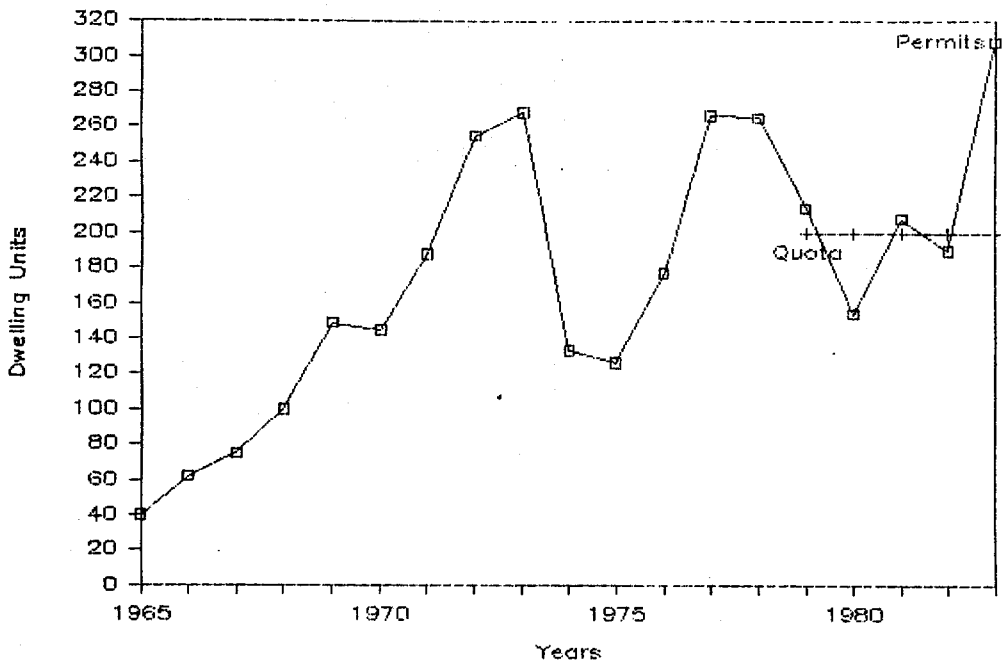
COUNTY BUILDING



BOURNE BUILDING



SANDWICH BUILDING



V. CAPE COD LAND USE PLANNING

Almost all Cape Cod towns have prepared Master Plans, but most of them date from the early '60s and early '70s and have not been employed consistently as planning tools. By contemporary standards the Cape's towns are only now beginning to plan effectively for the use of their land. This chapter outlines methods by which the use of land can be planned with greater care.

There are three traditional land use techniques, still the center of most planning board efforts: town planning, zoning and subdivision control. Each is discussed here, not in its traditional form but as it ought to be if growth is to be managed effectively, involving commitment of resources and willingness to innovate.

But gaining land for use as open space and recreation requires a different set of techniques, the most applicable of which are also discussed in this section. Special attention is given to two of them: community land trusts and conservation easements. Inevitably, meeting open space objectives will require funding. A land transfer tax dedicated to open space acquisition is presented here as one of the major proposals toward that end, and as a means of gaining needed funding.

Finally, land consumption is explored through case studies, and visual concerns are addressed: how local character and visual quality can be protected or even strengthened in the face of rapid development.

A. TOWN PLANNING

The image of "rural seaside charm" may have originated in the 1920s as a clever marketing campaign to promote tourism and second home development, but it also reflects a special quality, even magic, that literally millions of people have found here. Cape Cod is a special place, and for that very reason it is imperative to mobilize planning efforts to safeguard the essential qualities that make it special.

Planning includes many things: creating visions of a wished-for future, comparing that future with what is likely, designing public actions to bring the likely closer to the wished-for, working with town officials and others to get those designs implemented, and then reviewing the specific proposals through which change takes place: subdivisions, site development plans, and public facility investments.

Few towns do all of that. Most planning boards do the last of those, reviewing proposals, and a little of the designing of public interventions, chiefly through the medium of zoning amendments. Unfortunately, creatively designing hoped-for futures and joining efforts across town agencies are rare efforts, grossly out of pace with Cape Cod's rate of change. Town zoning inadequately substitutes for town planning: by default zoning plans become the blueprints for the future.

The speed and intensity of growth now taking place on Cape Cod are transforming the very essence of our communities. Now it appears that

each buildable lot will contain at least one building, and open space will remain only where construction is physically impossible, or where a deliberate decision has been made to avoid development. In less than ten years most undeveloped land in many towns will be subdivided; within the next 25 years many communities will have arrived at a "saturated" state of development.

Each year Cape Cod communities make painful new discoveries as to how inadequate are their planning, zoning, and land use regulations; how unprepared they are for the growth that is taking place; and how fragile and transient are the basic ingredients of the Cape Cod environment. Inadequate trash and waste disposal, contamination of the ponds and groundwater supply, crowded traffic conditions, and destruction of town character are among the most obvious problems resulting from the applications of the zoning blueprints and the evident lack of sufficient planning.

Had all Cape Cod towns done more planning at least 10 years ago, some major losses that have occurred could have been avoided. Yet there is still time for positive action. The greatest challenge at this time is to reach agreement within each town and among all of the towns that there are problems, that action is needed, and that action can be effective.

RECOMMENDATIONS FOR ACTION

1. Obtain Professional Planning Assistance.

Professionalism in planning has made enormous strides on Cape Cod. Ten years ago no town on Cape Cod had a professional planner. Today, a third of the towns, containing 60 percent of the Cape's current population and almost 60 percent of the Cape's projected growth to 2000, have at least one full-time planner. Barnstable led in hiring professional staff, followed by Falmouth, Yarmouth, Dennis, and Mashpee. Others have increased their use of other professional resources, including assistance from CCPEDC and professional consultants.

It still isn't enough. The demands on planning staff in the larger and faster growing towns are so large that current reactive reviews and administration consume all available time. Two-thirds of the towns still have no full-time staff.

Traditionally, Cape towns have relied upon volunteer citizen planning boards, and in fact, the state has charged these boards with the authority and responsibility for community planning. Town planning boards face a heavy work load of subdivision reviews, reflecting extensive residential and commercial construction. Many planning boards have additional responsibilities for review of cluster development proposals, site plan review, and sign and architectural review. The record of these boards is for the most part quite impressive, but part-time citizen boards, no matter how conscientious and experienced in the mechanics of subdivision review, cannot by themselves prepare the full range of plans, performance standards, and implementation

strategies that community planning demands. Their work load leaves neither time nor energy for other planning work, even though board members keep fighting to find extra time.

The answer for the larger and faster growing towns is full-time staff. More towns should join the ranks of the first five to have such staff. However, given the constraints of Proposition 2 1/2 and the understandable reluctance to increase the size of town government, some communities may not find it feasible to hire a full-time professional planning staff. Fortunately, there are other means of gaining needed assistance.

Here are three such options. First - a multi-town planner. Two or more towns could jointly employ one or more professional planners on a contracted service basis to provide professional planning assistance. These "circuit riders" could either be employed by individual towns or by the Cape Cod Planning and Economic Development Commission.

A second option is for a town to get planning services through contracts rather than employment. Although all Cape Cod towns would benefit from continued professional planning assistance, what is of greatest importance is immediate help in developing growth management policies, goals and tools to insure proper implementation and updating of community plans. Professional planners or planning firms can be hired on a short-term, contract basis for these tasks, shielding towns from the commitment to permanent staff.

Finally, all Cape Cod towns could jointly explore a new level of special planning assistance, the Financial Planning Assistant. Cape Cod is the fastest growing county in the Commonwealth and in New England; improper planning will have state-wide consequences. With towns unable fully to address growth-related problems under Proposition 2 1/2, it is perhaps time to request or even demand adequate state assistance. This could take the form of planning grants such as the one recently awarded to Yarmouth, or the provision of top-quality itinerant planners.

2. Assure a Comprehensive Perspective

The turf of Cape Cod planning boards is typically limited to land use. Planning boards are not and probably should not be super boards, exerting influence and authority over Conservation Commissions, Water Commissions, Historic District Commissions and Sewer Commissions, to say nothing of Selectmen and School Committee. However, managing town character and function cuts across the functions of all those agencies. For planning to be fully effective, with or without professional staff, there needs to be horizontal integration as well as a long-term perspective. The best way of getting that horizontal integration will vary among towns. However it is done, it is urgent that integration be done. These are some of the possibilities.

a. A Development Cabinet structure, in which agency representatives meet regularly to review what has been happening and to plan next steps. That group could, with the Planning Board's blessing, be charged with doing comprehensive planning.

b. Creation of a growth committee, similar to a development cabinet but perhaps not a permanent structure, and involving non-agency citizen participants as well as town officials. Again, this could be the group charged with planning, both developing policy and doing necessary implementation.

c. Use of ad hoc workshops and other devices. Without formal structural change, enormous improvement in understanding can result from conscious efforts at promoting communication. Occasional joint meetings, occasional cross-departmental workshops, and members designated to attend meetings of other agencies are but a few of the ways communication can be enhanced.

3. Prepare Action-Centered Plans

Townspeople themselves need to clarify what they must do to make a better future. The plans of the 60s and 70s should have pin-pointed those actions but seldom did, in part because the plans were generally created by off-Cape professionals remote from the local scene, and in part because the plans focused on ideal future states rather than on needed actions. Planners now know better how to engage the public, involve all necessary agencies and facilitate the local evolution of plans that truly reflect local priorities. Forging action strategies depends heavily on that laborious, time consuming but indispensable investment in creative rather than reactive planning.

To put it another way, an old-fashioned "revealed" blueprint for a distant future ignores too many contingencies and specifics to be useful, while a more dynamic and locally-grown approach can better help towns gain perspective, galvanize action and achieve control of their future.

The elements of those plans and the tools to carry them out are contained in this manual. What is needed is the local effort to bring those tools into action.

B. INNOVATIVE ZONING

The zoning bylaws and the zoning map are the strongest and most widely employed planning tools available to a community to control the use of land and the density of development. For many years in Massachusetts, Chapter 40A of the General Laws, "The Zoning Act", has provided the legal basis for community zoning, which, in its simplest form, specified areas for single and multi-family housing, for retail and wholesale businesses, for light and heavy industry (if desired) and for public uses such as parks, schools, hospitals and similar community institutions. Minimum lot sizes, set-backs from property lines, maximum height of buildings and attendant parking requirements (where

applicable), as well as commercial sign control are provisions common to most zoned cities and towns throughout the Commonwealth.

This simple zoning format served as the blueprint for most of the towns on Cape Cod, as noted in the previous section.

More sophisticated means to guide future growth, while better protecting the environment, are now possible with the mid-70s revision of the Zoning Act (Chapter 808 of the General Laws), and with the design and judicial approval of new techniques. Indeed, if properly drafted and applied with great care to avoid overstepping legal bounds, certain of the zoning innovations cited hereafter offer the Cape towns the best opportunity to turn the tide of development into constructive channels.

OVERLAY DISTRICTS

Flood plain zoning, groundwater districts and historic districts are all familiar examples of overlay zoning. It is a flexible technique which allows towns to recognize unique areas or critical resources. In such districts "overlay" regulations are applied in addition to the existing, regular zoning of the underlying zone.

Of great significance, overlay zoning permits towns to proclaim legally that not all land in the same basic zoning district is identical. It puts the control where it is needed without subjecting property owners to undue regulatory interference. However, it does require careful work to define the district adequately prior to adopting a bylaw. Without a clearly identifiable district the enforcement and administration of a bylaw becomes a mire open to legal challenge, which could result in overturning an otherwise well-written law.

The best know forms of overlay districts on Cape Cod are floodplain, aquifer and historic districts. Others as well can yield real benefits for many parts of the Cape. Examples include:

1. Ecological districts, identifying and providing protection to wildlife habitats, etc.
2. Harbor or coastal overlay zones for control of the visual environment, including special set-backs and/or planting.
3. Onshore districts to insure that important maritime activities will have land access to perpetuate the fishing and boat-building industries.

WATER ZONING

Zoning districts need not stop at the water's edge. They can continue over the water, providing a legislative means of managing use of water bodies. Few communities have done anything to manage water bodies for appropriate uses - except, perhaps, to ban motorboats on a few ponds. Stricter zoning would appear to be absolutely essential unless Cape waterways and harbors are to be regarded as future extensions for population growth with floating neighborhoods of houseboats.

In addition to prevention of the foregoing, water zoning should give consideration to:

1. Mooring areas with channel capacity reserved for commercial fishing. Areas for pleasure craft, recreational use, skin divers.

2. Areas free of motor boating.

3. Water areas, as well as wetlands, reserved for wildlife.

CONTROL OF GROWTH RATES (SEE SECTION IV, MANAGING GROWTH RATES ON CAPE COD)

INCENTIVE ZONING (AUTHORIZED BY SECTION 9 OF CHAPTER 40A)

Instead of zoning always saying what is not allowed, incentive zoning focuses on what is wanted. The town of Bourne, for example, explicitly retains woodland, or gets housing equipped and reserved for the elderly, in exchange for bonuses to the developer such as a specific percentage increase in the allowable number of dwelling units.

Other towns might reward provision of housing for low and moderate income families or amenities such as off-site pedestrian improvements with similar percentage increases in allowable density. The law specifies only that trade-offs be explicit and that a limit to the bonuses be established.

PERFORMANCE ZONING

Performance zoning is based on the premise that more flexibility in the application of zoning regulations can often achieve development which more precisely carries out the regulatory intent - similar to the way incentive zoning works. Performance characteristics of the land (suggested by topography, soil types, and soil conditions, for example) together with the performance attributes of development (such as sewage output, potential traffic to be generated) serve as the basis for regulation, rather than basing it on categories of land use and categories of district.

Refining zoning in this manner requires skill and care to avoid making administration more complex. Cape towns, with growing planning expertise, may be prepared to adopt this innovation in the near future.

TRANSFERRING DEVELOPMENT RIGHTS*

Under many present bylaws, "cluster" or "open space village" development employs transfer of development rights (TDR) permitting the developer to transfer all his building rights to one part of his

* Edited from A Guide to Massachusetts' New Zoning Act - Chapter 808 of the Acts of 1975, prepared by Philip B. Herr and issued by the Cooperative Extension Service.

property in favor of permanent open space on another portion of his land, while not exceeding the overall allowable number of housing units. Bylaws in some Cape Cod towns go farther and allow the transfer of development rights to adjacent parcels as well, even though the parcels may not be under the same ownership.

The next step is to allow transfers between non-contiguous parcels, as a number of off-Cape towns now do. In this way, transfer of development rights can achieve the preservation of agricultural, horticultural and forest land or scenic views. The virtue of this approach is that it encourages development on well-suited parcels and allows those parcels best undeveloped to remain in their natural state.

OPEN SPACE VILLAGES II

The open space village (OSV) model for cluster development, designed in the early '70s under CCPEDC sponsorship, has had major influence on Cape Cod land development, having been adopted in various forms by many of the Cape's towns. Perhaps now it is time for OSVII. These are the key features of the OSVII approach.

1. All subdivision of, say ten or more lots would require a special permit.

2. A submittal requirement for that special permit would be concept-level plans for two or more alternative schemes, including at least one utilizing OSVII flexibility. The Planning Board would be able to select that plan which best serves the bylaw criteria, including habitat preservation, protection of groundwater quality, and impact on town character.

3. The OSV rules would, as the older model does, fix the overall development density at the parcel level, and allow individual building lots to be smaller if compensated for by reserved open space. The difference in OSVII would be one of degree, allowing much deeper reductions in individual lot area requirements and in turn allowing reservation of much more significant open spaces.

4. There would be several refinements beyond the OSV rules to allow wide application, including provision that the open space need not be common open space (but could be more simply deed-restricted against development while remaining individually owned), and elimination of the common minimum tract threshold of 10 to 20 acres.

The foregoing are the most prominent of innovative zoning possibilities now available to communities under Chapter 808 (and Section 9 of Chapter 40A). Of course, it should be stressed that communities still cannot take property without compensation or in any other way violate the United States or Commonwealth Constitutions.

C. SUBDIVISION CONTROL

Town control over subdivisions is authorized by the Subdivision Control Law, Chapter 41, section 81-A to 81-GG. Unlike the Zoning Act, the Subdivision Control Law has not undergone comprehensive revision in recent years, still retaining its 1950s structure despite ad hoc amendments since then. APCC has been clear in its criticism of that law (see "The Massachusetts Subdivision Control Law and Local Control by the Towns", Nickerson and Nickerson, APCC, 1974). However, in spite of the law's constraints on local authority, much constructive management beyond that commonly exercised is possible under it. Three things in particular should be done by Cape Cod towns.

First, the standards by which subdivision streets are built has enormous impact on how streets affect town character. There is a choice between rural and suburban character in arcane topics like maximum allowable grades, lengths of tangents connecting curves and vertical curve specifications. Too often wrong choices are made because of inability to understand that connection, because of anxiety to serve vehicular convenience and because of belief that only controls which are punitive to developers are sound. The result is legislated suburbia. Rules which are strict in regard to how steep or curvy roads may be, or whether there are curbs or sidewalks, often destroy Cape Cod character in service to the auto and urban amenities. Similar and even more obscure issues regarding stormwater management also actively require environmental destruction. Each town should reexamine its subdivision controls, most of which reflect 1950s ideas if not 1950s authorship, to see how they might be revised to better fit roads to the land rather than vice versa, and how to more substantially emphasize environmental protection in the process of development.

Second, a great deal of development escapes subdivision control altogether by dividing land along existing ways having some degree of public standing. These "approval not required", "81-p" or "Form A" plans, as they are variously called, are the vehicle for a great deal of the Cape's development and have permitted development where road conditions and utilities are inadequate - two of the worst offenses. Recent court decisions[1], however, clarify that nothing of the sort need be allowed.

Towns may and should specify in their subdivision regulations what standards are to be met by existing roads in order to qualify land for division. Those standards would vary with potential demand, roads potentially serving many homes being required to be more substantial than those potentially serving few. Plans for lots having frontage on substandard roads and which therefore fail to provide access as intended by the Subdivision Control Law can then be refused.

Similarly, recent case law allows towns to establish standards of access for the streets by which a potential subdivision is to be reached, and to require that, within reason, the developer bring the access streets to that standard or be refused plan approval.[2] Too often perfectly sound streets within a subdivision are only reached

via hopelessly inadequate existing ones. The town is under no obligation to upgrade streets simply in order to make land speculation profitable; however, upgrading can and often should be made a private obligation.

Third, town planning boards should be given choices in acting on plans, not just be forced to face a single "take it or leave it" plan, as is common. Alternative plans can reasonably be requested at the preliminary plan stage, perhaps showing conventional versus clustered development, or even single-family versus multifamily development. Only by wide choices can decisions effectively address the broad questions of habitat protection, visual character and environmental quality. The cost of designing alternatives at the early stage is small, especially when compared with the private cost of later definitive plan rejection, let alone the public cost of permanent environmental damage.

Alternatives may be requested under subdivision control, but requiring them appears to demand provisions under zoning as well. Recent case law is encouraging in having left intact a town's requirement that certain divisions of land be authorized only under a zoning special permit.[3] An example of this new zoning concept might be that subdivision of more than, say, ten lots would be allowable only on special permit with a requirement for submittal of alternative plans. A carefully constructed set of decision criteria would be the basis for selecting among those alternatives. Precedent for this doesn't exists, but its promise merits its exploration.

Alternatives are meaningless unless controls are flexible enough to allow real choice. The typical Cape Cod town's cluster zoning allows some variation, but flexibility is limited by the relatively small reduction allowed in individual lot size. Greater choice and therefore potentially greater environmental protection is offered when zoning fixes the density at the parcel level but then gives great flexibility in choice of dwelling type, whether single-family detached or townhouse, and in minimum lot size, whether essentially uniform or varying down to that which is the very smallest environmentally supportable. By allowing more compact development on parts of the parcel in return for open space reservation on other parts, location becomes a choice within the parcel. It is then no longer necessary to cover all of the land with development, as results even with conservative cluster laws, and as a result there is real choice and the potential for truly creative solutions to development opportunities.

Notes

[1] See especially, Perry v. Planning Board of Nantucket (1983) 444 N.E. 2d389, 15 Mass. App. 144.

[2] North Landers Corp. v. Planning Board of Falmouth, (1981) N.E. 2d 934, 382 Mass. 432.

[3] Louis Giuliana et al. v. Town of Edgartown, et al, Civil Action 81-2868-6, U.S. District Court, District of Massachusetts, Feb. 8, 1982.

D. TECHNIQUES TO SECURE OPEN SPACE AND RECREATION LAND

Providing open space and recreational opportunities together with establishing land conservation programs is not a luxury that Cape Cod towns can afford to provide after all their other needs are satisfied. It is an essential ingredient in the lives of town residents and thus must have high priority in the planning for services and facilities. Land conservation planning can hardly occur too early, for as development pressures increase, the opportunities for meeting recreational and conservation needs automatically decrease.

Depleted municipal revenues and inflated costs of undeveloped land have reduced individual towns' abilities to purchase land. The increasing number of sales of land parcels to commercial, industrial and residential developers has reduced the amount of land available for acquisition. Although such development may serve to broaden the local tax base, (an initial plus, but increasingly, a long term minus due to the costs of added services), several Cape towns have discovered that in many instances within their more congested neighborhoods, they have lost the only land available for needed park, recreation and conservation lands.

The acquisition and protection of open space provides a number of economic and social benefits to the community. In addition to allowing for park and outdoor recreation opportunities, the preservation of community open space increases adjacent land values, helps retain a community's character, and most significantly, permits the channeling of growth in a more effective manner than mere enforcement of zoning or subdivision regulations. For these very reasons, it is recommended that Cape officials and residents take advantage of whatever programs, processes and regulations are available for the systematic procurement of open land within the towns.

Once traditional methods of land planning for park and outdoor recreation facilities are no longer accepted as entirely reliable. Old formulae such as space standards are inadequate guidelines for local acquisition programs. Furthermore, plentiful dollars and abundant land are simply not available. There exist, however, numerous innovative legal and administrative techniques individual towns can use to acquire and preserve lands for parks and outdoor recreation facilities, as well as conservation and agricultural lands.

Although many land acquisition and control techniques are available to municipalities, they have traditionally been grouped into three major categories: acquisition (fee simple, easements and convenants); taxation (preferential assessment, tax deductions); and regulation (zoning, subdivision controls). Recently, many municipalities have supplemented these traditional acquisition strategies by establishing community land trusts. A discussion of this variation from the traditional methods of land procurement follows a brief review of subdivision dedication requirements, purchase and lease back, community land banks and acceptance of private donations which continue to enjoy considerable success.

SUBDIVISION DEDICATION REQUIREMENTS

Subdivision dedication requirements permit towns to require land developers to reserve land for park and outdoor recreational uses within a subdivision. By requiring developers to provide adequate open lands as well as septic systems, drainage and road improvements, subdivision regulations can positively guide the development of a municipality. Mandatory dedication requirements represent an effective means of procuring park land in developing municipal areas. This acquisition device is least useful, however, in those portions of a municipality already developed.

Although statutes requiring the dedication of park land as a precondition to the approval of subdivision plans exist in most states, Massachusetts prohibits planning boards from requiring mandatory dedication of park lands for a period of more than three years. This prohibition seriously reduces the ability of rapidly developing towns such as Falmouth and Barnstable to set aside open space through subdivision control regulations.

The town of Falmouth countered this difficulty by establishing an "Open Space Residential Development" zoning bylaw. In addition to being an imaginative alternative to the typical grid layout of lots in a subdivision, the bylaw allows the town to require land from subdividers to be set aside in perpetuity as open space. In return, the subdivider enjoys several benefits vis-a-vis lower roadway, utility and construction costs.

MGL, Chapter 40A, section 9 allows towns to accept lands set aside as open space within open space residential developments. This provision allows Falmouth an opportunity to develop interconnected open space throughout the town as open space residential developments are laid out.

PURCHASE AND LEASEBACK

As a form of land use control, purchase and leaseback has been successfully used by the town of Falmouth for several years. Purchase and leaseback is the acquisition of land by purchase, eminent domain taking, or by gift, and the subsequent leasing of the land to an individual or individuals for a specific use.

Falmouth has been using purchase and leaseback in the operation of the town's cranberry bogs by acquiring the bogs and then leasing the rights to farm the land on a ten-year basis. This arrangement could easily be expanded to include farmlands. Essentially, towns would acquire suitable agricultural properties, post bidding notices and grant long-term farming leases to the highest qualified bidder. The town would also have the right to impose restrictions on what can be done on the land, in a fashion similar to the restrictions imposed upon the lessee of Falmouth's cranberry bogs.

COMMUNITY LAND BANKS

Land banks have traditionally been used, and are currently being viewed as a more efficient and effective means of combatting the disappearance of park and open space land than subdivision regulations, easements or other traditional land acquisition strategies. In actuality, land banking refers to the process of the town entering the real estate market to buy and sell land. An advantage of community land banks is that the municipal ownership of the land permits implementation of comprehensive land use plans that would otherwise be impossible. The principal advantage of land banks, therefore, is that the town makes major development decisions, rather than having a host of private developers make such decisions.

The advantages of establishing a municipal land bank include many other benefits which are well beyond the scope of this paper. These benefits, like the costs associated with a municipal land bank (lost tax revenues, distrust of governmental land ownership, and the potential conflict of purchasing private lands with public funds for an assumed public purpose) must be weighed by Cape town officials and residents.

E. COMMUNITY LAND TRUSTS

As a response to the acute shortage of suitable park land in many municipalities and an inability to purchase land because of lack of dollars in others, towns are searching for ways to solicit land, funds and services from the private sector.

The motivation for donating or selling land to a municipality at a reduced market value is similar for both the corporate sector and private individuals. Tax deductions, improved community relations, a desire to preserve an aesthetically pleasing parcel of land or the inability to develop profitably a particular land parcel are some of the reasons private sector contributions of land are made. It is important, therefore, that Cape Cod's town officials not only be aware of the pool of private land available in their jurisdiction, but also that they formulate ways to tap this resource.

A conservation trust is a private organization dependent upon public support for its initial creation and continued existence. It is private in the sense that it is not an instrumentality of government. It is an effective mechanism for the acquisition and administration of land for preservation in its open and natural state.

Conservation trusts arose as a positive step out of a dissatisfaction with instrumentalities of government such as conservation commissions. Unfortunately, conservation commissions are so inundated with plans for development that they do not have time to work on their other delegated function, which is to acquire land for preservation.

As a charitable organization, a conservation trust has a perpetual existence. Its Board of Trustees is analogous to the Board of Directors of a corporation, but as a requirement of its non-profit status, it has members rather than shareholders. Another form of organization for the same purposes is the conservation foundation,

which can also be a non-profit corporation. A key attribute of both these entities is that upon the winding up of their affairs, should that ever have to occur, the assets thereof are not distributed among the members, but rather are turned over to another similarly qualified non-profit corporation.

The existence and utilization of the trust as an organizational entity has long been recognized under the laws of the Commonwealth of Massachusetts. In terms of the conservation trust organizations with which the writer is most intimately connected, the trust form of organization was selected on the basis that a trust is a simpler device to operate than a corporation, even a non-profit corporation. Both can, however, achieve the same results.

After the organizers of either a conservation trust or a conservation foundation have chosen that form, there must be obtained from the Internal Revenue Service a designation as a qualified charity. This has two effects. First, such a designation means that the organization is exempt from federal income taxation. Normally, the Commonwealth of Massachusetts will recognize a determination of tax exemption by the Internal Revenue Service. Secondly, the determination from the IRS qualifies the organization as a charitable entity, making donations from donors deductible as a charitable contribution. This latter designation is obviously vital in terms of attracting donors for the support and operation of the organization from the public at large.

As an indication of the perceived need for conservation organizations of this type, five such organizations have been created on the Lower Cape within the last five years. One Cape town, Dennis, has gone another route, acquiring considerable acreage of land for the purposes of conservation through governmental efforts. Dennis has even used bonding and eminent domain to acquire conservation land. This suggests that there are considerable tools available for the purposes of preservation when and if the citizenry is aroused to utilize them.

Despite fears to the contrary, land designated for conservation by one of these instruments is fairly safe. While a town meeting can vote to rescind land being held for conservation purposes, Massachusetts law allows land so held to be removed from that designation only by a special act of the Legislature. Such acts are seldom opposed, however, and routinely sail through the Legislature. In contrast, the trustees of a conservation trust or foundation which relies on public donations must be very public-relations conscious about their management decisions if the public is to be encouraged to continue making donations. A conservation trust relies on public trust, and so far in over a decade of experience on Cape Cod, this trust has been fully justified.

For the most part, conservation trusts rely on donations of land for the holding which they acquire. In some instances purchase has been resorted to, but they are few and far between. However, the existence of an organization like a conservation trust is a mighty tool for a campaign to acquire funds for the purpose of land which needs to be protected and preserved in its natural and open state. These fully

qualified charitable non-profit organizations provide an inducement to the public at large to make cash donations, if needed, to raise funds for purchase. Along the same lines, this charitable entity constitutes a selling tool that can be employed to convince a land owner planning to convey his land in exchange for money to do so at less than full market value. He, too, can take a deduction for that portion of the value that he donates, an action which saves him some portion of capital gains taxes.

A conservation trust is an effective method of acquiring land to preserve it in its open and natural state. In this manner we may continue to enjoy it in the face of the unrelenting pressures of development.

F. Conservation Easements and Agricultural Restrictions

Conservation easements offer many property owners a valuable option. By foregoing future development of the land, the owner benefits from significantly lower property taxes and, upon sale or inheritance, the estate should also benefit from much reduced capital gains taxes. Of course, the community benefits as well by a reduction of developable land and the addition of permanently protected open space.

While this option may have its widest appeal among large land owners, there are many smaller holdings to which the conservation easement can apply. While conservation easements may be designed to suit the property and persons involved, care must be taken to be consistent with federal and state laws in the preparation of such agreements between the grantors (owners) and the grantees (towns) to avoid legal misinterpretations that might negate or lessen the benefits to both parties. (Recent IRS examinations give importance to this note of warning.)

For example, conservation or restriction easements may:

1. Restrict the number of houses to be build upon a certain parcel of land;

2. Restrict the future uses of a piece of land;

3. Allow public access across the land;

4. Specify that the land remain undeveloped in perpetuity, prohibiting clear cutting of trees or vegetation, for example;

5. Prohibit the location of billboards, signs, etc., upon the land.

It is important to note that conservation easements do not necessarily guarantee public access to private land. Specific access and/or construction plans, if applicable, must be written into each easement. This must be worked out between the land owner and the town or receiving agency. Generally, conservation easements and restrictions do not remove land from the tax rolls in its entirety or remove the

owner's right to sell or lease the land at any time subject to the terms of the restriction and - under certain circumstances - the repayment of back taxes. The Massachusetts Land League cities estimated annual losses of agricultural land in excess of 11,000 acres per year between 1951 and 1971 to urbanization. In the past decade losses have continued at a reduced pace. In forty years Massachusetts has lost over a million and a half acres of farm land. The disparity between the value of land for agriculture and and the value of development land has widened rapidly since World War II. The incentive to sell farm land for non-agricultural uses is too often difficult to resist. Even the value of farm land carries too high a price for another farmer if the potential development value is included in the asking price.

In 1980 the Commonwealth added to its conservation restriction options the Agricultural Preservation Restriction Program (APR) to help offset the continued rapid loss of farmland. The voluntary APR Program provides for purchase of the development rights from a prioritized list of applicants. (Priorities are based upon specific criteria employed by the APR nine-member committee.)

The Commonwealth pays the landowner the difference between the appraised value of the land for development and its agricultural value. Thereafter, the land is taxed solely as farmland. The economics of this program have kept more than 130 farms in business and thus have passed on the opportunity to continue farming that property.

A model of the success of this program is the 220-acre Windstar farm on Cape Cod. According to the August 1984 letter from the Massachusetts Land League, this farm was destined to become a 440-unit condominium development and golf course. It is "now producing over 25 tons of vegetables this year because two young farmers have had the opportunity to lease the farm on a long-term basis now that the owner has sold his development rights".

The APR Program is currently funded through legislative bond authorization in the amount of 45 million dollars.

The above two programs, conservation easements and agricultural restrictions, differ in that the first is negotiated with the town and the second with a state agency. A third program again works locally. The MGL Chapter 61A tax assessment law enables a working farmer to apply to local assessors for a tax abatement which in some instances on Cape Cod has cut tax liability by a factor of 20 (from a "highest and best use" market value-based tax of $20,000 down to $1,000 per acre for a vegetable farm in Falmouth.) To qualify, farmland must total five contiguous acres and show revenue of $500 per year for two years in a row. Town tax assessors or the County Extension Agent can supply complete details of the program's fairly complicated requirements.

To be more useful on Cape Cod, the required acreage under Chapter 61A needs to be reduced to three contiguous or five non-contiguous acres, and the tax incentive should begin on the first day rather than only being available as a rollback after two years. These amendments are

the subject of legislation which has been filed several times in the General Court and is being carried by the Massachusetts Farm Bureau, whose current president is a Cape Cod farmer.

G. Land Transfer Tax

The fairest and most straightforward way to control the use of land and/or its development is to buy land outright. This is how our earliest American communities regulated land-use for the benefit of the common good. Acquiring open-space land would return to the practice of the community ownership of "common" lands, with one important distinction. Cape Cod's earlier community leaders were concerned to promote the settlement and exploitation of Cape Cod. And from very early times, their approach to this task was to pursue policies that, throughout the history of Cape Cod, have tended to deplete its natural resources. The present day objective for acquiring "common lands" is to promote the general welfare and protect the quality of life by preserving natural areas.

One consequence of the development of Cape Cod has been to create a very substantial economic base from which to generate the wherewithal to carry out a plan of community acquisition of land, or development rights in land. The authority for such acquisitions exists -- by negotiated purchase or taking by eminent domain. Improved procedures are needed for linking the authority to acquire land with the resource capacity to pay for acquisitions.

A promising new mechanism which has been established by state legislation enacted in 1983 for Nantucket County is the so-called "land bank."[1] This type of legislation could well be the key to the future as it provides a viable model for 1) just compensation of land owners and 2) proper municipal acquisition and protection of important resources. The Nantucket bill created a special new Nantucket Islands Land Bank Commission which is empowered to acquire and manage land and interests in land as follows:

1. ocean, harbor and pond frontage in the form of beaches, dunes and adjoining backlands;

2. barrier beaches;

3. fresh and salt water marshes, estuaries and adjoining uplands; and

4. heathland and moors.

The commission is obliged to hold the land it acquires "in its natural, scenic or open condition" and is charged not to allow any exploitation of the land or anything unsightly or detrimental to be done thereon.[2]

The commission is given the right to finance land acquisitions by borrowing money,[3] or by drawing upon a special land bank fund into which are to be deposited funds appropriated by the county commissioners of Nantucket County or a town meeting of Nantucket,[4]

voluntary contributions to the fund, proceeds from disposal of real property or interests therein, and revenues from a 2 percent fee on the purchase price paid for the transfer of land or any interest in land situated in Nantucket, subject to certain exemptions.[5]

The authority to use the land-bank funds for this purpose achieves the necessary linkage of authority to acquire land with the wherewithal to pay for acquisitions. It means that the commission can, without time-consuming prior approval procedures, proceed promptly to negotiate purchases that are within the current fiscal capacity of the land-bank fund. When land acquisitions must be made by condemnation, or when the commission elects to raise funds by the issuance of bonds, there must be a two-thirds vote of town meeting. However, the commission's authority to use land-bank funds to pay for staff and professional services assures its ability to prepare necessary surveys, appraisals, and public information materials without delay or the need for prior approvals.

It is too early to assess the Nantucket commission's land-acquisition program, but transfer-tax revenues are reported to be running at an annualized rate of about $2 million.

Bills have been introduced to establish land-bank arrangement for Dukes County (Martha's Vineyard)[6] and Cape Cod.[7] Because our concern is for Cape Cod, and because the measure proposed for the Cape differs more widely from the Nantucket legislation than does the Dukes County bill, we will focus on the proposal for the Cape.

The chief difference between the land bank proposed for Cape Cod and those for the islands is that the former is not a regional arrangement. Instead of providing land-acquisition authority and funding capacity to be employed on a countywide basis, the Cape Cod proposal would establish a land bank in each of the Cape's 15 towns. Any two or more towns could presumably concert their efforts, but the proposed legislation gives towns no obligation, incentive, or facilitation to work together on a regional or sub-regional basis.

Instead, the proposed bill for Cape Cod calls for each town in Barnstable County to decide, for itself, by referendum, whether or not to accept the proposed "open space land fund" legislation. If a town's voters accept the law, a 2 percent sales tax goes into effect on the purchase price over $50,000 of all transfers of land in the town, subject to certain exemptions.[8] The town would be free to lower the rate of tax and/or to raise the $50,000 threshold of taxable purchase-price, through the adoption of a general town bylaw, by majority vote of town meeting.

Revenues generated by the land-transfer tax would be received by the Barnstable County Registrar of Deeds on behalf of each town's tax collector, and paid over to the town treasurer for deposit in a special account. The Cape Cod bill creates no new body to expend these revenues for the acquisition of open space land. Instead, as explained below, the bill provides that revenues may be used by the

town conservation commission for various land-acquisition and management purposes for which towns already possess authority under the General Laws of Massachusetts.

The bill provides that the town's conservation commission may use the land-bank funds for all its activities authorized by MGL Chapter 40, section 8-C, viz.: 1) promoting and developing natural resources, 2) protecting watershed resources, 3) researching local land areas, 4) coordinating unofficial bodies organized for similar purposes, 5) producing and distributing books, maps, charts, plans, and pamphlets necessary for its work, 6) employing staff and consultants, 7) purchasing interests in any land or waters in the town, 8) acquiring, maintaining, improving, protecting, limiting future use of, or otherwise conserving and properly using, open space in land and water areas within the town. The bill provides that for any single expense less than $50,000, approval of the selectmen/town manager is needed; for any single expense in excess of $50,000, town meeting action by simple majority vote is needed, with two-thirds majority vote required for condemnation of land.

Under the bill, the conservation commission may also use land-bank funds for 9) recreational purposes deemed by the selectmen/town manager to be "active recreational purposes not harmful to the environment", and 10) acquisition of agricultural, horticultural, and forest lands held under MGL Chapter 61 and C. 61A. For these two purposes, the bill calls for town meeting action, by simple majority vote, with a two-thirds majority vote required for condemnation of land.

The bill also provides that revenues from the land-transfer tax may be expended to retire any debt incurred by a town to acquire land for conservation, recreation, or open space purposes, even if the debt was incurred, or the acquisition made, before the town accepted the open space land-fund law.

Table 1 shows what the revenues would have been from a 2 percent land sales tax for each of the 15 towns of Cape Cod, if the tax as proposed had been in force in 1983.

Consideration is being given to modifying the Cape Cod land-bank proposal to provide for a portion of the land-transfer tax revenues to be retained in a land-bank found to be managed by some county body for regional purposes. This would facilitate the acquisition of key parcels of open space land lying athwart town boundaries. It would also enable the county to provide incentives and assistance to towns, and to achieve economies, with respect to the administration of their land-acquisition programs.

Notes

[1] 1983, Massachusetts Acts, C. 669.

[2] Ibid, Sec. 6.

Notes

[3] Through the issuance of bonds to be general obligations of Nantucket (town or county), as authorized by a two-thirds vote of a Nantucket town meeting.

[4] County and town are one and co-extensive in Nantucket.

[5] Exemptions include the first $100,000 of the price of any first time purchase of Nantucket property made for a permanent domicile, and transfers made to any government agency, without consideration, to any charitable or religious organization.

[6] 1984, S. No. 1972.

[7] 1984, H. No. 5914.

[8] 1984, H. No. 5914, Sec. 14E. Exempted transfers would include those to government agencies, those made without consideration, and those made to public charitable or religious organizations.

Table 1
Revenues from land transfer tax,
as per House Bill No. 5914(1984)
based on 1983 land transactions

	(1)	(2)	(3)	(4)	(5)
	Sales @ Price > $50,000		$ Value of	Taxable	Tax yield
Town	No.	$ Value	exemptions	value	at 2%
Barnstable	1,196	$ 117,151,860	$ 59,800,000	$ 57,351,860	$1,147,037
Bourne	247	21,689,966	12,350,000	9,339,966	186,799
Brewster	162	17,479,800	8,100,000	9,379,800	187,596
Chatham	291	34,119,092	14,500,000	19,619,092	392,382
Dennis	490	42,267,304	24,500,000	17,767,304	355,346
Eastham	129	10,155,032	6,450,000	3,705,032	74,101
Falmouth	548	62,484,546	27,660,000	34,824,546	696,491
Harwich	301	28,679,218	15,050,000	13,629,218	272,584
Mashpee	240	29,308,090	12,000,000	17,308,090	346,162
Orleans	217	25,462,514	10,943,000	14,519,514	290,390
Provincetown	111	15,514,000	5,550,000	9,964,000	199,280
Sandwich	320	26,107,305	16,040,000	10,067,305	201,346
Truro	61	7,098,250	3,050,000	4,048,250	80,965
Wellfleet	74	6,908,050	3,700,000	3,208,050	64,161
Yarmouth	687	61,012,879	34,350,000	26,662,879	533,258
Cape Cod	5,074	$ 505,437,906	$254,043,000	$251,394,906	$5,027,898

These statistics were compiled with assistance provided by the Cape Cod Planning and Economic Development Commission from data on individual transfers recorded at the Barnstable County Registry of Deeds and published by Warren Publishing Corporation (Boston) in Banker & Tradesman, and aggregated and republished by Real Estate Data Publishing (Framingham) in the 1983 Transfer Directory for Barnstable County.

(1) Total number of 1983 land transactions at a price of more than $50,000.

(2) Total dollar value of the transactions counted in column (1).

(3) $50,000 per transaction counted in column (1), plus the entire value above $50,000 for each transaction entirely exempt, e.g. transfers to government agencies and to religious or charitable organizations.

(4) Column (2) minus column (3).

(5) 2% of column (4).

H. CONSUMPTION OF LAND: BRIEF CASE STUDIES

One of the key elements in the APCC Growth Report is a survey of the potential capacity for additional housing permitted under the individual town zoning bylaws. Just what are the town's capacities for additional population, based on their current zoned lot area minimums?

Such a survey requires reviewing each parcel of land in the town in relation to its zoning. Since it was impractical to conduct such a survey in each town in Barnstable County, the next best approach was to select a sample of towns based on character, location within the Cape, and availability of records. Four of the 15 towns were thus chosen: Falmouth, to represent a typical highly developed South Shore area; Harwich, a rapidly developing Mid-Cape town; Orleans, a quickly urbanizing town on the Outer Cape; and Wellfleet, an Outer Cape town still retaining much of its rural seaside charm. In each case, the surveys indicate that these towns have the potential capacity to more than double their number of housing units.

1. ORLEANS RESIDENTIAL ZONING CAPACITY

The 1980 census found a total of 3,678 housing units in the town. Building permits for another 313 units were issued up to January, 1983, resulting in a total of 3,991 housing units as of that date. A survey of Orleans' Assessors' parcel data as of January, 1983, reveals that a theoretical 5,458 additional housing units could be built under existing town zoning on remaining developable land. About 2,000 of these units would be eligible under "grandfathering" of non-conforming lots (see below).

Orleans has a total land area of about 9,000 acres, of which about 3,200 acres are developed, according to APCC data. APCC, as part of its Cape-wide buildable lots survey, estimates from aerial survey data that the town has about 3,700 acres of "vacant buildable" land. This area compares closely to the theoretical developable residential acreage of 3,762 acres, based on data from the assessors' print-out.

In the following table summarizing APCC's findings, please note this caveat:

<u>"Grandfathered" Lots</u>

Current zoning requires a minimum of 40,000 square feet lot size for new subdivisions. There were 1,302 vacant parcels in the print-out with 40,000 square feet or more. The town's zoning allows an additional housing unit on existing lots of one to two acres (40,000 to 80,000 square feet), without allowing such lots to be subdivided. This was to "grandfather" rights created under previous zoning when a minimum of 20,000 square foot lot area per house was required. The print-out indicated 1,060 such lots.

<u>Large Lots</u>

Vacant parcels of five or more acres have been reduced by 10 percent to allows for access road areas in computing potential housing units.

ORLEANS ADDITIONAL HOUSING CAPACITY
as of January, 1983

	Parcels (Number)	Developable Land (Acres)	Estimated Potential Housing Units
Total Vacant Parcels	2,219	2,140	3,312
Total Developed Parcels with additional housing unit capacity, two acres or more, subdividable	283	1,122	1,086
Subtotal	2,502	3,262	4,398
Additional Housing Units permitted on developed lots under two acres, not subdividable	1,060	500	1,060
Total Potential Housing Unit Additions	3,562	3,762	5,458

The impression many have that the town no longer has many large parcels of land awaiting subdivision appears to be true. The assessors' print-out lists only 18 parcels of 10 acres or more, totalling just under 300 acres. Another 34 parcels are between five and ten acres, totaling only 123 acres. Most of the developable land has thus already been subdivided.

Wetlands

The assessors' print-out did not separate out wetlands portions of otherwise buildable lots. The town previously required 30,000 square feet of upland, and recently increased it to 40,000 square feet (equal to the minimum lot size) per housing unit. This further analysis could adjust the potential housing units accordingly, but would be time-consuming. Since the assessors' parcel map atlas does depict those portions of lots classified as wetlands, we recommend that the town assessors include a wetlands area classification in their next computer print-out data up-date.

2. HARWICH RESIDENTIAL GROWTH CAPACITY

The town of Harwich could more than double its present number of housing units under current zoning, APCC has found. At least 7,000 additional housing units could be built on vacant land. The town had 6,510 housing units, according to the 1980 Census.
At least 2,000 housing units could be built on existing vacant subdivided lots, and 5,000 more on unsubdivided larger parcels. Over 40

percent of the subdivided lots are "grandfathered", i.e., buildable but below current zoning minimum lot size. Undevelopable wetlands were excluded where possible.

3. FALMOUTH RESIDENTIAL GROWTH CAPACITY

The following is a quantitative analysis of the potential for land division and accompanying population growth within the town of Falmouth based upon 1984 zoning regulations. It should be emphasized that this study does not include potential population increases or dwelling unit additions as regards multi-family development or conversion of existing dwellings into two or more units. Thus, this study represents only the potential of existing zoning in relation to vacant acreage. It does not estimate the additional population increases that could result from multi-family development, dwelling unit conversions, variance or changes in zoning regulations.

TOWN OF FALMOUTH
Developable Residential Lot Study

I. Subdividable Parcels:
Total Parcels - 1,216; Total Area - 9,918 acres

Net Developable	Total Lots/Dwelling Units	Total Population
9,037.60 acres	8,813 lots/dwlg units	26,439

II. Existing Vacant Lots:

Total Area	Total Lots/DUs	Total Population
1,155.68 acres	3,552	10,656

III. Sum Total - I + II:

Total Lots	Total Population
12,365	37,095

IV. Existing Winter Population: 25,823

V. Potential Winter Population - III + IV: 62,918

Notes to accompany residential lot study:

a. Multi-family developments are allowed only in Business and Light Industrial Zoning Districts. These Districts comprise approximately 9 percent of Falmouth's gross land area.

b. Falmouth Zoning bylaws allow for a Board of Appeals Special Permit for the conversion of dwellings on lots since January 1, 1980 in Residential, Public Use and General Residence Districts into up to four dwelling units if the conversion involves.. "no material changes to the exterior of the existing dwelling, and if the Board of Appeals determines that the size of the building and the lot are suitable for the remodeling."

c. Total subdividable parcels were calculated by determining if the parcels could be divided as an "approval not required" division (Mass. Gen. Laws, Ch. 41, Sect. 81-P). Other parcels were subdivided in accordance with the regulations of Mass. Gen. Laws, Ch. 41, Sect. 81-L and Sect. 81-O and Sect. 3441 of the Falmouth Zoning Bylaw.

d. Net developable acres is a category used to reflect true subdividable acreage for those parcels requiring subdivision approval. Net developable acres is the total area of the parcel less 15 percent of the area subtracted for road and utility layouts. Falmouth wetland areas cannot be used to meet minimum lot size requirements.

e. Total lots and dwelling units were determined by dividing the net developable acreage by the minimum acreage allowed within the parcels' zoning district. Section 3430 of the Falmouth Zoning Bylaw restricts new development with Residential Districts to one dwelling per lot.

f. Total population was calculated by multiplying total lots/dwelling units by a factor of three persons per dwelling.

g. Existingvacant lots represent lots "grandfathered" by state or local statute and thus protected from subsequent zoning changes. (See Mass. Gen. Laws, Ch. 40A, Sect. 6 and Sections 3410-3422 and 3441 of the Falmouth Zoning Bylaws.)

h. Existing winter population figures represent 1985 estimates by the Cape Cod Planning and Economic Development Commission, Population Estimates and Projections for Barnstable County 1980-2000. June, 1982.

4. WELLFLEET HOUSING UNIT POTENTIAL

Existing housing units: 1980 Census 2,629; 1984 CCPEDC estimate 2,860.

Additional potential housing units by categories:

Grandfathered vacant lots, under 20,000 square feet.		
5,000 - 10,000 sq. ft., 12 acres est.	73 H.U's.	
10,000 - 20,000 sq. ft., 61 acres est.	177 H.U's.	
73 acres		250 H.U's.
Small vacant lots, over 20,000 sq. ft.		
20,000 sq. ft. - 5 acres, 1300 acres est.*		1543 H.U's.
Large vacant parcels		
5 - 10 acres, 95 acres		
10 acres plus, 353 acres		
448		615 H.U's.
Developed lots with additional potential H.U's.		
2 - 5 acres 183 acres		
5 acres plus, 309 acres		
492 acres		650 H.U's.

Total Additional Housing Units-2,300 acres est. (rounded) 3058 H.U's.

* at 37,000 sq. ft. average parcel size.

I. VISUAL CHARACTER

The mention of Cape Cod raises expectations of wide sandy beaches and neat shingled cottages. Each of us can expand on these simple images to include sailboats, pine trees, beach plums, blueberries, striped bass, golf courses and clambakes.

Cape Cod is the epitome of rural seaside charm, surrounded by salt water bays, warmed by the Gulf Stream and bounded by miles of wide beaches. The land is low and gently rolling. The predominant oak and pine are sculpted by the ocean winds. Acres of salt marshes provide a dynamic transition between the sand beaches and wooded uplands.

Cape Cod is thought to be a land in balance. The tide flushes the marshes twice a day, presenting plentiful banquets to waiting fish. Sea birds roost on nearby dunes. Our activities respond to the seasons and celebrate historic happenings. Cape Cod is the place where we recharge our senses.

The historic Cape Cod cottage with its single story height and pairs of single paned windows bracketing the central door is a cherished image. Several hundred years later, however, we continue and encourage its widespread reproduction with litttle concern for the copy's fidelity to proportion or siting. We espouse its image to such a degree as to discourage a contemporary design of compatible scale. We applaud a new bank's colonial facade, quickly forgetting the three displaced historic houses which were so integral to the historic village-scape.

Historic architecture evolved by responding to realities of particular eras: craftsmanship, natural and political climates and available materials. What evolved on Cape Cod - as to scale, texture and color - was a sense of region, where architecture with low profiles was better protected against the frequent coastal storm, and a house clad in indigenous cedar shingles would dry out quickly.

The study of historic patterns is important for understanding the changes and adaptations that are occurring in these patterns. Early residents of Cape Cod evolved patterns of living that complemented the land.

Traveling the length of the Cape, we notice that the original villages have certain similarities. Houses are close together with narrow front yards. Large trees arch over the main street. The houses are typically one story. Village centers are for people, not cars. Between the villages the road is defined by natural hedges and marsh grasses, pine trees and forest trees, rather than street trees. The houses become homesteads set some distance from the road, separated by fields, orchards, wood lots and marsh. The critical ingredients of this scene are the trees and proximity of building to building and buildings to the road. This pattern from village center to more open land illustrtes a strong social pattern. Many of these historic patterns persist today, although in an overtaxed condition or in an entirely different context. Narrow lanes and northside stagecoach routes have become state highways. Villages are now towns. New

houses fill the fields and orchards and line the marshes. Social awareness and understanding need to be translated into actions in order to retain the valued character while allowing contemporary patterns to evolve. The historic patterns present us with comparisons and choice toward our future growth.

Change is coming fast. Villages centering along Route 6A are expanding with various convenience and specialty stories serving a growing market. The village populations are multiplying. Development along Route 28 is starting to witness a second generation of business, motels, stores and housing. Just as some landscapes are ecologically important to such things as the quality and quantity of water, other landscapes are psychologically important to meet our expectations of the quality of life which attracted us to Cape Cod. The land that is ecologically critical or culturally significant must be defined and managed. The psychologically important land, the land representing the quality of life upon which our expectations are set, must also be identified. From this assembled information, management priorities in the form of policies, regulations and guidelines can be supported. The time is right for local institutions to define the visual character they want for their communities, and to evolve the mechanisms needed to help assure it.

Visual character clearly involves much more than building design. It involves the overall development pattern, whether of clustered villages or continuous development. It involves the siting of buildings, parking, landscaping and other elements within a parcel. The same "ingredients" of land use and even building design produce sharply different visual consequences depending upon relationship to the road, to ocean views, to hilltops and to other site-related elements. Visual character also involves building design, but most importantly the scale, massing, materials and proportions of buildings, only secondarily the commonly regulated issue of style.

Unfortunately, efforts to manage Cape Cod's visual character have centered on architectural style to the neglect of the rest, and "style" is the hardest issue of all, involving subjectivity and difficult choice (are vinyl clapboards "appropriate"?). However, no amount of architectural review can protect the overall pattern of clustered village centers and open areas. Only careful zoning design integrated with open space acquisition, utilities policy and road design can do that. Well-designed and well-administered site plan review rules can assure that the road's edge is respected by major development, that parking is not the chief visual feature and that scenic views are respected. Many Cape Cod towns' subdivision regulations unwittingly require suburban qualities in new development. When the complex rules governing street geography, drainage and other features are written, visual character should claim equal footing with automotive safety and convenience. By doing so, the rgulations can at least avoid requiring the worst of suburban character.

Scenic roads laws can protect the road's edge. Sign laws can reflect pedestrian versus highway scale in regulating signage. The common rules of zoning control can be re-examined with visual character in mind. Are yard and height regulations in fact supportive of desired character? How about the parking rules? Too often these rules require that development be destructive.

Finally, if communities choose, even building design can be managed with some objectivity through carefully-drawn rules about things the community cares about, whether it be avoiding blank walls along pedestrian streets or controlling roof pitch or even stating preferences in colors and materials, all of which can be legislated and administered without subjective discretion.

The Old King's Highway Regional Historic District was created to preserve historic buildings valued by society and to rule on the appropriateness of new construction within the district. The Historic District contributes valuable service to Cape Cod by making us further aware of our heritage. Unfortunately, the Historic District is concerned more with historic styling than with issues of scale, proportion, materials, siting and continuity. Most architecture constructed on the Cape from 1700-1880 resulted from a companionship with the land and climate, as well as the social patterns of the day. By evaluating new construction only on the basis of style, a mere portion of historic significance and form is acknowledged, often to the exclusion of contemporary creative responses toward the present or future.

All this may seem simple and even obvious, but it has largely eluded the towns to date. What is needed is a planning effort centered on managing visual character, not on historic preservation or open space or zoning but all of those and more. It requires self-education, dialogue and invention. When successful, it can be a key to maintaining Cape Cod's livability in the face of growth.

VI. PERSISTENT LONG-TERM ISSUES

A. INTRODUCTION: THE HYDROLOGIC CYCLE

The hydrologic cycle refers to the continuous circulation of water which is transported from the ocean to the atmosphere to the land and back to the ocean by the physical processes of evaporation and precipitation. During this cycle water may become temporarily stored in streams, lakes, soil or as groundwater, at which time it becomes available for use by plants, humans or animals. The components of the hydrologic cycle are illustrated in Figure 1.

Energy from the sun provides the initial driving force of the hydrologic cycle by evaporating water from the ocean and other surface water bodies such as lakes, ponds and rivers. The evaporated water is then carried by winds and forms clouds. Upon encountering the right atmospheric conditions, the clouds will precipitate the trapped water, generally as rain or snow. As the precipitation travels to the earth, some of the water may not actually reach the earth's surface. Water may be temporarily stored as snow accumulation if conditions are cold enough. If the precipitation is in the form of rain, some of the moisture may be caught by vegetation and evaporated directly back to the atmosphere, a process known as interception.

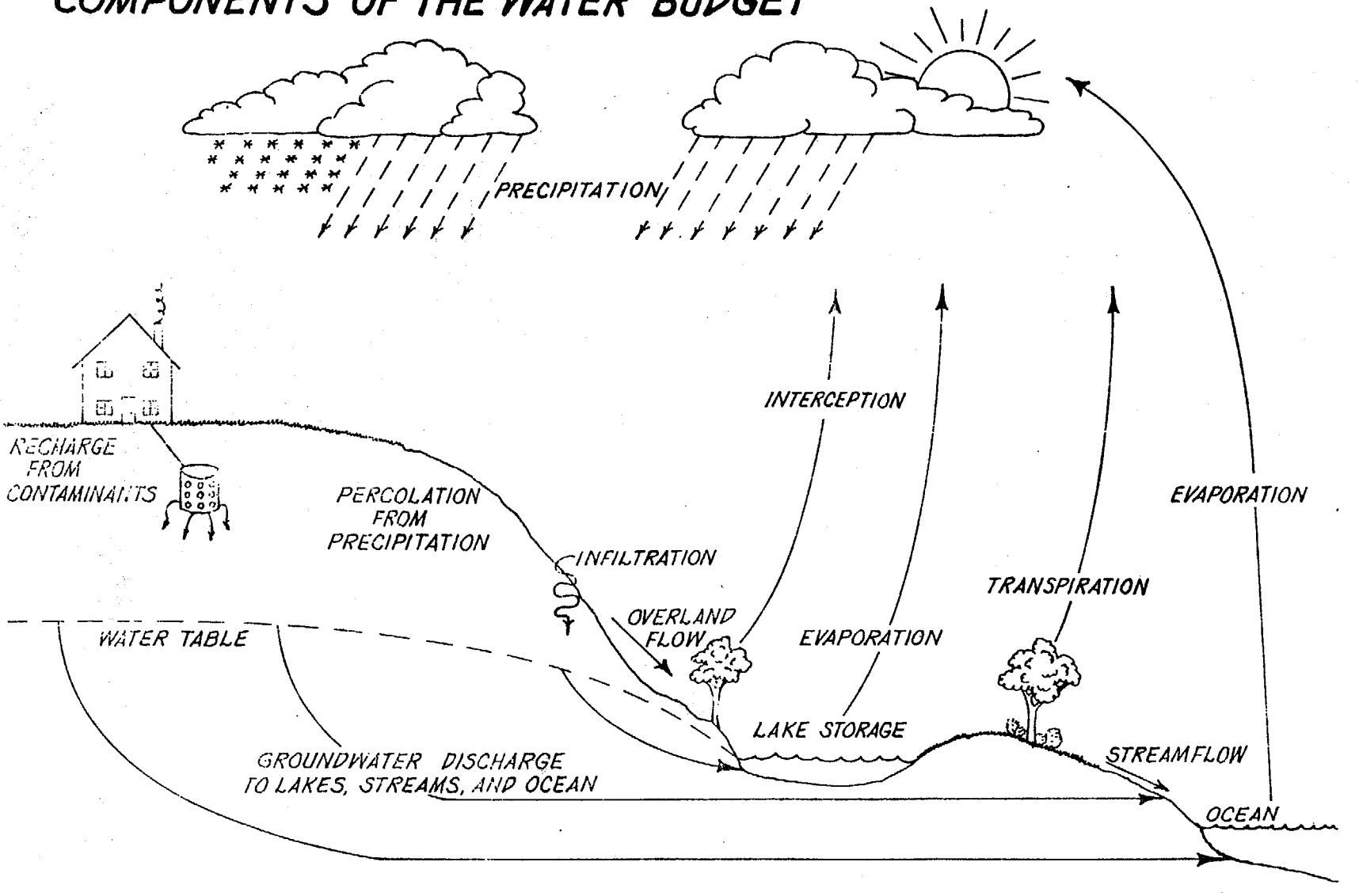
Once the precipitation has reached the earth's surface as rain or melted snow, the water may follow many different paths. On Cape Cod most of the water is absorbed directly into the soil by the process of infiltration. Small amounts of precipitation are held in the upper layers of soil as soil moisture, but if the water content is increased water will percolate vertically through the soil until it reaches the water table or groundwater zone, where all the pores of the soil are completely filled with water.

Groundwater then moves slowly towards the ocean, where it is discharged. Along the way, where the land surface intercepts the water table, lakes, ponds and streams are formed. Water which is not absorbed by the soil may collect in small depressions and eventually run downslope as overland flow. Areas with poor infiltrative surfaces such as paved areas or ground with hardpacked clay can generate this type of runoff. Overland flow may discharge into lakes or ponds, or to the ground via catchbasins or upon encountering porous soils.

A small portion of the precipitation which has been absorbed by the soil will not be recharged to the ground. Some remains in the topsoil and is returned to the atmosphere by evaporation from the soil surface or by transpiration by plants - collectively this process is called evapotranspiration. Once the water has been transformed into atmospheric moisture, the hydrologic cycle is ready to begin again.

Cape Cod depends on precipitation to replenish drinking water supplies, virtually all of which come from groundwater. Certain human activities, such as the construction of homes, parking lots and roads, may interfere with the natural path of precipitation as it recharges into the soil. These activities create impervious surfaces and restrict the amount of land area available to soak up precipitation.

COMPONENTS OF THE WATER BUDGET



WATER IN ENVIRONMENTAL PLANNING – T. DUNN, L. LEOPOLD © 1978

Fig. 1-112A

Measures that may be taken to maximize recharge include construction of roads using pervious materials, avoiding construction of densely sited dwellings, and preserving native vegetation.

B. Water Supply and Demand

It is almost impossible to have a conversation about growth, the future and Cape Cod without someone raising the question, "Do we have enough water?", and then the next question, although articulated in many different ways, is, "Won't there be a time when the water situation tells us that the Cape can accept no further population increase?"

If there were easy answers to these questions, the conversations could quickly shift to another topic, perhaps the impact of growth on traffic, recreation opportunities, aesthetics or where the best quahog beds are. But, unfortunately, as for so many other public policy issues, there are no ready answers, and time devoted to the study, discussion and planning of Cape Cod's water supply continues to increase.

There are two aspects to water supply, quantity and quality. At the present time, the Cape is naturally well endowed with both. There is a plentiful indigenous supply of high quality fresh water. In some locations it appears on the surface in the form of ponds, lakes and fresh water wetlands, but for the most part it is stored well below the land's surface elevation in the pore spaces of the soil. Because the Cape's soils are relatively permeable, this groundwater aquifer is highly transmissive, which makes it possible to pump millions of gallons of water per day from public supply wells on a continuous basis.

The problem for the Cape is that the same characteristics that make the groundwater so productive mean that contaminants can easily be drawn into the water supply system. With the continuing growth of the Cape's population, development has gradually moved away from the coastline into the interior, the prime water supply recharge areas. Now, waste disposal and potential sources of contamination that accompany development threaten the future quality of the recharge that replenishes our water supplies. A more appropriate water supply question for the Cape is not "Do we have enough?" but rather "Will the Cape towns have sufficient <u>high quality</u> water to meet rising demand?"

Having the right question does not necessarily make it easy to give a precise answer. However, using generally accepted assumptions, existing information and available projections, it is possible to make estimates of available supply and demand and to show the relationship between them. This type of analysis has been done for each Cape Cod town, and the results are presented on the water supply and demand graphs that accompany this report.

METHODOLOGY OF GRAPHS (See Appendix A)

A brief explanation of the construction of the graphs is necessary to understand both what they show and their limitations. The following assumptions are the basis of the graphs:

1. Of the average of more than 40" of rain that falls on Cape Cod each year, an average of 16" is annually recharged to the groundwater aquifer.

2. The recharge areas of Cape Cod that are suitable for public water supply are those where the groundwater elevation is at least five feet above sea level. (High volume pumping at a lower groundwater elevation could result in the intrusion of salt water into the supply.) The amount of land area in each town under which groundwater elevations are at or above the five foot level is identified as the <u>total recharge acreage available</u> on the graph. It seems best for planning purposes to focus on the recharge areas suitable for public supply as the trend has been to extend municipal water to an increasing percentage of the population.

3. The total volume of water supply which is available for a town on an annual basis can be calculated by multiplying the recharge area by the recharge rate, 16" per year. The annual supply available is converted to an average daily supply by dividing by 365. The graphs show water supply and demand on a daily basis, as <u>millions of gallons of water per day</u>. Since a constant rate of recharge is assumed, it follows that the towns with the largest recharge areas have the most potential supply.

4. The quality of the water recharged to the aquifer is related to population density and other uses that accompany development. On Cape Cod leachate from municipal landfills and septage lagoons and nitrates from fertilizers and septic systems are the prime concern. By using nitrate loading estimates developed by the Cape Cod Planning and Economic Development Commission in combination with twenty year projections for population increases, observed development patterns and land use regulations, it is possible to predict when the recharge for a given area will contain nitrates in excess of the five parts per million which is the level recommended as the maximum for drinking water supply planning purposes. The key assumption is that if nitrates are above that level in the recharge, the recharge should be considered degraded and not a reliable source of drinking quality water. The <u>quality supply</u> line on each graph represents the change in the amount of non-degraded vis a vis degraded recharge that will occur as a result of projected development in the recharge areas. Degraded recharge is represented by that portion of the total supply above the quality supply line, non-degraded recharge by that portion below the quality supply line.

5. For towns with extensive public water supplies, water use is shown in millions of gallons on an average daily basis for the year, summer months of June, July, and August, and week of maximum use. The basic source of the information is water department pumping records. Because there is no town in which 100% of the population is served by public water supply, the pumping figures are adjusted to create a measure of total water use. The adjustment was done by using the public suppliers' estimates of the percent of population served and then assuming that for a given period the remainder of the population would have used water at a similar rate. For towns without public supply, estimates were made only for average summer daily use. This was done by assuming per capita water use of 65 gallons per day and multiplying that figure by the estimated summer population. (For Provincetown-Truro a hybrid calculation was used.) It is assumed that if there is no policy of intervention, demand for water will increase at a rate proportional to population increase. (Specific projections have only been graphed for those towns which are without public supply systems.)

THE GRAPHS' MESSAGE (See Appendix A. page 152)

The graphs are certainly not an appropriate tool for detailed planning as they do not take into account the specific location of degraded recharge. Their value is that they bring into focus a striking feature of our groundwater resource. Namely, while groundwater is a renewable resource, i.e. on average the total recharge available remains constant, it is being "consumed" from two different directions. On the one side, there is increasing use of water, and on the other the quality of the available resource is being diminished by the impact of development on the ground above it. There is rising demand to use recharge areas for waste disposal. Projecting into the future, it is obvious that if both of these demands on the groundwater continue to increase, there is a time at which the demand for water will exceed the supply of non-degraded water. In some towns, endowed with vast areas of recharge and volumes of underlying aquifer, the point at which demand would meet supply is remote, but in others the possibility for demand to outstrip supply is not at all remote. In all towns, however, the demand and supply curves are converging.

Once it is acknowledged that the potential exists for water demand to exceed the amount of non-degraded supply, it is time to address the next question: What are the policy options for Cape Cod? The graphic water quality supply/demand format makes clear what the long term choices for water policy are:

1. To maintain the level of supply by protecting the quality of the resource.

2. To control demand.

3. A combination of the above.

4. A default option: to let present trends continue and accept the fact that eventually some towns will be treating water or obtaining supplies from another political jurisdiction.

Particular strategies to carry out these options are varied. All involve political economic and/or social costs, some to be borne by individual property owners, others by the community as a whole. A non-inclusive list of strategies for options one or two would be as follows: Water quality can be protected by land acquisition, regulation of activities, large lot zoning and/or sewering with appropriate recharge. Demand can be constrained by adopting measures to limit population growth, by taking steps to reduce per capita water use or by restructuring supply so that water of drinking water quality is supplied only for those uses that require it.

The fourth option at this point is problematic. Water treatment on a reliable long term basis is very expensive and leaves behind a waste product which creates disposal problems. How long it would take to make the political and economic arrangements for large scale transfer of water from one part of the Cape to another is unpredictable. Another factor is the difficulty of restoring the quality of groundwater once it is degraded. A purposeful decision to allow its indiscriminate contamination hardly seems a wise policy.

The Cape towns do not appear to be choosing the default option. Facing the reality that quality water supplies are a finite and potentially endangered resource, towns have begun resource protection planning. Most of the strategies developed so far fall under the classification of option 1. Towns have adopted water resource protection zones, hazardous materials by-laws, regulations for underground storage tanks and requirements for increased lot sizes. There has been an increased effort to purchase land to protect well sites.

Even those towns that appear groundwater rich have realized that they cannot be complacent. Regardless of their relative groundwater wealth, towns may have site specific water quality problems. The Town of Falmouth had to close its Ashumet well less than two years after it began pumping because of contamination that originated at the Otis Air Force Base sewage treatment plant. The Provincetown Water Department was forced to shut down its South Hollow well because of gasoline leaking from an underground storage tank. Elevated nitrate levels are being observed at wells in Barnstable and Yarmouth. Once public supply wells are developed, there is a large investment to be protected. The cost of losing or renovating a particular source of supply is too high to make neglect of protection an acceptable policy.

A COMPLICATING FACTOR

There is a complicating factor to the water supply situation which is obscured by analyzing supply and demand on a town by town basis. The fact that is ignored is that groundwater flows across political boundaries. The public supply well zones of contribution map prepared by CCPEDC (Figure 1) makes the regional nature of the resource abundantly clear. It shows that water which emerges at the well head in

one town often begins as recharge within another town's boundaries, and that ultimately no town has the luxury of total control over its water supply.

The common property aspect of groundwater has advantages and disadvantages. The advantage for towns with limited recharge areas is obvious. By strategic placement of their wells, they have access to more potential supply than if groundwater respected political boundaries. The disadvantage or perhaps it could better be termed the challenge is that while effective groundwater management should be done on a regional basis, virtually all the existing management tools are only available at the local town level. Negotiating the political and economic arrangements to enable regional management will certainly be one of the prime policy challenges as the Cape Cod towns prepare to enter the 21st century.

RECOMMENDATIONS

Specific recommendations on water policy can only be made after deciding on the basic goal. The choice for Cape Cod is: Should we try to live within our natural endowment of high quality water or should we accept the inevitability of treatment and/or desalinization? The basic premise of the recommendations that follow is that Cape Cod should live within its groundwater means, by both taking steps to protect supply and control demand.

Water policy cannot be made in isolation from other policies. Acceptance of the above premise brings with it a commitment to the idea that Cape Cod has a unique environment, a unique endowment of resources which deserve to be protected. A corollary basic premise of these recommendations is that limits and controls on growth are essential and desirable in order to maintain not only a high quality water supply but a high quality natural environment.

1. The towns should set definite goals for the ultimate amount of water they want and expect to be able to supply on an annual and peak basis.

2. New sources of water to meet the supply goals should be identified as soon as possible.

3. The efforts already begun to protect supplies should be strengthened. More accurate delineation of some aspects of zones of contribution to supply wells is essential if protective strategies are to be improved upon. Regular monitoring of the location and behavior of contaminated plumes (e.g. from landfills and septage lagoons) is needed to avoid their being drawn into the supply system.

4. APCC advocates that users pay the full cost of water resources and services they use, including the cost of the protection of the aquifer by land acquisition or otherwise.

5. The role of the Cape Cod Planning and Economic Development Commission in Water Planning should be expanded. The model regulations and by-laws developed by the Commission's staff have been widely

used. Once towns have identified specific zones of contribution, the Commission could recommend strategies for protecting the supply. Where protection requires regional cooperation, the Commission could act as a liaison in developing a joint strategy. Where Cape towns are competing for state funds for water protection, the Commission should be given the authority to rank proposals. Willingness to cooperate on regional water planning should be a prerequisite for high ranking.

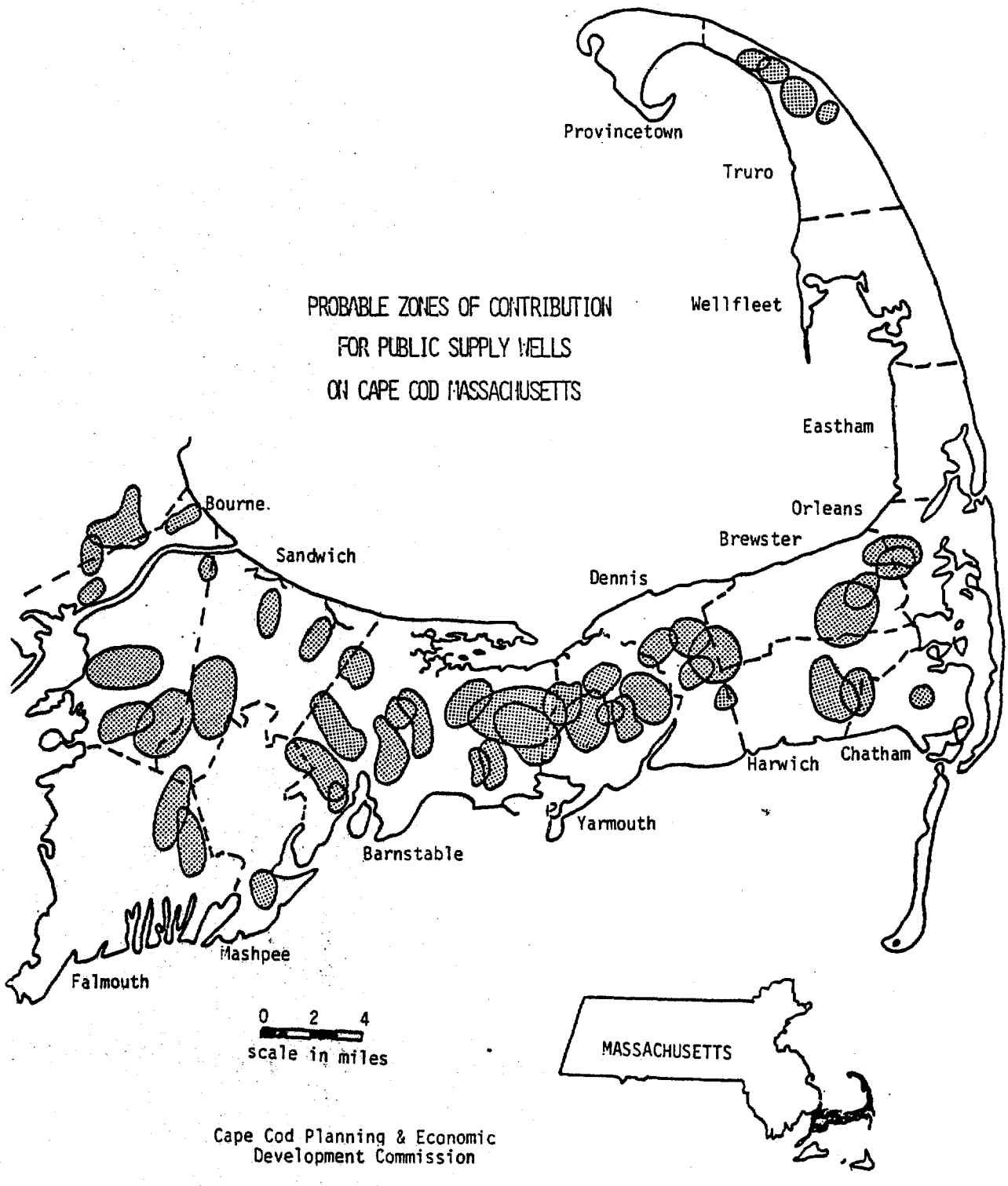
6. Purchase of development rights and/or transfer of development rights should be explored as an alternative to full purchase of land or as a substitute for large lot size requirements. While a community cannot be expected to purchase all the land in its water resource areas, it is inequitable to expect individual property owners to underwrite the cost of protecting supply beyond a certain level.

7. Continuing analysis of the projected demand and its relation to supply is essential. With existing land use regulations what is the expected future volume of water demand? Is it feasible to limit demand on public water supplies by requiring that water used for outdoor purposes be drawn from on-site private wells?

8. At locations where existing development has caused or threatened serious degradation of water quality, testing of innovative on-site (de-nitrifying) sewage disposal systems should be encouraged.

9. Title V requlations should be revised to provide better protection in Cape Cod soil conditions to prevent direct contamination problems between septic systems and wells.

10. Need for water is only one element of development impact. Given the abundance of water on the Cape, with careful planning, it will be a long time before the quality of water becomes a limiting factor to the Cape's population growth. For those who are drawn to the Cape because it provides a uniquely pleasant environmental character, there are compelling reasons to limit development other than the long term adequacy of the water supply. The management tools to shape and/or limit development are weak in relation to the pressures for growth. Since state laws have been the source of authority to manage development, to a large extent the ability of Cape Cod to maintain a special environment will in the long run depend on the state's recognition that the Cape is different, that its environment is an asset that deserves a higher level of protection.


PROBABLE ZONES OF CONTRIBUTION
FOR PUBLIC SUPPLY WELLS
ON CAPE COD MASSACHUSETTS
Provincetown
Truro
Wellfleet
Eastham
Orleans
Brewster
Dennis
Bourne.
Sandwich
Harwich
Chatham
Yarmouth
Barnstable
Mashpee
Falmouth
0 2 4
scale in miles
MASSACHUSETTS
Cape Cod Planning & Economic
Development Commission

C. SOLID WASTE DISPOSAL

MORE SOLID WASTE - LESS WATER

The importance of safe solid waste disposal lies in its relation to the quality of the water supply of Cape Cod. Protecting the quality of the Cape's water supply is of extreme importance because, unlike other New England towns, the towns on the Cape have no rivers or extensive watersheds from which storage reservoirs can be filled during periods of high run-off. The Cape's water supply consists of its ponds and underground aquifer. It is a sole source aquifer that depends upon precipitation for replenishment.

Once pollution from sources such as leaking fuel tanks, road salt, improper septage disposal or improper solid waste disposal has seeped into the ground, it forms a plume which then moves through the aquifer. A number of such plumes now exist, and each represents a threat to a portion of the water supply, in some cases making it no longer available for use as drinking water.

Since the disposal of solid waste can pose a direct threat to groundwater quality, it becomes very important to understand how best to dispose of this waste. While the rest of this section deals with solid waste as a distinct problem, the reader should not lose sight of its importance to water quality and the future growth and development on Cape Cod.

SOLID WASTE - HOW MUCH

There has been much discussion on how to estimate the daily flow into any given landfill. Weighing, sampling and other methods have proven unreliable. The U.S. Environmental Protection Agency has recommended the figure of 3.5 pounds per day for each individual. This same figure was used by Harvard University in solid waste studies in New England. All things considered, it would appear that in the absence of much industrial waste, a figure of 3 pounds per day per individual is as close as can be estimated.

Pounds of waste translate into volume going into the landfill. The ordinary degree of compaction achieved in landfills on Cape Cod varies with the equipment used and the depth of cover. Generally 600 pounds per cubic yard is an acceptable figure. Present day compactors are said to achieve 1000 pounds or more per cubic yard. But using 600 pounds, every ton of solid waste going to the landfill would occupy 3.3 cubic yards of space.

The most recent information regarding generation and disposal statistics for Cape Cod has been compiled in CCPEDC's study ALTERNATIVE SOLID WASTE MANAGEMENT SYSTEMS FOR BARNSTABLE COUNTY, October 1982, and will be relied upon heavily in the following discussion.

Table I provides the estimated total yearly volumes of solid waste for each Cape Cod town. It is to be noted that the towns are divided into three subregions for the purpose of analyzing subregional disposal alternatives. Table II shows the estimated volumes generated in each

subregion by month. This illustrates the great fluctuation that occurs and shows the great difficulty in planning and sizing a solid waste facility. A facility which can handle the peak summer load will by definition be operating at less than capacity for most of the year.

SANITARY LANDFILL - HOW MUCH TIME IS LEFT?

The question most frequently asked when the subject of solid waste comes up is: "How much time do we have left in our dump?" Sanitary landfill is at present the only method of disposal in use on the Cape. Under new regulations which are being proposed and those already in place, it is probable that no new landfills will ever be opened on the Cape for the following reasons: First, compliance with requirements such as monitoring wells, lining of the disposal area, collection of leachate, disposal of leachate, and venting for methane gas will make this method of disposal very expensive. It may be more costly per ton than disposing of solid waste through a resource recovery facility.

Second, land on the Cape is becoming more and more expensive as it becomes less and less available. In the future a tract of land large enough for a landfill operation may not be available at any price. Third, opening a new landfill in an area where none has existed before is guaranteed to bring on a storm of protests and lawsuits.

Notwithstanding the foregoing, and no matter what other technology is used for disposal of solid waste, some form of sanitary landfill will always be necessary because many wastes can be disposed of only by landfill. Their operation will also be needed for emergencies such as plant breakdown or work stoppage for other reasons.

Table III, also from ALTERNATIVE SOLID WASTE MANAGEMENT SYSTEMS FOR BARNSTABLE COUNTY shows the estimated years of use, as supplied by each town, in their landfills. This table can be summarized as follows:

1. Ten towns have less than ten years use left.

2. Three towns have in excess of 15 years, with the other two towns somewhere in between.

These figures do not reflect consideration of increasing populations or the two-year lapse since publication of the CCPEDC report.

TABLE I
SOLID WASTE GENERATION, 1980-2000

(Tons Per Year)

SUBREGION 1	1980	1985	1990	1995	2000
Bourne	14,256	15,208	16,273	17,563	18,463
Falmouth	24,781	26,768	28,566	31,119	32,566
Mashpee	4,718	6,480	8,460	10,814	12,885
Sandwich	8,803	10,899	12,967	15,540	18,180
Total	52,558	59,355	66,230	75,036	82,094

SUBREGION 2	1980	1985	1990	1995	2000
Barnstable	32,625	38,213	44,174	49,588	52,762
Dennis	13,443	15,035	16,536	17,851	18,705
Yarmouth	22,596	24,489	26,315	28,219	28,797
Total	68,664	77,737	87,025	95,658	100,264

SUBREGION 3	1980	1985	1990	1995	2000
Brewster	5,168	6,397	7,404	8,638	9,784
Chatham	5,952	6,388	6,885	7,269	7,627
Eastham	4,171	4,716	5,204	5,603	5,832
Harwich	8,156	9,207	10,247	11,169	11,653
Orleans	4,624	5,099	5,576	5,995	6,329
Provincetown	3,909	4,159	4,259	4,341	4,417
Truro	2,410	2,718	2,985	3,158	3,338
Wellfleet	2,978	3,212	3,474	3,730	3,956
Total	37,368	41,896	46,034	49,903	52,936

	1980	1985	1990	1995	2000
CAPE COD	158,590	178,988	199,289	220,597	235,295

SOURCE: Cape Cod Planning and Economic Development Commission, January, 1982

TABLE II
ESTIMATED ANNUAL VARIATION IN SOLID WASTE QUANTITIES, 1985

(Tons)

Month	Subregion 1	Subregion 2	Subregion 3	Barnstable County
January	3,400	4,600	1,720	9,720
February	4,110	4,560	1,920	10,590
March	3,740	5,080	2,150	10,960
April	4,140	5,830	2,690	12,660
May	6,270	6,610	3,450	16,330
June	5,150	7,220	4,550	16,920
July	5,900	9,020	6,360	21,280
August	7,450	9,490	6,580	23,520
September	5,020	7,480	4,410	16,910
October	5,490	6,410	3,220	15,110
November	4,950	5,820	2,560	13,330
December	3,740	5,640	2,290	11,670
TOTAL	59,360	77,740	41,900	178,990

SOURCE: Cape Cod Planning and Economic Development Commission, January 1982.

TABLE III - LANDFILL LIFE EXPECTANCIES

Town	Landfill Life Expectancy (Yrs.)	Landfill Size (Acres)	Plans For Expansion
Barnstable	*2	61	Study committee to make recommendations by April 1983
Bourne	15-20	24	None
Brewster	25	44	None
Chatham	10*	35	None
Dennis	14	167	None
Eastham	4-5	5.5	Have tentative site for future use
Falmouth	20	53	None
Harwich	18	150	None
Mashpee	4-6	16	Seeking to obtain 35 acres to extend landfill life to at least 15 years
Orleans	8-10	18	None
Provincetown	9	25	None
Sandwich	3*	14	Seeking to obtain 10 acres adjacent to existing landfill to extend landfill life to 10 years
Truro	7	5.5	Plan on talks with the Cape National Seashore (CCNS) about expansion
Wellfleet	9-12 months	10	Awaiting DEQE decision on "stacking" plan on extend landfill life on 5 years
Yarmouth	7	105	None
Otis	20+	176	None

SOURCE: Cape Cod Planning and Economic Development Commission, January 1982. *September 1982 data.

LAG TIME - THE CRISIS TRIGGER

Even allowing for a year or two plus or minus variation in the foregoing estimates, the stark reality becomes alarming when they are considered in relation to "lag time". This is the period of time that lapses between the point of first serious consideration of a new facility and the construction and actual first operation. Pittsfield, Massachusetts completed in 1981 a resource recovery plant in which the lag time was ten years. A project in North Andover, Massachusetts had a lag time of fifteen years. A period of at least six to ten years must be expected. It is also true that construction time for the simpler prefabricated units is shorter than the more complicated field-erected resource recovery plants.

Another illustration of lag time is the fact that during the past five years three private firms, SEMASS (Energy Answers Corp.), TRICIL (Resources Limited Corp.) and STELEC, have held discussions with town officials with a view toward securing contracts for delivery of solid waste for the proposed plants. As of this time, only SEMASS has taken positive contractual steps based on their own capital expenditure.

If a lapse time of eight years is taken as reasonable and then applied to the estimates in Table III, a solid waste crisis exists for many towns. With rapid growth projected until the year 2000 and beyond, those towns with more landfill time would do well to consider contractual arrangements now and conserve these areas for materials that will not be handled by SEMASS.

CURRENT DEVELOPMENTS

In the summer of 1983 the selectmen of the towns of Barnstable, Dennis, Mashpee, Sandwich and Yarmouth formed a Five Town Committee for the purpose of exploring methods of solid waste disposal for their towns. Other Cape towns immediately expressed their interest and requested that any facility considered be large enough to include their waste. This request was favorably received, but the Committee decided for the sake of expediency to retain its five town membership. This Committee considered all viable methods of solid waste disposal, including on-Cape facilities. However, it has now concentrated on a specific proposal of SEMASS to construct a plant at Rochester, Mass., using solid waste to generate electricity. Hurdles still to be overcome:

For SEMASS

- state air quality permit
- approval of transfer station by Yarmouth Board of Health/voters
- state DPW approval of limited-access ramp to Yarmouth landfill
- revised landfill agreement with the Tri-Town Regional Landfill District.
- commitment of private equity (25% of capital cost) from a credit-worthy institution
- a modified contract with COM Electric
- a contract with a construction contractor to build the plant
- achievement of financing package (including issuance of revenue bonds)

for towns

- development of an efficient regional transportation strategy
- development of weight data (town and SEMASS scales)
- decide what actions, if any, should be taken regarding waste control
- development of improved strategies for disposal of non-processable waste (composting, stump dumps, recycling)
- design and layout of transfer stations (provide input to SEMASS)
- minor modifications in contract if desirable
- pursue investigations for a site for an on-Cape facility in case SEMASS does not overcome its hurdles.

As of now, Chatham, Provincetown, Wellfleet and Yarmouth have signed binding 27-year contracts with SEMASS, and the other eleven Cape Cod towns have signed letters of intent. These eleven towns have made a commitment to place articles in their town warrants to seek Town Meeting approval for contractual arrangements with SEMASS.

Mashpee and Brewster at Town Meetings in December authorized their selectmen to sign the contract, but Truro's meeting was postponed. Barnstable, Bourne, Dennis, Eastham, Falmouth, Harwich, Orleans and Sandwich, will decide at spring Town Meetings.

The state Department of Environmental Quality Engineering has refused to exempt the Rochester plant from using scrubbers, which control emissions of sulfur dioxide and hydrogen chloride--the chemicals which combine to form acid rain. Installation of the expensive scrubbers could raise waste disposal fees by $4 to $14 per ton of waste.

In 1971 APCC, by issuing Impact Study II "The Environmental Impact of Solid Waste Disposal on Cape Cod", sounded the alarm regarding this environmental "time bomb", which had much the same effect as APCC's later report Impact Study III, "The Environmental Impact of Groundwater Use on Cape Cod", in stirring the communities to action.

The solid waste disposal problems for Cape Cod towns are far from over, but after more than a decade of investigation of alternatives a viable solution may be at hand.

D. TRANSPORTATION

ROADS AND HIGHWAYS

Cape Cod has an extensive road system which is one of its charms as well as one of its chief environmental hazards. Route 6A on the north or bay side of the Cape is doubtless one of the most scenic highways in the country. Its winding and rolling character reveals periodic views of beauty and contrast, from great marshes to intimate villages of historical character.

On the other hand, Barnstable County has one of the significantly high accident rates in the state. The only arterial on the Cape of modern highway design is the four-lane divided, controlled access portion of the Mid-Cape Highway, Route 6, going between the Canal and Dennis. The remaining thirteen mile Mid-Cape between Dennis and Orleans, while having controlled access, has a two-lane undivided design which has earned it the common name of "Suicide Alley". Few major highways of this design are left in the country because they allow passing against on-coming high speed traffic. Poor passing judgment results in deadly head-on collisions or severe side swipes, as the accident record for that section of the highway shows.

The remaining portion of Route 6, the thirty mile stretch from Orleans to Provincetown, is not controlled access. In the four-lane sections vehicles may cross all four lanes to reach a destination on the opposite side of the highway. Such a destination may be a side road, a highway business or even a private house. Route 6 also contains several three-lane sections. The three-lane design has long been regarded as extremely hazardous and is prohibited in most states today.

Another problem of Route 6 is the three rotaries that serve as traffic interchanges at the two Canal bridges and the Orleans/Eastham line. Such rotaries are considered obsolete for today's high speeds and traffic volumes and are rarely found at major highway intersections elsewhere.

The hazards of Route 6 cannot be avoided by driving along the south or Nantucket Sound side of the Cape. Route 28 has problems that are equal to those of Route 6. It experiences intersection traffic jams of formidable size and has a notoriously high accident rate per mile. These attributes have earned it the reputation of being one of the most congested and hazardous highways in the state.

Because Cape Cod is a peninsula, all the traffic that comes onto the Cape at the Canal must leave by the same road system. It has no "through traffic" and little choice of routes. Hence at peak use periods drivers on or approaching Cape Cod experience some of the longest traffic backups in the country.

Despite the high traffic flows that the Cape generates, it has no federal interstate highways. There also is no county-maintained road system. Except for the relatively few state highways, inter-town roads are maintained by the county's fifteen individual towns.

Technically there are some county roads but there is no county highway department to maintain them. By default or by choice, the towns must do the job and the maintenance that does occur is not necessarily done in a coordinated fashion.

Much of the Cape's road system dates back to Colonial America. Such roads generally contribute to the "rural seaside charm" of Cape Cod but portions of them have become extremely hazardous. Some of their charm, deriving from tortuous curves and a meandering nature, is not conducive to the safe handling of the present traffic volumes. Laid out to connect rural hamlets, these roads do not well serve many square miles of small lot subdivisions.

The net result of an incompatibility with the current level of development is miles of traffic jams, high accident rates and intersection gridlock. Lack of street lighting and a high proportion of older drivers, the latter resulting from the Cape's attraction for retirees, only make the traffic problems worse for all concerned.

A TRANSPORTATION PHILOSOPHY

It is much easier to recite the litany of Cape Cod's automobile traffic problems than to offer solutions. Each situation must be reviewed in detail before deciding what specific improvements would be desirable. However, the making of specific decisions will be facilitated if Cape Codders can agree on a transportation philosophy. Some suggestions regarding this philosophy follow.

1. The extreme view that congestion is the ultimate growth control for Cape Cod and that highway improvements are undesirable because they will only result in more business coming here is unacceptably short-sighted. Existing development becomes blighted as traffic problems interfere with access and failing commercial districts are in the interest of no one. If traffic problems are not alleviated, the pressure to allow commercial development to sprawl out to less congested areas increases, and a very inefficient pattern of land use occurs.

2. Equally unacceptable is the opposing extreme that Cape Cod's roadways should be ever widened, straightened and otherwise improved to maximize their carrying capacities. The benefits of highway improvements have to be measured against the cost in environmental quality, such as visual ugliness, pollution from run-off and loss of open space and wetlands. The present lack of funds and environmental review requirements have at least temporarily made the construction extreme almost moot, but this situation could change if allowed.

3. A desirable transportation philosophy will be one that recognizes the need to find a balance point between extremes. In some situations such as the often proposed widening of Route 6 east of Dennis, finding the balance will be extremely difficult, but for others it may be easier. In congested commercial areas a public/private cooperation should be possible that would combine publicly financed intersection and roadway improvements with

private agreements to improve parking lot design and aesthetics, or even to develop parallel service roads. Because many of the worst congestion problems involve state roads, it will be necessary to secure a corresponding commitment from state transportation officials to design solutions that seek to balance different interests and values. Evidence of such commitment will be increased coordination between state officials and local officials and interest groups.

4. The other cornerstone of the Cape Cod transportation philosophy should be support for as many attractive alternatives to private automobile use as possible. In some instances the alternative can be as small scale as a sidewalk and in others it could be a bike path. An alternative with increasing potential is transit service to beaches. With beach parking lots reaching capacity in the morning hours, remote parking with transit service is becoming a more attractive option for beach goers. At a larger scale and expense this philosophy dictates that when transportation plans are made there be constant consideration of the potential for increasing public bus and train transit.

A detailed analysis of Route 28 and other similar Cape highways, an in depth look at the alternatives for widening Route 6 from Dennis to Orleans and the investigation of the merits of hydroplane service between Provincetown and Boston are beyond the scope of this report. Clearly these three issues should be addressed in the near future by those repsonsible for transportation planning on Cape Cod.

PUBLIC TRANSPORTATION

In the mid-70s state legislation was passed which authorized regional transportation authorities outside the MBTA district. In so doing the legislation insured that each region would have an institutional advocate for and provider of alternatives to private automobile use. On Cape Cod the intent of the legislation has been realized. The Cape Cod Regional Transit Authority has become synonymous with public transportation here. A Cape Cod Growth Report would be incomplete without reference to the existing projects and future plans and concerns of the Authority.

The Cape Cod Regional Transit Authority was created to provide, regulate, plan and coordinate mass transportation services on Cape Cod. The Transit Authority's member towns (Eastham is not a member) work together to design and manage a network of transportation services which will meet the diverse transportation needs of the region, for today and the years ahead.

This Transit Authority is currently working on a long range plan that will provide a framework whereby its advisory board can plan and enact decisions with a constancy of purpose. The goal is to foster the most efficient and effective utilization of the various components of Cape Cod's network of transportation services.

The Transit Authority can become involved with service in a variety of ways. One is to contract for a service totally controlled by the

Authority. The b-bus system is the best example of this. A second is to provide a partial subsidy to a private operator, in exchange receiving guarantees regarding some aspects of routes, fares and schedules. The subsidy paid to Cape Cod Bus Lines to add a midday run to its Provincetown-Hyannis service is such a case. The Authority exercising regulatory jurisdiction over transit service, such as Plymouth and Brockton's Chatham-Hyannis route, is a third type of involvement. A fourth is for the Transit Authority to provide technical assistance to an individual town or transportation firm. Finally, the Authority acts on behalf of the entire Cape on any development with potential for impacting on transportation in the region.

1. Railroad Service from New York

The reinstitution of passenger rail service from New York, scheduled for 1986, constitutes the single most important development in Cape Cod's network of transportation services in years. The Transit Authority will not have any regulatory jurisdiction over this rail service; neither will any of the Cape towns. The state controls the development and, in the future, management of the New York-Cape Cod railroad operation.

It is imperative, however, that Cape Cod have real input in determining how this service is designed, developed and managed. The issue that the Authority must address directly is how to manage the flow of people and vehicles in the neighborhoods surrounding each train station.

Local control, by the Authority and its member towns, is most suited to the development of a coherent plan for managing traffic in adjacent neighborhoods, as well as moving private automobiles, taxis, pedestrians, limousines, buses and other vehicles in and out of the stations smoothly and efficiently. With local control in hand, the Authority and those towns with train stations should plan, regulate, coordinate and manage the broad variety of privately held firms which will certainly express interest in operating transportation services to meet the New York trains.

A town can directly control this situation by limiting the number of local licenses it issues. A local license is required in order for a firm to operate over the town's streets. The towns, using the Authority as a technical resource, should reach a compromise between two considerations: free market competition versus controlling a potentially devastating traffic problem. The Transit Authority will issue operating rights to firms for the operation of bus routes which allow train passengers to reach a variety of destinations throughout the Cape without the need for a private automobile.

2. Fixed Route Services

Buses running on a fixed route and schedule have existed on the Cape for decades. There is excellent service linking Cape Cod to Boston, as well as to New York and the eastern seaboard. However, in recent years fixed route services have played a very limited role in meeting our intra-Cape travel needs.

Year-round fixed route services currently serving this on-Cape travel market include the Cape Cod Bus Lines/Provincetown-Hyannis service; Plymouth and Brockton's Chatham-Hyannis route; and the transit Authority's Woods Hole-Hyannis service. These three routes, in conjunction with the various off-Cape bus routes originating in Hyannis and Falmouth, provide year-round connections to all fifteen towns. There are also seasonal fixed route services in Falmouth and Provincetown.

A repeated theme of this report is that the Cape will continue to experience a rapid rate of growth. Some of the growth will result in increased density of development, which provides an improved situation for fixed route bus service. In addition, an ever growing population base means an increase in the number of people wanting or needing transit. Simply put, each year there will be more potential riders. The Transit Authority should be evaluating the need for additional fixed route services on an annual basis. Trends of growth in the area of fixed route services must be closely monitored and predicted. This way sufficient lead time can be maintained in identifying and filling a need for buses.

3. B-Bus

The b-bus system is an advanced reservation, door-to-door mini-bus service administered by the Transit Authority and operated by its prime contractor, Cape Transit, Inc. Although the system is available to all Cape residents, the b-bus exists primarily to serve the transit dependent population. The handicapped, the elderly, the poor, children and single-parent families are the people most in need of public transportation and the b-bus service is designed and operated in such a manner as to give priority to their needs.

4. Vehicle Leasing Policies

Vehicles purchased by the Transit Authority and then leased out for operations by another entity can provide needed service to the region with only a relatively small investment of capital funds. Under existing policies, the federal government pays 80 percent of the cost of vehicles and other capital expenses.

Two avenues present themselves for the leasing of Authority-owned vehicles. First, mini-buses can be leased out to individual member towns. The towns then pay all operational costs and are given a broad degree of freedom in how the vehicles may be used. This has already been done for several years, with the towns typically obtaining the mini-bus for their Council on Aging. Second, buses can be purchased and leased to private companies for operation on fixed routes serving the Cape. This, too, has been done recently; Plymouth and Brockton operates four CCRTA buses on its Chatham-Hyannis-Boston service and Cape Cod Bus Lines runs two CCRTA buses on its Provincetown-Hyannis route.

Demand from member towns for CCRTA vehicles has not yet exceeded the supply of vehicles available for lease. At some point it will, and when this occurs the Authority will have to evaluate all existing and proposed leases and decide whether a reallocation of resources is needed. Having the CCRTA purchase and own such buses, whether or not they operate them, may be the best possible way of filling this need.

CONCLUSION

Choosing a course of action which not only meets current needs but lays a foundation upon which we can build for the Cape's transportation future will not be easy. The days of rapid expansion of public funding for transportation are probably past. Therefore, it will be very important for the Authority to identify clearly its long term goals. Once these goals are defined, the Authority can build towards the future one step at a time. Over a period of five to ten years the cumulative result of a series of small advances could be several major new transit programs. It is possible that ten years from now the Cape's fifteen towns will be linked by an extensive network of fixed route transit services, operating on a coordinated schedule and through a central terminal in Hyannis.

E. TOWN FINANCES

In 1773 the colonists of Massachusetts revolted against taxation without representation. More than 200 years after the famous Boston Tea Party, the people of Massachusetts are continuing to debate the issue of financing government. While it is generally accepted that government has a responsibility to provide essential services, there is still little agreement concerning the level of service which should be provided, and the method of taxation to finance these services.

Taxes have been defined as an "enforced contribution." Many studies of the various forms of taxation have indicated that the income tax is an equitable method because it is directly related to a person's ability to pay. The limited sales tax, which excludes tax on food and clothing, is also considered a fair method of raising revenue. Property taxes, however, are related specifically to market value and are not directly related to a person's ability to pay. Income taxes generated by payroll deduction and sales taxes paid at the time of purchase are relatively easy to collect. The assessment and collection of property taxes is a cumbersome system requiring complex mass appraisal systems which are costly to administer.

Historically Massachusetts has relied heavily on the property tax to finance municipal and county government. In addition, cities and towns are assessed by the state for the operation of a number of programs including state recreation areas, mosquito control projects, and regional transit systems. State aid to local communities is distributed through several complex formulas. A few of these categories represent partial reimbursement for such actual expenditures as abatements for the elderly, veteran and blind persons, school transportation, veterans' benefits and maintenance of highways. These

reimbursements amount to a small percentage of municipality total operating budget and are subject to annual appropriation by the legislature. In recent years, total state funding for these accounts has been insufficient to reimburse the communities to the extent provided by law, thus requiring municipalities to fund a number of state mandated programs through the local property tax.

State aid to education, known as Chapter 70, is based on a formula which relies heavily on a community's ability to pay as measured by its relative wealth in property value. Because Cape Cod towns have high property values in relation to the number of school age children, they receive the minimum amount of state aid to education under the "hold-harmless clause" of Chapter 70. (In 1980 the Legislature enacted a provision known as the "hold-harmless clause" which guarantees that all communities will receive, as a minimum, a percentage of the Chapter 70 school aid which they received in 1979.)

The distribution of the local aid fund also relies on an equalizing formula which divides the population of a community by its total property valuation and compares the per capita valuation of each community to the statewide per capita valuation. Because of the high property values in Barnstable County and the number of non-resident taxpayers, Cape Cod communities receive a relatively small share of the local aid fund. On the other hand, other economic factors indicate that the permanent residents of Cape Cod fall below the state average in terms of ability to pay. The 1980 Federal census indicates that the median family income in Barnstable County is only 91 percent of the Massachusetts median family income. In addition, unemployment in Barnstable County has been approximately 2 percent higher than the statewide percentages over the past five years. Unfortunately the distribution of state aid, like the property tax itself, is not based on the ability of the individual taxpayer to support necessary public services.

Due in large part to limited state support of education and other local services, property taxes in Massachusetts ranked among the highest in the nation by the late 1970s. In 1980 a group known as Citizens for Limited Taxation persuaded the voters of Massachusetts to enact Proposition 2 1/2 which limits the total taxes which may be assessed by a community to no more than 2 1/2 percent of the total property valuation. The supporters of Proposition 2 1/2 theorized that limiting property taxes would force the state to increase local aid to municipalities. However, Proposition 2 1/2 did not provide for tax reform, nor did it guarantee that state aid would replace the property tax in providing for essential services. In practice, all communities have received some additional state aid since 1980. However, nearly every municipality has also been required to cut services.

Until recent years, local officials encouraged growth. Because new construction added to a town's total valuation, it was assumed that growth in the tax base would allow a community to raise additional revenue without increasing the burden on existing residents.

Now it is more widely recognized that, in fact, residential developments may or may not support their own costs, depending upon how many of their residents are school-attending children, and how heavily they are assessed relative to the existing average dwelling. Even under Proposition 2 1/2, growth does indeed add to the permissible town budget, but the added demands may be even greater. That is especially true on Cape Cod, whose growth involves a great deal of conversion of homes to year-round occupancy by householders who were once only seasonal visitors.

Along with the conversion of the summer residence to a year-round home, there is frequently a change in the newly permanent resident's attitude toward the quaint rural quality of Cape Cod. The individual who retired to Cape Cod to get away from it all often finds that the dirt road with no sidewalks or streetlights, which provided an ideal atmosphere for a summer retreat, is not acceptable for year-round residential use. Increased demands for road improvements, streetlights, traffic signals, sidewalks, ambulance service, police protection, public transportation, senior centers, etc., can not be accommodated within the tax levy limits imposed by Proposition 2 1/2.

Recognizing that residential growth may create demands for public services in excess of the additional tax revenue generated by the new construction, some communities have begun to encourage commercial and limited light industrial growth. Many Cape Cod towns are in the process of developing industrial parks in the hopes of gaining additional tax revenue as well as creating employment opportunities for local people. If new commercial enterprises employ existing residents, require limited water resources, discharge no pollutants and create no demands for highway and traffic control improvements, local communities benefit from commercial growth. However, due to the difficulty in attracting commercial enterprises which are compatible with Cape Cod's limited resources, the commercial tax base remains a small percentage of the total property valuation in Barnstable County.

Massachusetts communities with a high percentage of commercial and industrial property have been able to take advantage of a constitutional amendment passed in 1978 which allows communities to shift part of the tax burden from the residential class to the commercial and industrial classes of property. Under the law local officials must assess all classes of property at 100 percent of fair market value, but are permitted to increase the tax rate for the commercial and industrial classes. In cities such as Boston the commercial and industrial properties were frequently assessed at a higher percentage of fair market value than residential properties. Such communities resisted the court-mandated revaluation programs because assessing all property at 100 percent of fair market value would shift the tax burden from the commercial and industrial classes to the residential class of property. By implementing classification, Boston and other cities with similar assessing practices are able to retain the same distribution of the tax burden which existed prior to revaluation.

Because of the high percentage of residential property on Cape Cod, it is not feasible to shift the property tax burden to the commercial and industrial classes of property. The savings to the individual resi-

dential taxpayer would be very small, while the increased taxes assessed to the commercial and industrial properties would be significant. In addition it would be difficult to implement classification in an equitable manner due to the permissive zoning laws on Cape Cod which permit residents to conduct home occupations in residential areas, and the seasonal nature of many local businesses such as guest houses which only operate during a few months of the year. For these reasons, public officials on Cape Cod have elected to tax all classes of property at the same rate.

Another provision of the classification amendment permits local officials to classify vacant land as open space and to reduce the share of the property tax burden paid by this class of property. However, assessors must determine that the property contributes significantly to the public good and is not being held for the production of income. A more appropriate method of reducing the tax burden on open space parcels is the use of the conservation restriction. For those landowners who wish to preserve open land in perpetuity while retaining private ownership of the property, a conservation restriction makes it possible for local officials to reduce the assessed valuation of property to reflect the fact that it cannot be sold for development and therefore has a greatly reduced market value. The process of revaluation has resulted in an increased number of landowners being willing to trade their development rights for significantly lower taxes. In other cases, homeowners with additional building lots adjacent to their residential property have chosen to combine the extra lots with the developed parcel rather than pay taxes on the value of separate building lots. Frequently this process of combining lots has resulted in the elimination of undersized lots which were protected from zoning changes by various "grandfather" clauses in local zoning bylaws. For those property owners who are unwilling to give up the right to develop their vacant land, the increased taxes which result from revaluation may cause landowners to develop or sell their property for development rather than continue to pay the higher taxes.

Faced with rising costs of providing public services and the limitation on taxation imposed by Proposition 2 1/2, local officials have attempted to increase revenue by charging higher fees for water, sewer, shellfish permits, beach stickers, licenses, parking meters, and parking fines. The result of changing fee structures to bring charges in line with costs has been beneficial to those taxpayers not making use of the service, as they are no longer subsidizing the operation of these activities through the property tax. As government is not designed to be in the business of making a profit, however, various state laws restrict local governments from charging more for a service than it costs to deliver it. There is also a limit to taxpayer tolerance of ever increasing fees for services previously paid for in large part by property taxes, along with a suspicion that local officials are simply attempting to take their money out of a different pocket.

Communities on Cape Cod are now faced with another threat to financial stability. The legislature has become increasingly alarmed about the effects of Proposition 2 1/2 on communities that were required to make

significant reductions in the property tax levy to comply with the law. The result is a series of efforts to alter state aid formulas to shift resources from the "rich" to the "poor" measured at the municipal level using such distorting (for Cape Cod) measures as assessed valuation per capita. School aid formula revisions are a favorite device. Under one recent proposal, every town on Cape Cod would have received negative school aid, actually being assessed to contribute to meeting school costs for areas with better numbers.

For example, serious consideration has recently been given to amending state aid distribution formulas to include another "equalizing" criterion which would provide increased amounts of local aid to communities already assessing taxes at the full 2 1/2% of the total valuation, or at a tax rate of $25. The theory behind this additional aid being granted to communities taxing the maximum allowed by law is that those municipalities have no other option to increase revenues, whereas in theory, Cape Cod communities may obtain additional tax revenue by asking the voters to approve property tax increases beyond the annual increase of 2 1/2 percent allowed by law.

In practice, it is extremely difficult to obtain voter approval of property tax increases. It is also unrealistic to assume that the property taxpayer on Cape Cod has the ability to pay taxes at the rate of $25 per thousand when property valuations on Cape Cod have escalated at a rate much faster than the increases in valuations for the state as a whole, and residents, many on fixed incomes, have purchased property at values reflecting the traditionally lower Cape Cod tax rates. The new theory of "equalizing", based on the ability of the community to increase its tax rate to $25 per thousand, does not take into account the fact that the Cape Cod taxpayer would be required to pay $2,500 in taxes for a property which might well be taxed at $1,250 if it were located in a different community.

The proposals to eliminate the "hold-harmless clause" in the chapter 70 school aid distribution formulas, combined with the proposal to distribute increasing amounts of local aid to those communities already taxing at $25 per thousand could lead to serious reductions in state aid to Cape Cod communities. If the present trend in growth on Cape Cod continues, it will become increasingly difficult to provide local services to the expanding population. Those who have retired to Cape Cod on fixed incomes, as well as those with incomes well below the statewide average, will be faced with the alternatives of voting to increase property taxes beyond the limit of their ability to pay, or facing reductions in the level of local services.

F. THE ECONOMIC FUTURE

The growth of a community is shaped by the needs and desires of its residents and the directions of its economic and business thrusts. If the trends described in the previous portions of this report continue, by the year 2000 the business community of Cape Cod will have undergone a series of subtle yet profound shifts. Perhaps the best way to understand them is to take important elements of the economy and see where each is headed.

CONSTRUCTION AND REAL ESTATE

Currently one of the most important factors in Cape Cod's economy, the number of construction-related jobs as a percentage of the total will drop significantly over the next 15 years. Subdivision and commercial development will be slowed by lack of land, tighter zoning restrictions and building moratoria. The building trades will be forced to greater specialization in additions, alterations, and interiors, rather than soup-to-nuts building or "spec" housing. Finish work will replace rough work.

Related to this, real estate agents will also find less business, and their numbers may decline. The reason is simple: fewer new properties will be created, and fewer old properties will change hands.

HEALTH SERVICES

Health and human services may replace construction as the perceived backbone of the peninsula's economy. The continuing expansion of the number of nursing homes, the anticipated growth in the size of the Cape Cod Hospital, the constantly increasing percentage of elderly in the population all point in this direction. For example the Cape population 65 years old and above was 16 percent in 1970, 21 percent in 1980 and is projected to be 22 percent by the year 2000. Jobs related to servicing this segment of the population run the gamut from institutional support through office and secretarial personnel, therapists, nurses, pharmacists and physicians.

PROFESSIONAL SERVICES

To a large extent the proliferation on Cape Cod of professional services such as accountants, lawyers and stockbrokers relates directly to high unearned income levels in the retirement population. These professionals will probably constitute an even greater share of the workforce in the year 2000 than they do today.

TOURISM

The tourist economy may be expected to occupy a smaller share of the business pie. The earlier analysis of Cape Cod income sources in this report showed that income from leisure related sources on the Cape had decreased from 32.2 percent of the total in 1970 to 27.1 percent in 1980. This number is estimated to decrease to 21.7 percent in the year 2000 as the relative share introduced by retirees and commuters is increased. The Cape businesses will still rely heavily on the summer to make their money, however. It is possible that we are on the brink of overbuilding motels, and that many of these will be converted to condominiums by the year 2000. The number of pure summer entertainment palaces--bars, lounges and nightspots--will if anything decrease.

FISHING

The fishing industry has a cyclical pattern which can be dramatically affected by environmental issues both local to Cape waters and foreign

to them. The present enormous drop in the stiped bass population, for example, may well in part be related to acid rain conditions in their spawning grounds in the Chesapeake Bay. Practical local issues such as harbor maintenance and dock space are also important, however, and these may be serious obstacles to an expanded fishing industry on the Cape. It will be diffcult to prevent some shrinkage of a beleaguered industry faced with a local fish population reduced by over fishing and strong pressures for growing recreational use of the available waterfront space.

While at present the probability of large scale oil drilling on Georges Bank appears relatively low, changing events may renew this possibility. The influence it might have on fishing and other aspects of the Cape's economy cannot be readily predicted since the scale of operations will depend entirely on the significance of the oil or gas findings which might be made.

BANKING

The past several decades have seen continuing expansion in the number of banking institutions on the Cape and the number of operating branches. Employment levels in the industry have thus been increasing. A significant counter trend is now developing through the use of automated tellers and similar innovations. This can be expected to actually reduce the levels of employment in the local banking industry over the next 15 years.

OTHER TRENDS

1. Raw Business Numbers

Recent census information shows us that the raw number of Cape Cod businesses is not increasing. It appears that as many businesses are failing as are being created. However, those businesses which remain are growing larger as the economy expands. This trend is expected to continue.

2. Computer Decentralization

Increasingly sophisticated communication means that businesses can locate in remote areas yet not lose access to their contacts and markets. Already Cape Cod has begun to see a few relatively high-growth businesses locate here rather than, say, New York City, simply because computers and telephone lines are eliminating the idea of a "central" home office. Because of quality of life considerations, the Cape will see an increasing number of idiosyncratic, high-tech, fast growing businesses setting up shop.

3. Industrialization

On the other hand Cape Cod will not become an industrial area to any great extent. The industrial parks presently blocked out will survive, but may turn more towards professional parks for the service industries. Plymouth County will abosrb the bulk of industrialization taking place south of Boston, while Cape areas close to the bridges,

like Sandwich, will tend to become bedroom communities for those industrial areas.

4. Business Ownership

An increasing percentage of Cape Cod business will not be owned by people living on Cape Cod. The attractiveness of this area for financial return is not lost on sophisticated marketers. Already chains, both regional and national, play a major role in the local economy. This phenomenon will have the effect of circulating money spent on Cape Cod off Cape Cod more quickly. While historically the Cape has imported much more money than it has exported, the future will see a balancing of payments and perhaps a strong shift in the opposite direction.

5. Geographic Concentration

While Hyannis will remain the economic hub of the Cape, and Falmouth will remain the second economic focus, Orleans will emerge as a strong third, attracting commercial activity from across the Outer Cape. Residential growth in Sandwich and Mashpee will spur strong economic growth in those two towns, particularly Sandwich. Provincetown will probably be the least changed economic community by the year 2000, mainly because it has no land to grow into and no water to support such growth.

VII. REGIONAL COORDINATION

It is clear that water, waste disposal, coastal protection, transportation and land use all have both local and regional aspects. What one locality does inevitably affects its neighbors, and the need for cooperation on a regional basis is clear. It is less clear what we mean by regional. Is the region state-wide, county-wide or smaller groupings within the county? Should the regional cooperation be coordinated by private groups, by governmental entities or by both? It is instructive first to consider what regional coordination exists today. Then we can consider what ought to exist tomorrow.

The two organizations probably most involved with long range planning for the Cape as a whole are the Association for the Preservation of Cape Cod (APCC) and the Cape Cod Planning and Economic Development Commission (CCPEDC). The former is a private organization founded in 1968 and funded by grants and private donations. Its annual budget is approximately $85,000. The latter (CCPEDC) was established in 1965 as an advisory agency to Barnstable County and its 15 municipalities "for the purpose of improving, developing and protecting the area's resources through research, recommendation and coordination of existing agencies with similar aims". Its annual expenditures are about $300,000.

Both of these groups have been active in assessing trends in the demographics and environmental character on Cape Cod. APCC, for example, has held seminars such as "Growth Management on Cape Cod" in Osterville in November of 1983. At that meeting a group of about 100 invited leaders from all segments of the Cape examined groundwater protection, planning tools and the changing nature of the Cape's economy. Studies have been commissioned such as that on "Income and Population" by Philip B. Herr & Associates. This present growth study is perhaps the most ambitious undertaking of APCC in regional coordination.

CCPEDC has made numerous studies of critical regional problems. Examples are the July 1983 study on "Regional Groundwater Management Needs", a study of "Estimated Future Landfill Costs in Barnstable County" in September 1983, a report on "Alternative Solid Waste Management Systems for Barnstable County" in October 1982 and "The Economy of Cape Cod - An Overview and Considerations" in March 1982.

While these are the two major "umbrella type" organizations trying to ensure regional coordination on Cape Cod, there are numerous state and national organizations with coordinating roles in many aspects of the Cape's environment and economy. A few of these are the Massachusetts Department of Water Pollution Control, the U. S. Environmental Protection Agency, the U. S. Geological Survey and the U. S. Soil Conservation Service. The Cape Cod National Seashore administers 44,000 acres of land on the Lower Cape and has a major regional coordination function in that area. At the other end of the Cape, Camp Edwards occupies 22,000 acres in Bourne, Falmouth, Mashpee and Sandwich. While most of this land is owned by the Commonwealth of

Massachusetts, it is under long term lease to the U. S. Government which places this huge tract essentially outside the normal routines of regional influence or regulation.

There are too many other organizations playing significant roles in regional coordination in selected areas to list them all. A few examples will help to highlight their range and nature, however. A Selectmen's Association made up of the Selectmen of all of the Cape towns holds regular meetings to provide information and discuss issues common to all the towns. The various conservation commissions on the Cape have recently formed a Cape Cod Council of Conservation Commissions (CCCCC) to consider regional implications of local conservation actions. Groups such as the Cape Cod Museum of Natural History and the Audubon Society are active in environmental education and control on the Cape.

A growing trend in regional land management is the establishment of private foundations for acquiring and managing land for conservation purposes and controlled public use. Conservation foundations or trusts now exist in Barnstable, Bourne, Brewster, Chatham, Eastham, Orleans, Provincetown, Yarmouth, Truro and Wellfleet. These bodies can accept land by bequest for conservation purposes and can raise funds by public subscription for the purchase of land to be set aside for public use.

A Water Resources Advisory Council has been established under the auspices of The Cape Cod Planning and Economic Development Commission with a member from each Cape town and other interested organizations.

It can be seen from the above paragraphs that Cape Cod is not wanting for bodies interested in regional coordination in all the growth areas of concern. Common to almost all of these bodies, however, is the fact that they are advisory in nature. The problem is not, therefore, obtaining data or recognizing the need for action; it is the implementation of this action in a forceful and coordinated manner.

On the following pages a checklist has been developed by a consultant to APCC to help citizens in each town learn more about how their town stands on the scale of environmental protection. We urge individuals in each town to pursue those questions which most interest them.

COMMUNITY CHECKLIST FOR ENVIRONMENTAL ACTION

The following checklist will help measure how well your community protects the environment and public health. It tests the adequacy of local environmental law, the use of legal authority to the maximum, the adequacy of staff and budget, and citizen participation. Cities and towns differ widely in appreciating environmental and public health issues, understanding legal powers and implementing authority in bylaws and regulations. As a result, protection of the public's health, safety and welfare varies tremendously from one town to another.

ENVIRONMENTAL LAW ON THE BOOKS

Massachusetts municipalities have extensive authority to adopt environmental bylaws and ordinances supplementing state environmental statutes. This municipal "environmental law" is the cutting edge of environmental protection today. Do not expect comprehensive federal and state legislation to bail your town out of environmental problems such as groundwater contamination, watershed development, dwindling open space and recreation resources, suburban sprawl, strip development, industrial pollution or ugly buildings.

There is enabling legislation which allows towns to create environmental law tailored to their individual needs.

1. Has your Town Meeting adopted floodplain zoning?

2. Has your town adopted wetland zoning?

3. Do you have aquifer and well or reservoir protection districts in your zoning?

4. Do you have Site Plan Review in your town? Do your bylaws require a local "environmental impact analysis" for major developments?

5. Have you adopted growth rate controls in zoning?

6. Do you have a non-zoning Home Rule Wetlands Protection Bylaw administered by the Conservation Commission?

7. Do your bylaws cover sand and gravel removal, erosion control at construction sites, outdoor advertising, historic districts and architectural design?

8. Are you developing groundwater, timber and agricultural bylaws?

IMPLEMENTATION BY LOCAL BOARDS

Having the basic legal authorities in place is only part of it. Effective implementation is next. Examine whether your boards have adopted policies, regulations and practices to be effective.

1. Has your Planning Board adopted comprehensive subdivision control regulations?

2. Has the Board of Health adopted local septic system regulations supplementing the state code?

3. Did your conservation commission issue guidelines under the Wetlands Protection Act or regulations under its local wetlands bylaw?

4. Are your wetlands mapped?

5. Is your Town Meeting considering adopting revised floodplain mapping?

6. Have the zones of contribution of your wells been established and mapped?

7. Have wildlife habitats (flora and fauna) been identified and mapped?

8. Does your community have an underground fuel tank testing and inspection program?

STAFFING

Volunteer boards unaided by adequate staff sometimes are unable to do more than process plans submitted to them. Professional personnel or consultants are essential to match resources with permit applicants and polluters. Find out whether your boards have depth beyond just meeting periodically and reacting to what comes before them.

1. Does your town have a full time planner?

2. Are engineering and water resource consultants on staff or on retainer?

3. Does the conservation commission have an office and staff?

4. Is there an agent for the Board of Health?

5. Has a hazardous waste coordinator been appointed? Is there a municipal coordinator for the hazardous materials Right-To-Know law?

6. Does each board centralize its files and organize them?

7. Are the resources and staff of one board or department available to others? Does the Town Engineer help boards to review technical plans?

LONG RANGE PLANNING

There is a tendency to fight "brush fires". Long range items at the end of the agenda never seem to be reached. Make sure your boards are studying, debating and resolving long term policy and program matters.

1. Is there a Comprehensive Master Plan?

2. Has the Open Space and Recreation part of the plan been updated to make the community eligible for state funds?

3. Is there a management and maintenance plan for open space areas?

4. Does your town actively use the service of a Regional Planning Agency? The Soil Conservation Service? Conservation Districts? Other state or county agencies?

5. Have your boards joined the Massachusetts Federation of Planning Boards and Boards of Appeals? The Massachusetts Association of Conservation Commissions? The Board of Health federations?

6. Has your community adopted a written growth policy? Is it being implemented?

7. Does each board schedule a monthly or quarterly meeting devoted only to long range or planning items?

BUDGETS AND FINANCE

Money must be available for effective local environmental protection. The cost of inaction is greater than any budget expense. See if your officials get the money they need to spend.

1. Is there an appropriation for each regulatory board in town? Does it include funds for expert consultants?

2. Do the boards have money to pay dues to their professional associations (MACC, MFPB, etc.)?

3. Does Town Meeting add to the Conservation Fund each year?

4. Do town boards solicit volunteer time from knowledgeable citizens and technical experts?

5. Have the boards set permit fee schedules for applicants?

6. Do the boards have a good working relationship with the finance committee?

7. Do your boards know that state money can be available for acquiring open space and recreation land; properties on lakes, rivers, great ponds and the ocean; easements to important resources; and aquifer and recharge areas? For rehabilitating town squares and commons? To buy rare and endangered species habitats? To purchase promises not to develop farmland? To

create trail networks? To expand wildlife management areas? To add to state parks? To close publicly owned landfills? And to rehabilitate ponds and lakes?

8. Does the town budget money for board members to go to conferences and workshops and subscribe to useful publications to gain perspective and professional expertise?

PERMITTING AND ENFORCEMENT

It is a disservice to the community for boards to just process the paperwork with routine approvals. Test whether they make maximum use of legal authority to require data and set permit conditions. See if they issue decisions which stick. See if they know how to foster voluntary compliance and take serious violators to court.

1. Do the boards require permit applicants to submit all data required by local bylaws and regulations? Do they set permit conditions reflecting current knowledge and legal standards?

2. Do your boards acquiesce when challenged because of costs involved in litigation?

3. Are the boards familiar with routine enforcement tools to secure prompt and continued compliance by violators? Have the boards made examples in some cases to foster voluntary compliance by others?

4. Does each board office have a complete, current set of applicable regulations and forms?

5. Do your boards issue written, understandable decisions explaining factual and legal reasons?

6. Do town departments comply with permit requirements for their own projects?

7. Does the Town Counsel respond in timely fashion to requests for legal action and opinions? Is she/he familiar with the laws you enforce? Have you arranged in advance for quick action when needed? Is there legal funding for advice and enforcement?

CITIZEN INPUT

A healthy approach to citizen input is a must. Check if boards know and obey the basic open meeting and public document laws. Test if boards appreciate the value of information from the public they protect as well as the parties they regulate.

1. Do your boards comply with the Open Meeting Law? The Public Records Statute?

2. Do they schedule a regular "public voice" section on the agenda for each meeting?

3. Do they appoint advisory committees to help with revisions of policies and programs?

4. Do they actively foster public input in decisions?

5. Are they aware that any ten citizens and any municipality can enforce Massachusetts environmental law in court using the Citizen Suit Statute?

6. Do they know that any ten persons can intervene in state license, permit and enforcement-type proceedings where damage to the environment is involved?

7. Are copies of written materials and maps available at Town Hall and the public library? Are copying facilities for the public available at these locations?

CITIZEN ACTION

Boards respond to an active constituency. Build that constituency for them. Counter the opposite pressures they get.

1. Have citizens in your town educated the general public, legislators and local officials through brochures, fairs, lobbying, new articles, environmental materials in the schools and libraries?

2. Are your citizens familiar with board jurisdictions and limits of authority? Do your citizens ask the boards to do what is realistic and allowed by law?

3. Do your citizens at hearings arm themselves with technical information, legal standards and policy arguments instead of just personal preferences?

4. Do they know how to use the Open Meeting Law and the Public Records statute? Do they utilize information provided by Right-to-Know and hazardous waste reporting requirements? Are they aware of the right of ten citizens in Massachusetts to sue environmental violators? Do they know about the ten person right to intervene in state adjudicatory proceedings?

5. Has a land conservation trust been formed to buy or accept gifts of land or conservation restrictions?

6. Do interested and informed persons regularly attend each board's meeting?

7. Does a newspaper actively report board actions?

ENVIRONMENTAL AWARENESS

A good test is whether your town has learned the lessons of the environmental movement since Earth Day 1970. Does your town have an environmental ethic?

1. In cases of doubt do boards give the benefit of the doubt to environmental protection?

2. Do your officials appreciate the indirect, secondary impacts of their decisions? Do they realize the value of interdisciplinary decisions, drawing on different areas of expertise?

3. Do your officials understand the cumulative impacts of individually small decisions?

4. Do your officials decide matters on relevant standards?

5. Does your town give tax abatements to those who conserve land or keep it in timber or agriculture? Does your town understand the economic benefits to the town of these tax incentives?

6. Are there publicly adopted memos of understanding between boards to make sure environmental matters receive proper attention?

7. Is there a recycling program sponsored by the town?

8. Are your boards sensitive to regional impacts of actions they take? Is your town a good neighbor?

Use this checklist to "take the temperature" of your town's commitment to environmental quality and daily implementation of environmental law.

At the present time actions may be carried out by the towns through executive orders where permissible or by the passage of warrant items by the Town Meetings. The present county government can and does act in many regional affairs such as law enforcement, regional planning through CCPEDC and health matters through the Barnstable County Health Department. By tradition and its organization the county government is severely limited, however, in the extent to which it can act in important regional matters such as water quality control, waste disposal, coastal and wetlands management and transportation development and control. Both federal and state agencies operate from too great a distance to deal effectively with problems in a region as small and cohesive as Cape Cod, yet coordination through cooperative efforts of 15 towns is too cumbersome. It is fortuitous that Barnstable County almost exactly matches the natural boundaries of the Cape. It is thus ideally constituted to play a major role as a regional coordinating authority. A stronger county government with ability to pass legislation and fund its actions appears to be the only path to a truly effective regional governmental body combining the power to act and the necessary sensitivity to regional concerns. The recent recommendations made by the Barnstable County Government Review Committee urge the creation of just such a strong county government and call for a Charter Commission to set about establishing it. It is in our judgment imperative that this course be pursued vigorously and that such a government be constituted as soon as humanly possible.

In the meantime each community must take its future in its own hands, working with the town governments, the many private organizations dedicated to beneficial controlled growth, the limited but effective assistance of the present county organization and the powerful but diffuse resources of the state and federal governments.

THE COMMUNITY OF CAPE COD

The Random House Dictionary defines community as "a social group whose members live in a specific locality, share government and have a common heritage". The Community of Cape Cod thus describes a region of common geography, common and diverse interests, shared government and a common heritage. This unique peninsula can only grow wisely if we recognize that it is our community and that all of us must participate by working not only for our own good but for the good of our neighbors and the environment in which we all live. The growth problems we all face are a challenge to our wisdom, our integrity and our courage. To solve the problems we must first understand them. It is our hope that this report will help provide the understanding on which wise growth policy must be based.

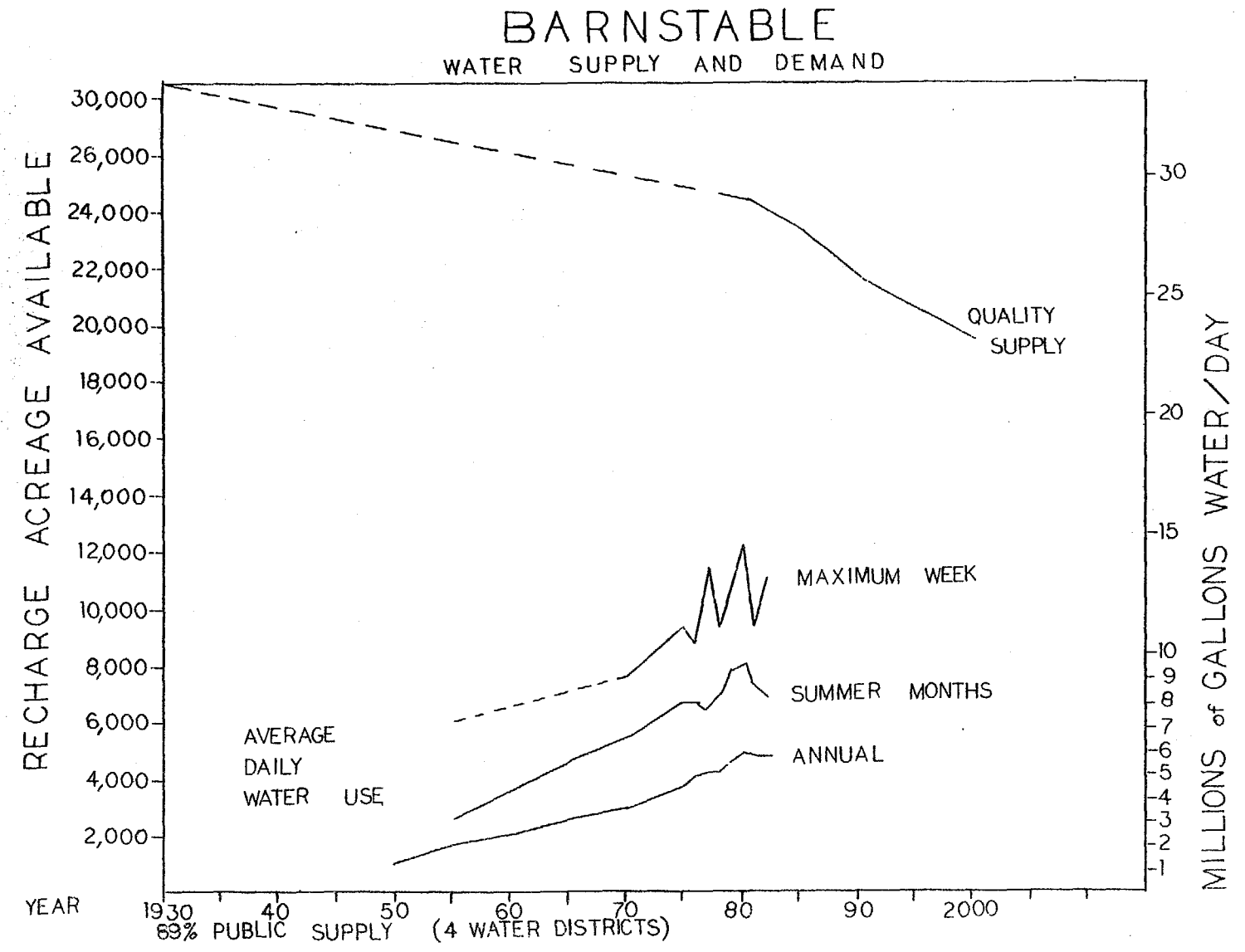
KEY TO ABBREVIATIONS

ACEC	Areas of Critical Environmental Concern
ACE	Army Corps of Engineers
ANR	Approval Not Required (Plan)
APCC	Association for the Preservation of Cape Cod
APR	Agricultural Preservation Restriction
ARM	Acid Rain Monitoring
BCHD	Barnstable County Health Department
BOD	Biochemical oxygen demand
Bt	Bacillus thuringiensis (Insecticide)
CAA	Clean Air Act
CCCCC	Cape Cod Coalition of Conservation Commissions
CCNS	Cape Cod National Seashore
CCPEDC	Cape Cod Planning & Economic Development Commission
CCRTA	Cape Cod Regional Transit Authority
CEQ	Council on Environmental Quality
CLF	Conservation Law Foundation
CLT	Community Land Trust
CPWB	Citizens for the Protection of Waquoit Bay
CRAB	Coastal Resources Advisory Board
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
DEIS	Draft Environmental Impact Statement
DEM	Dept. of Environmental Management (Mass.)
DEQE	Dept. of Environmental Quality Engineering (Mass.)
DMF	Dept. of Marine Fisheries
DOC	Dept. of Commerce
DOE	Dept. of Energy
DOI	Dept. of the Interior
EDF	Environmental Defense Fund
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
	Environmental Impact Study
ELM	Environmental Lobby of Massachusetts
ENF	Environmental Notification Form
EOEA	Exec. Office of Environmental Affairs (Mass.)
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FOE	Friends of the Earth
HDC	Historic Districts Commission
HWB	Hazardous Waste Board
IRS	Internal Revenue Service
LORAN	Long range aid to navigation
LUST	Leaking underground storage tanks

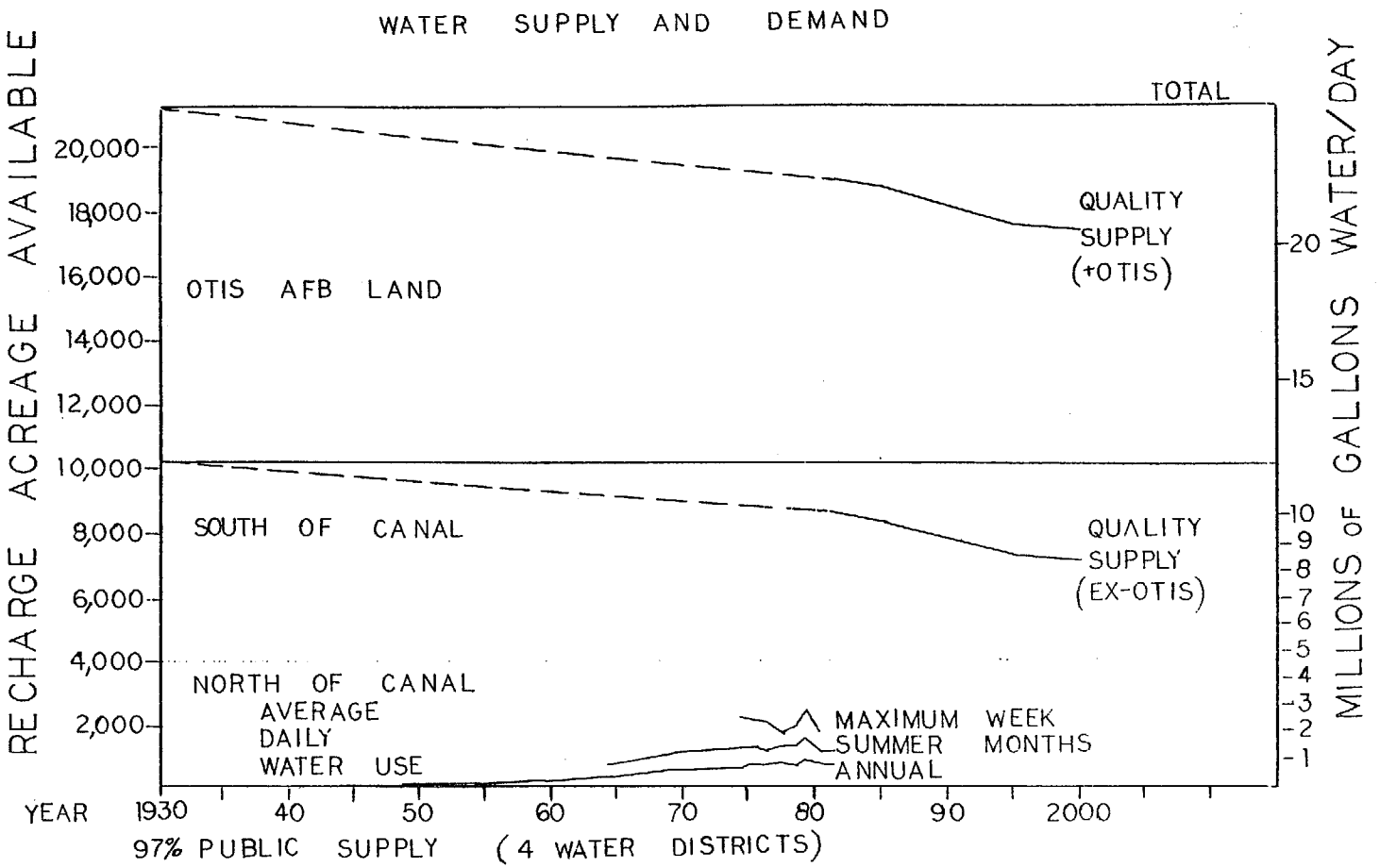
MACC	Mass. Association of Conservation Commissions
MEPA	Mass. Environmental Protection Act
NADP	National Atmospheric Deposition Program
NOAA	National Oceanic & Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NRDC	Natural Resources Defense Council
NSF	National Science Foundation
OCS	Outer Continental Shelf
ORV	Off-road vehicle
PCCS	Provincetown Center for Coastal Studies
PIRG	Public Interest Research Group
RCRA	Resource Conservation and Recovery Act
RPA	Regional Planning Authority
RTA	Regional Transit Authority
SCS	Soil Conservation Service
SENE	Southeastern New England Study
SWAC	Solid Waste Advisory Committee
TDR	Transfer of development rights
TOSCA	Toxic Substances Control Act
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VOCC	Volunteers of Cape Cod
WPA	Wetlands Protection Act (Mass.)
WQAC	Water Quality Advisory Committee
WRA	Wetlands Restriction Act
WRC	Water Resources Council
201	Wastewater Treatment Facilities Program
208	Water Quality Management Program
301	Massachusetts Pond and Lake Restoration Program

APPENDIX

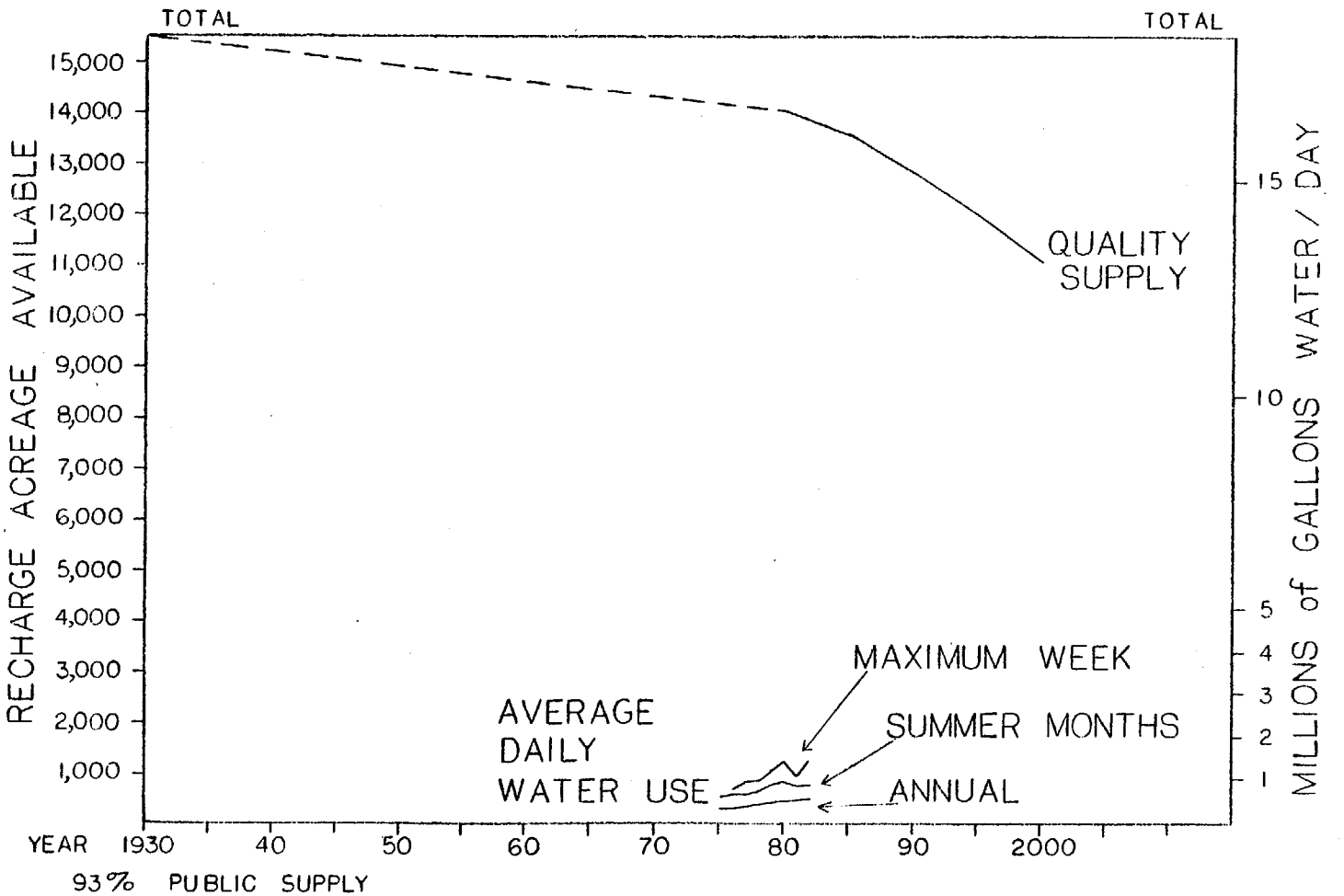
A. WATER SUPPLY & DEMAND GRAPHS


BARNSTABLE
WATER SUPPLY AND DEMAND
RECHARGE ACREAGE AVAILABLE
30,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
MILLIONS of GALLONS WATER/DAY
30
25
20
15
10
9
8
7
6
5
4
3
2
1
QUALITY SUPPLY
MAXIMUM WEEK
SUMMER MONTHS
ANNUAL
AVERAGE DAILY WATER USE
YEAR
1930
40
50
60
70
80
90
2000
69% PUBLIC SUPPLY (4 WATER DISTRICTS)

BOURNE

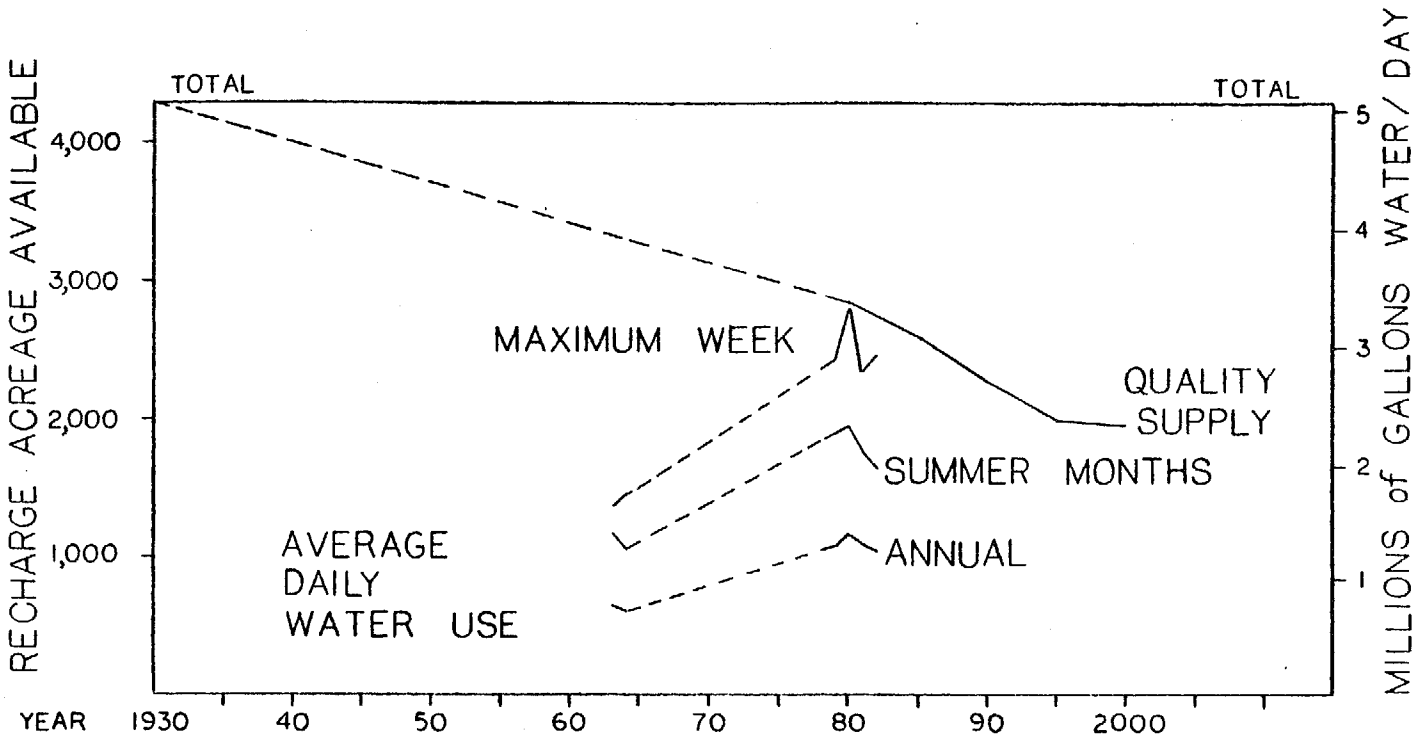

WATER SUPPLY AND DEMAND
RECHARGE ACREAGE AVAILABLE
MILLIONS OF GALLONS WATER/DAY
TOTAL
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
20
15
10
9
8
7
6
5
4
3
2
1
OTIS AFB LAND
QUALITY SUPPLY (+OTIS)
SOUTH OF CANAL
QUALITY SUPPLY (EX-OTIS)
NORTH OF CANAL
AVERAGE DAILY WATER USE
MAXIMUM WEEK
SUMMER MONTHS
ANNUAL
YEAR 1930 40 50 60 70 80 90 2000
97% PUBLIC SUPPLY (4 WATER DISTRICTS)

BREWSTER
WATER SUPPLY AND DEMAND



CHATHAM

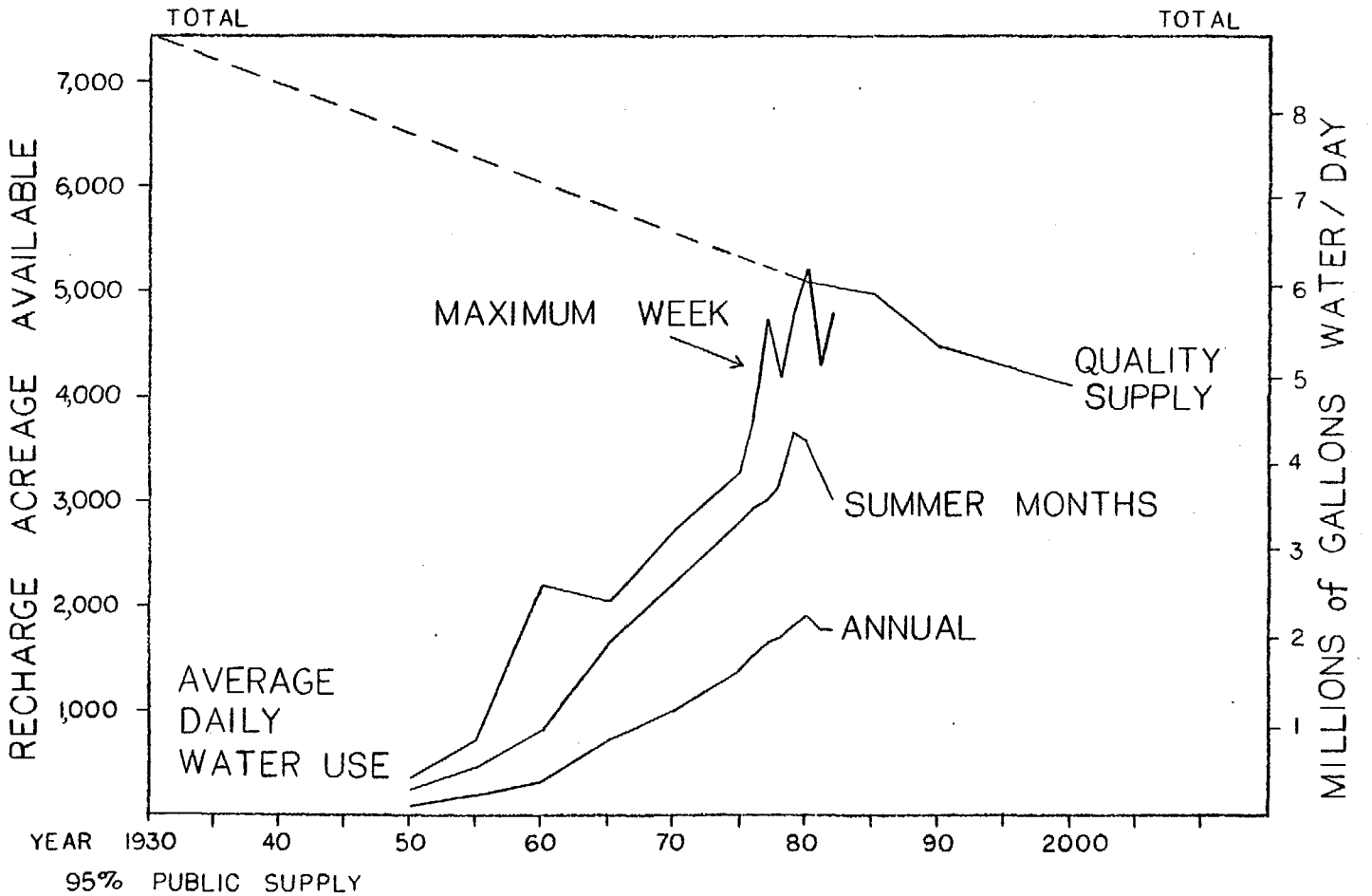
WATER SUPPLY AND DEMAND



55% PUBLIC SUPPLY

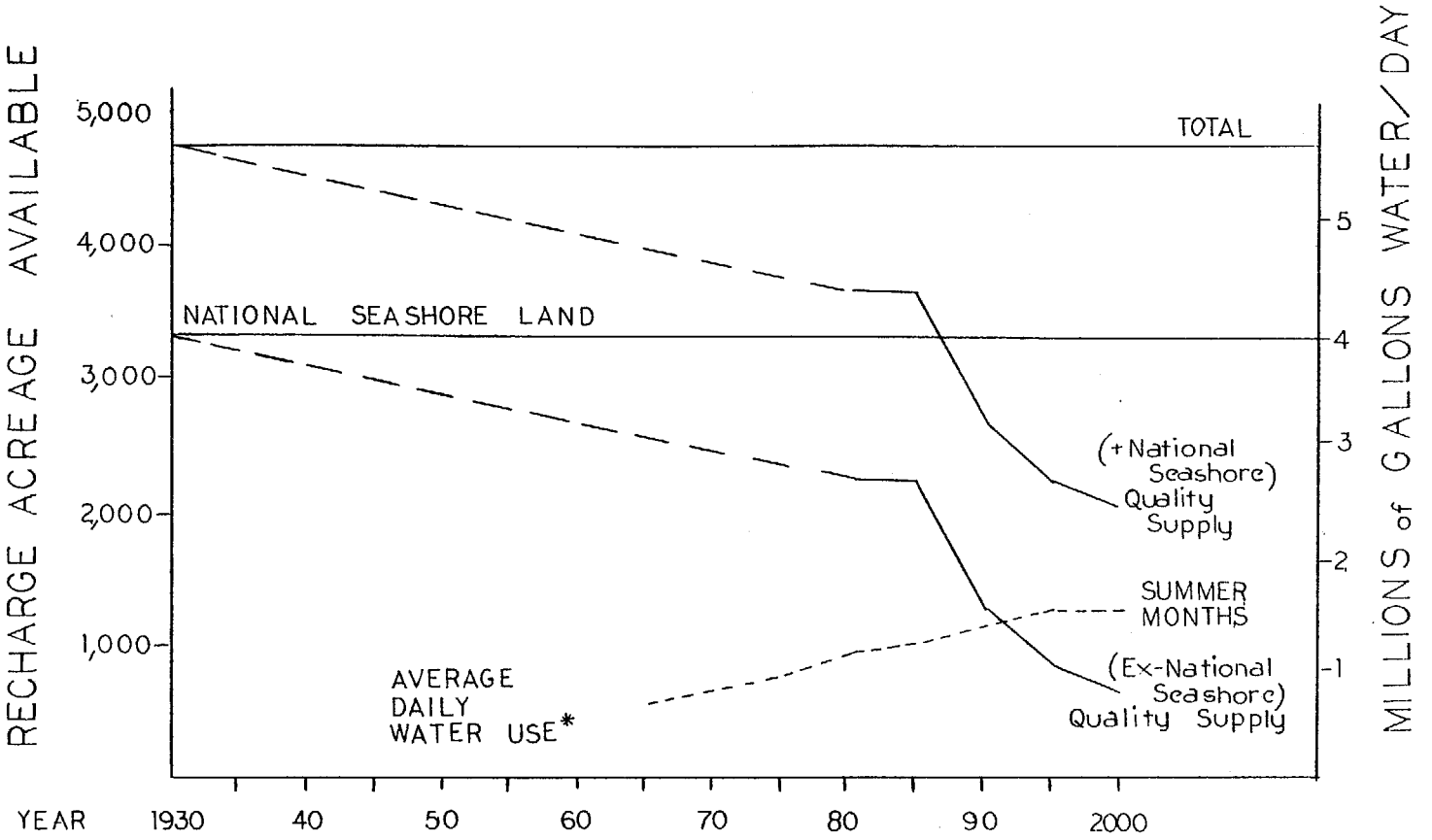
DENNIS

WATER SUPPLY AND DEMAND



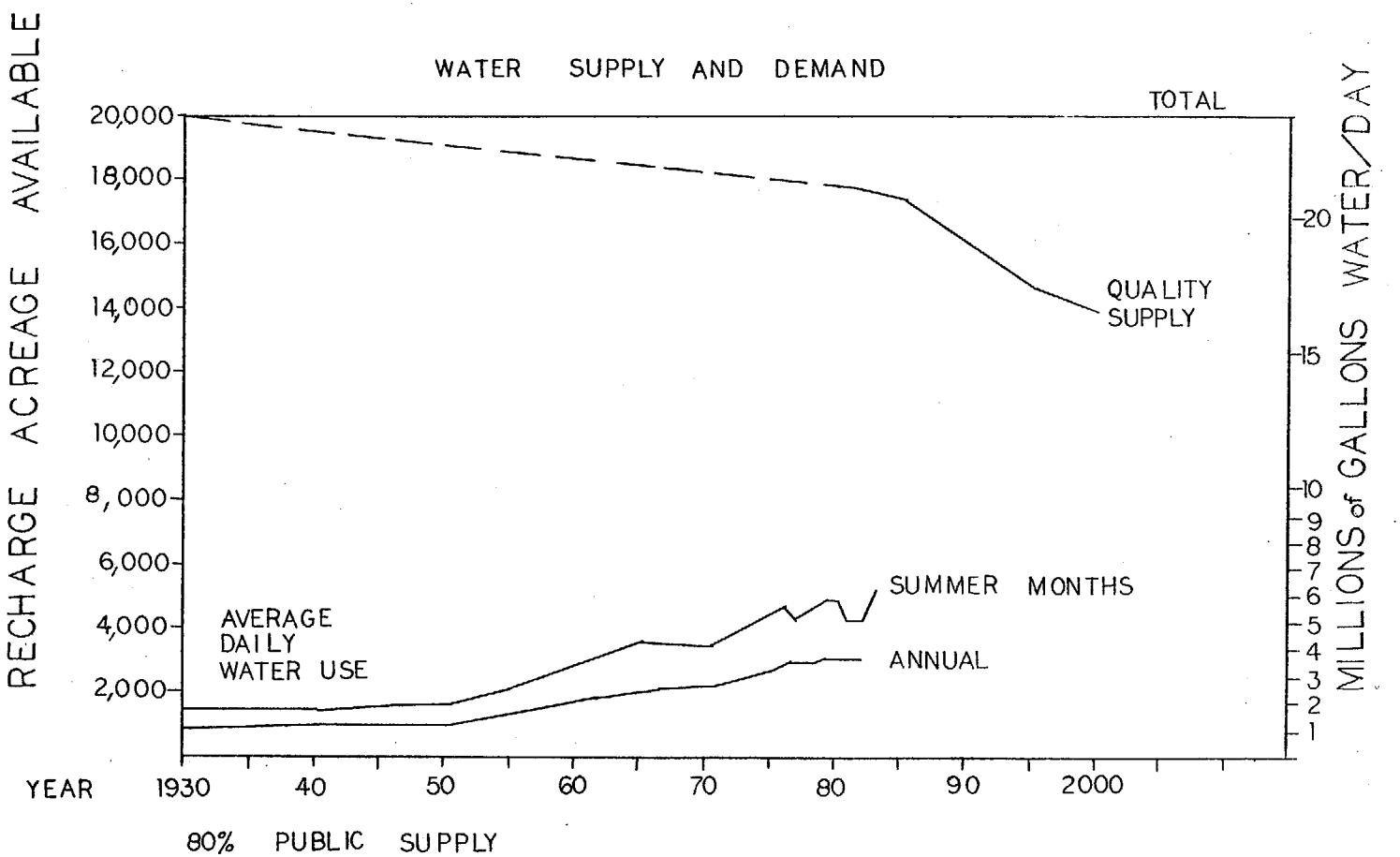
EASTHAM

WATER SUPPLY AND DEMAND



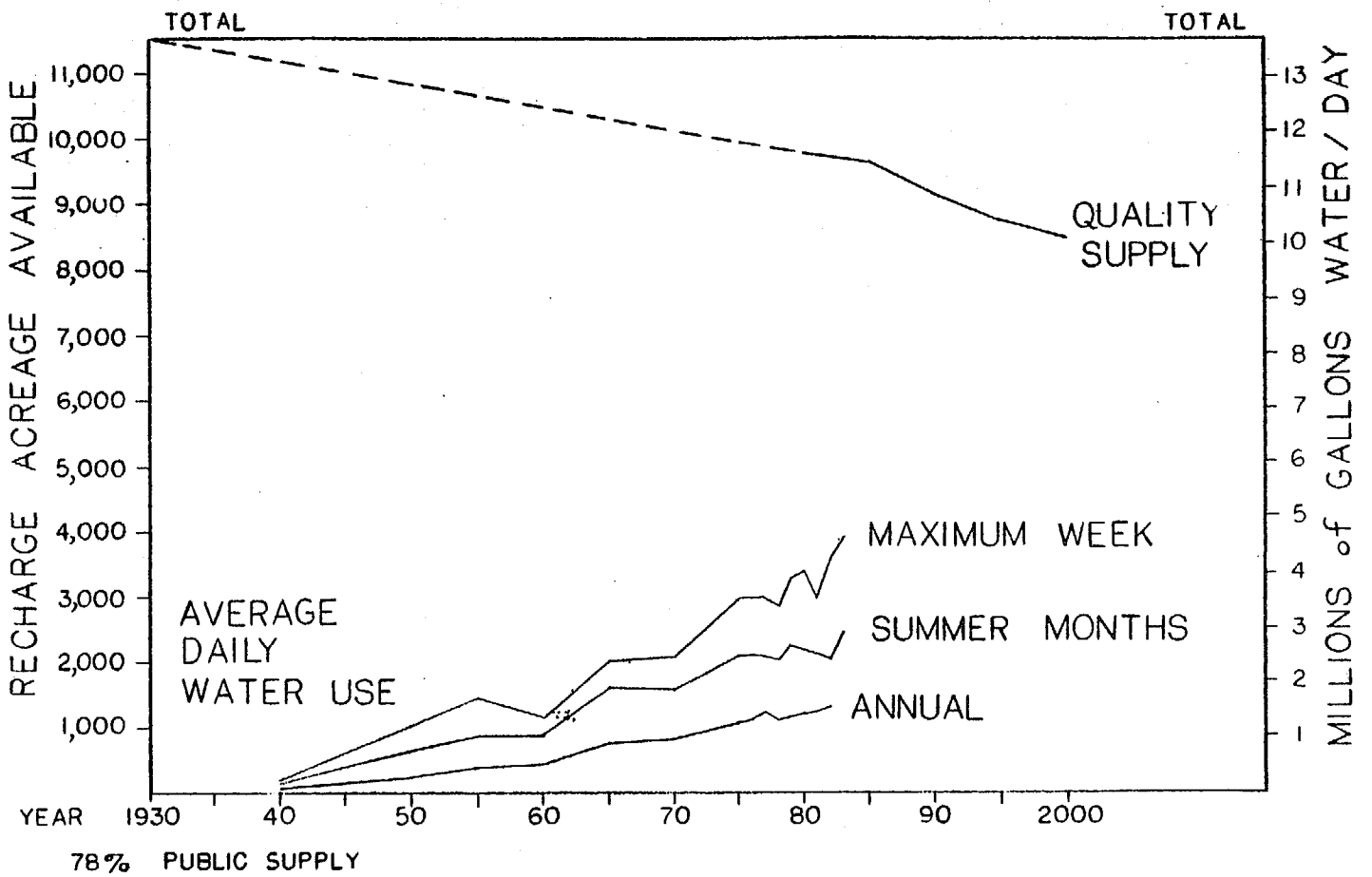
*Estimate - 65 gallons/capita/day x summer population

FALMOUTH

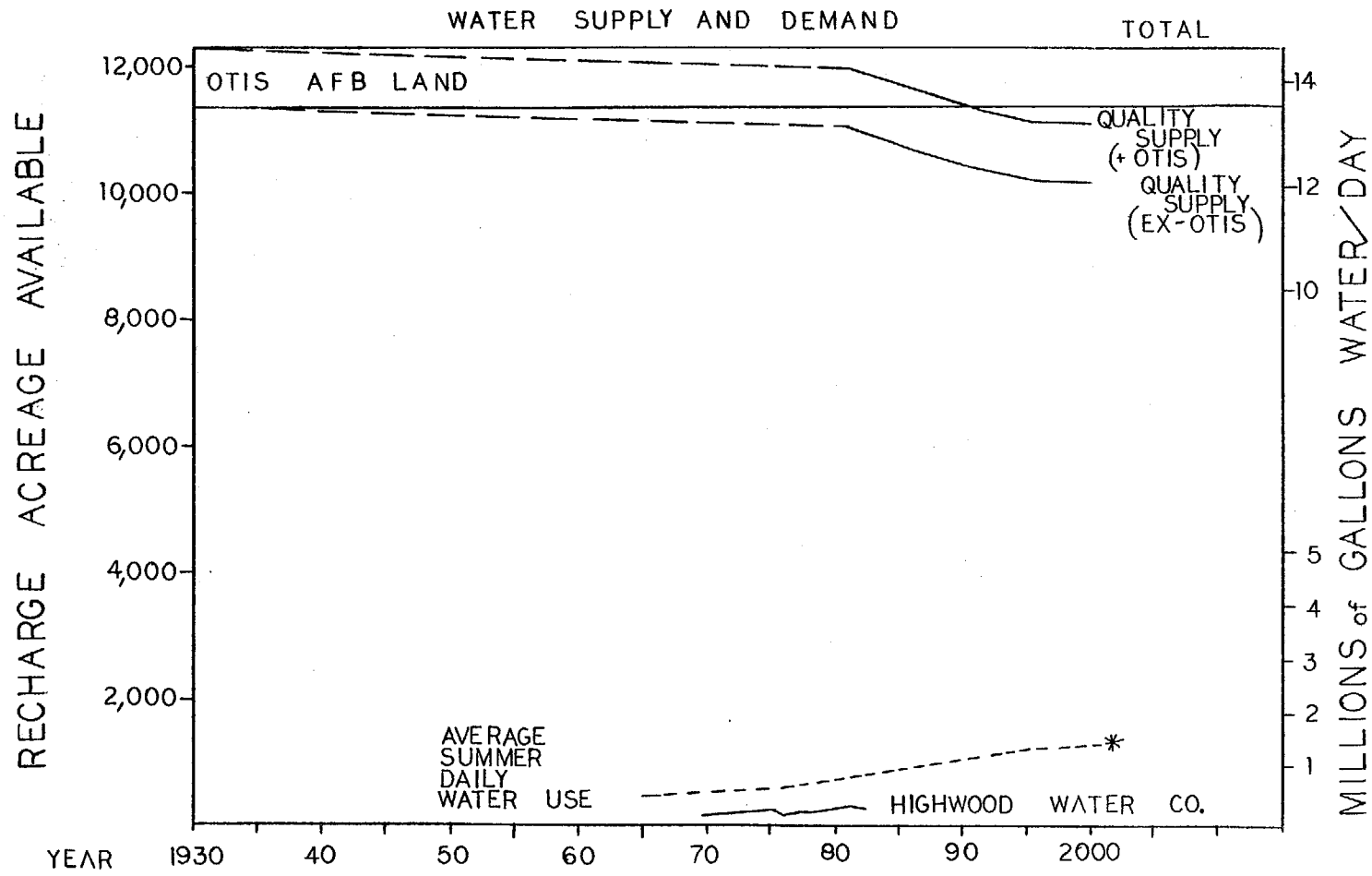

WATER SUPPLY AND DEMAND
RECHARGE ACREAGE AVAILABLE
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
TOTAL
QUALITY SUPPLY
SUMMER MONTHS
ANNUAL
AVERAGE DAILY WATER USE
MILLIONS of GALLONS WATER/DAY
20
15
10
9
8
7
6
5
4
3
2
1
YEAR
1930
40
50
60
70
80
90
2000
80% PUBLIC SUPPLY

HARWICH

WATER DEMAND AND SUPPLY

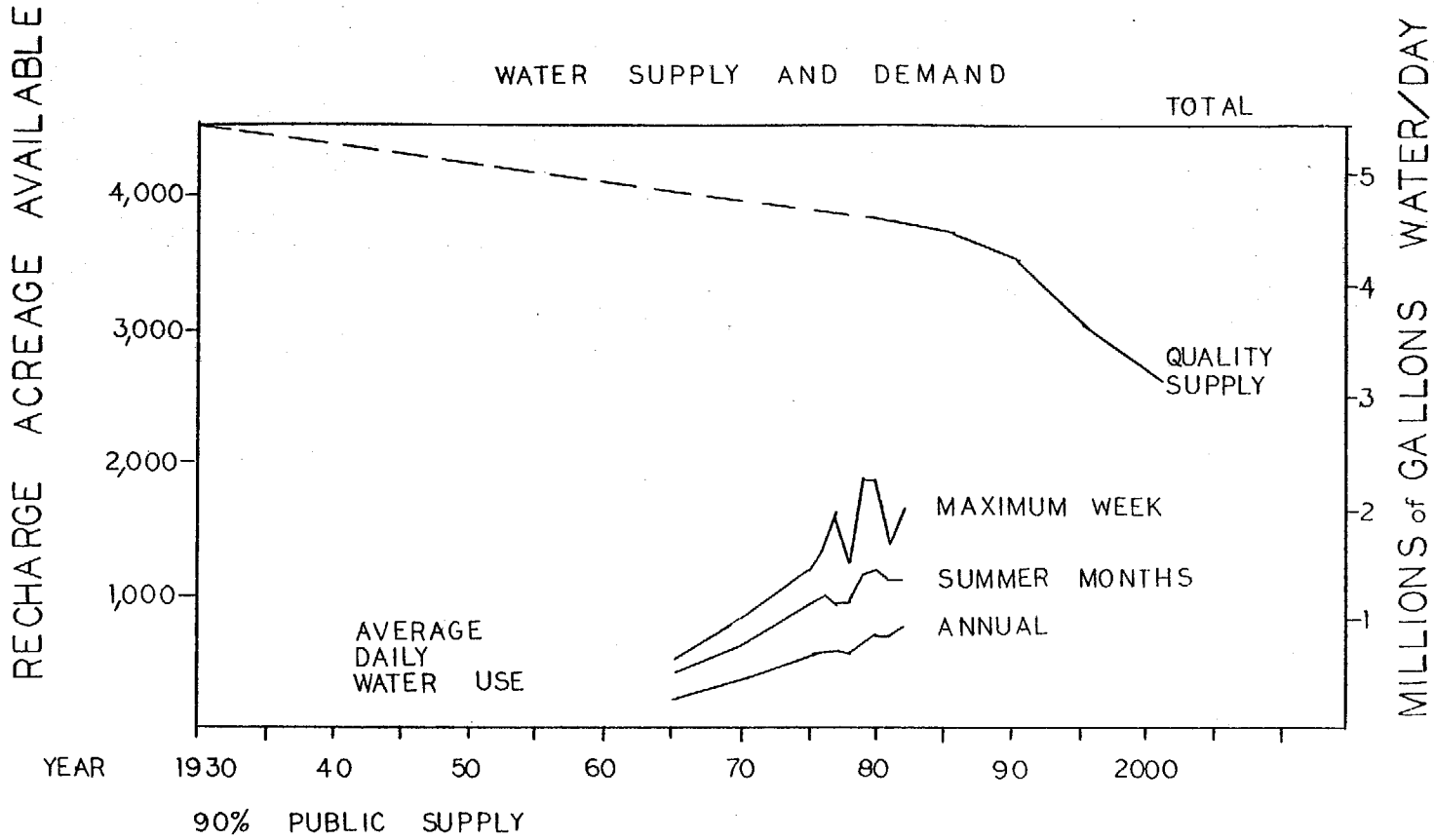


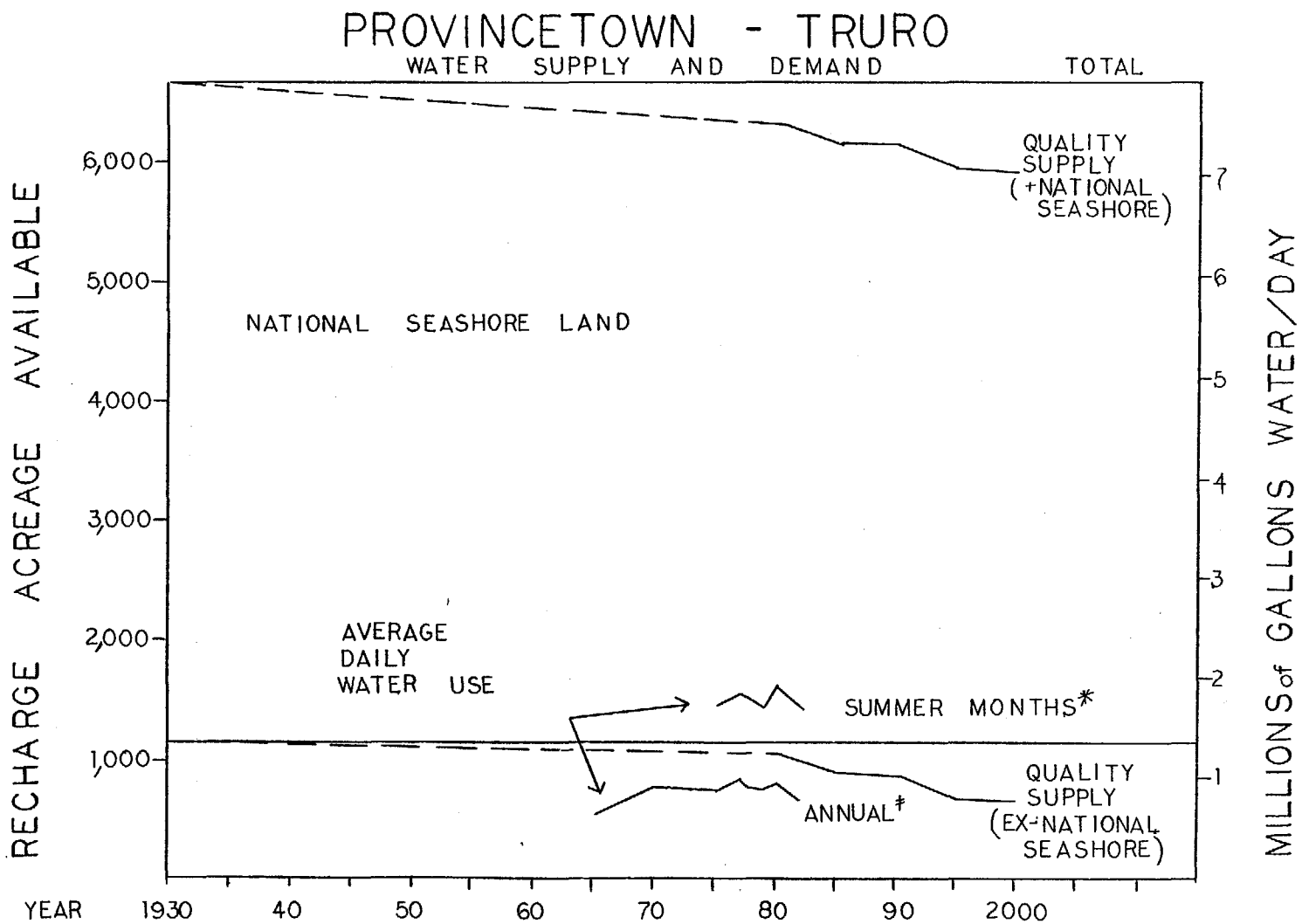
MASHPEE



*Estimate of Mashpee total: 65 gallons/capita/day x summer population

ORLEANS


WATER SUPPLY AND DEMAND
TOTAL
RECHARGE ACREAGE AVAILABLE
4,000
3,000
2,000
1,000
MILLIONS of GALLONS WATER/DAY
5
4
3
2
1
QUALITY SUPPLY
MAXIMUM WEEK
SUMMER MONTHS
ANNUAL
AVERAGE DAILY WATER USE
YEAR
1930
40
50
60
70
80
90
2000
90% PUBLIC SUPPLY

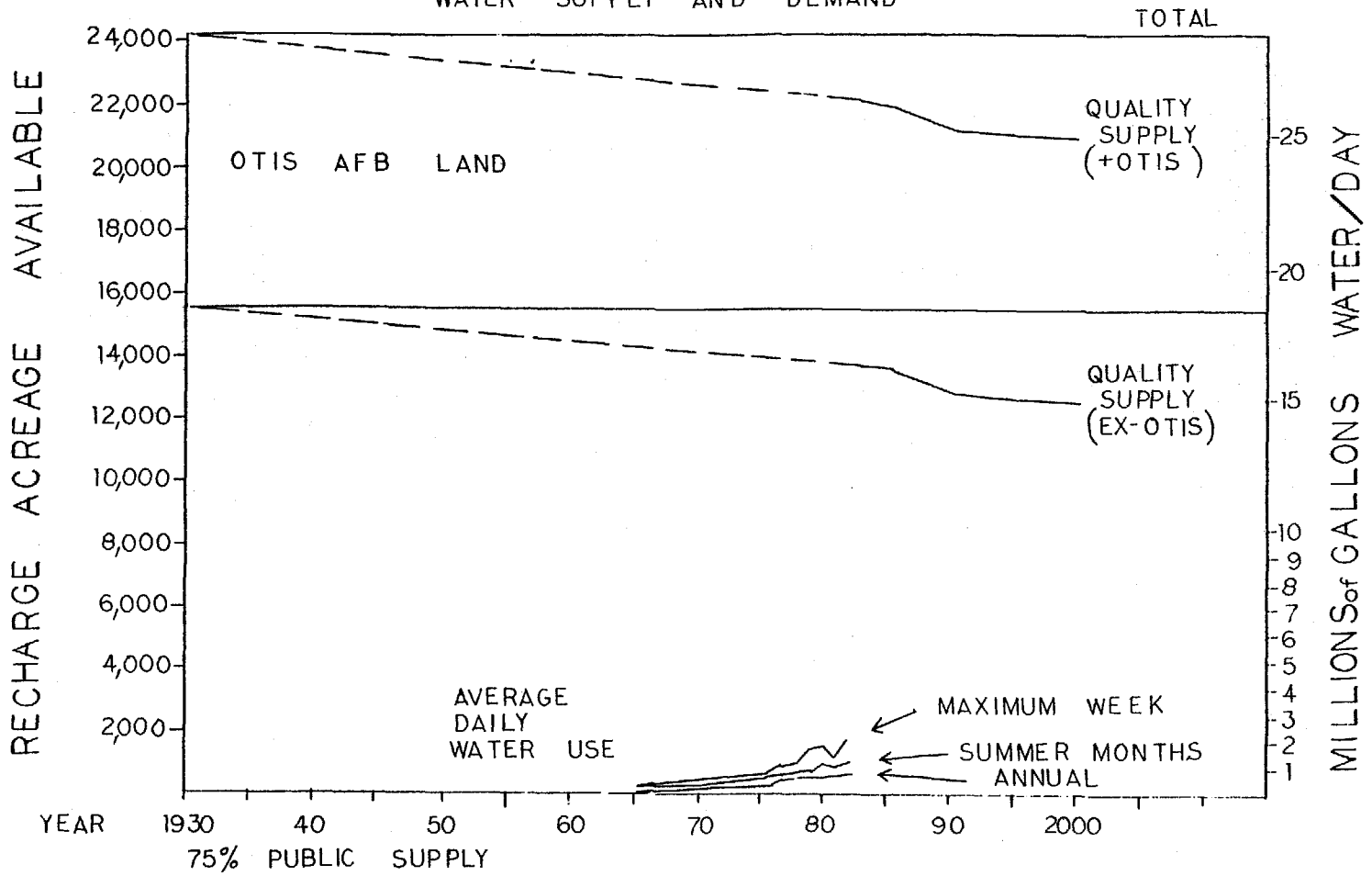


* TOTAL USE PROVINCETOWN - TRURO ESTIMATED

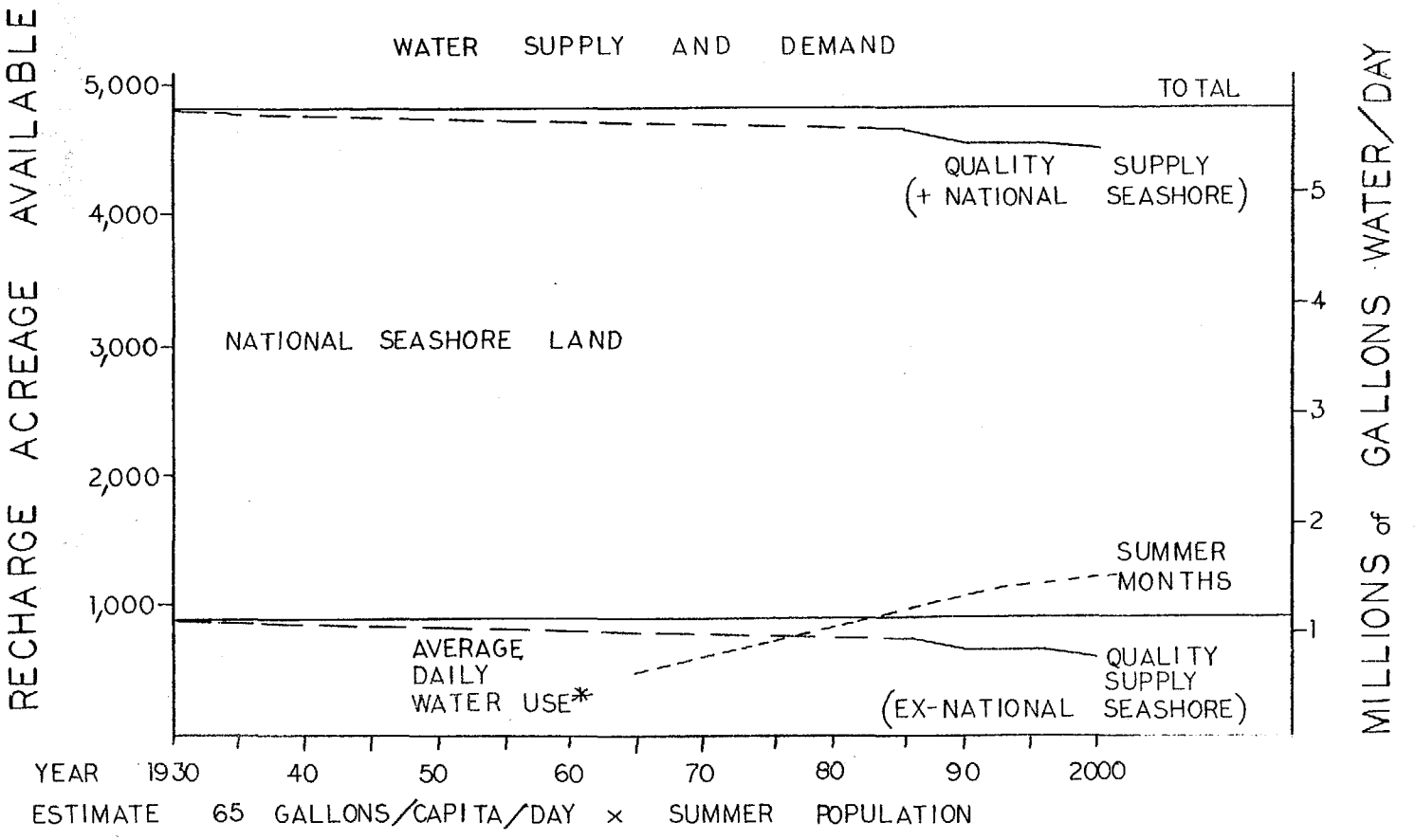
‡ PROVINCETOWN WATER DEPT. PUMPING ONLY

SANDWICH

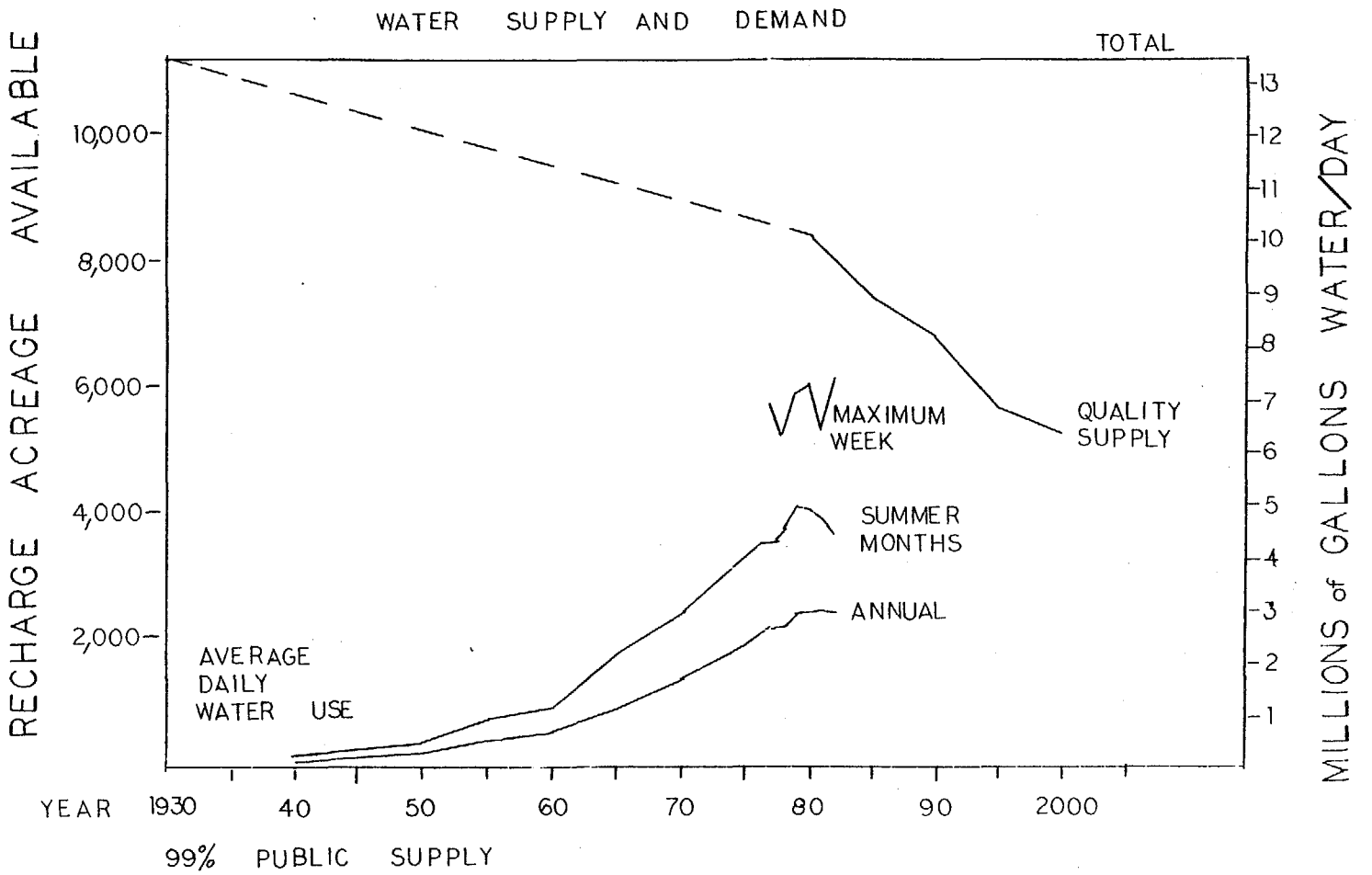
WATER SUPPLY AND DEMAND



WELLFLEET


WATER SUPPLY AND DEMAND
RECHARGE ACREAGE AVAILABLE
5,000
4,000
3,000
2,000
1,000
TOTAL
QUALITY SUPPLY
(+ NATIONAL SEASHORE)
NATIONAL SEASHORE LAND
SUMMER MONTHS
AVERAGE DAILY WATER USE*
QUALITY SUPPLY
(EX-NATIONAL SEASHORE)
MILLIONS of GALLONS WATER/DAY
5
4
3
2
1
YEAR 1930 40 50 60 70 80 90 2000
ESTIMATE 65 GALLONS/CAPITA/DAY × SUMMER POPULATION

YARMOUTH


WATER SUPPLY AND DEMAND
TOTAL
RECHARGE ACREAGE AVAILABLE
10,000
8,000
6,000
4,000
2,000
MILLIONS of GALLONS WATER/DAY
13
12
11
10
9
8
7
6
5
4
3
2
1
MAXIMUM WEEK
QUALITY SUPPLY
SUMMER MONTHS
ANNUAL
AVERAGE DAILY WATER USE
YEAR
1930
40
50
60
70
80
90
2000
99% PUBLIC SUPPLY

B. FORECAST METHODOLOGY, TABLES & GRAPHS

FORECAST METHODOLOGY

The following briefly outlines the methods used in the growth forecasts made in this study. Among the key sources were these:

Income: unpublished data from the U.S. Bureau of Economic Analysis.

Employment: Massachusetts Division of Employment Security.

Construction: building permit data compiled by the Cape Cod Planning and Economic Development Commission.

Population and housing: U.S. Census of Population and Housing.

Seasonal occupancy: field survey by APCC, 1982.

1. CAPEWIDE NON-WINTER POPULATION

1.1 Project number of second homes by five year intervals, based on the capture (declining from a rate of 0.03 in 1980 to 0.026 in 2000) of a growing Mass. population ages 35-54

(Number of 2nd homes = Capture rate x Mass population 35-54)

1.2 Project the persons in second homes as function of a declining person/second home rate (from 4.0 in 1980 to 3.8 in 2000)

(Second home population = persons/second home x Number of second homes)

1.3 Project extra summer population in year round homes using a constant 0.43 extra persons per year round home. The constant is based on findings from the 1982 APCC survey.

(Extra population = 0.43 x Number of year round homes)

1.4 Project non-dwelling population as a function of the sum of second & year-round homes. The non-dwelling factor is assumed to remain constant at slightly below the 1980 level.

[Non-dwelling unit population = Non-dwelling unit factor x (Number second homes + Number year round homes)]

1.5 Calculate non-winter population by five year intervals by summing second home population, extra population in year round homes and non-dwelling population.

(Non-winter population = Second home population + Extra population in year round homes + Non-dwelling unit population)

1.6 Project leisure supported income by assuming a constant 1980 adjusted basic income/non-winter population rate.

(Leisure supported income = Non-winter population x Adjusted basic income/ Non-winter population)

2. CAPEWIDE WINTER POPULATION AND INCOME

2.1 Capewide retirement aged population

2.1.1 Project Cape population aged 65+ based on 1980 mortality rate applied to existing Cape population aged 55-64 and 65+, and a migration rate that is a half of 1980's in 1990, and a third of 1980's in 2000.

(Population 55-64 + Pop. 65+) x (1- Mortality rate + Migration Rate)

2.1.2 Project retirement supported income by assuming a constant 1980 adjusted basic income per Cape population aged 65+.

(Retirement supported income = Cape population 65+ x Adjusted basic income/Cape pop 65+)

2.2 Other supported winter population

2.2.1 Project military supported income to remain at 1980 level through year 2000.

2.2.2 Project commuter supported income to increase by $30 million (in 1980 dollars) at five year intervals.

2.2.3 Project other outside supported income to increase by $22 million (in 1980 dollars) at five year intervals.

2.3 Calculate total outside supported income by summing leisure, retirement, military, commuter and other outside supported incomes.

(Total outside supported income = leisure support income + retirement support income + military support income + commuter support income + other outside support income).

2.4 Project respending income by assuming a constant 1980 respending rate.

(Respending income = total outside support income x respending rate).

2.5 Calculate total income by summing total outside supported income and respending income.

2.6 Project winter population based on the assumption that total income per capita remains constant through year 2000.

(Winter population = total income /total income per capita)

2.7 Calculate peak population by adding non-winter and winter populations.

3. TOWN WINTER POPULATION

3.1 Project 1990 and 2000 winter population by town using four alternative ways:

a) Linear Extrapolation
b) Land Share
c) Shift Share by Population
d) Shift Share by Dwelling Unit

3.2 Project by linear extrapolation.

3.2.1 Project year 2000 population by town by adding population change between 1960 and 1980 to 1980 base.

3.2.2 Project 1990 population by interpolation (midpoint).

3.3 Project by land share method

3.3.1 Calculate land consumption by town for 1975 and 1983 based on 1971 and 1980 land use information, town open space and recreation inventories, and an estimate of land consumed since base date as a function of the number of dwelling units authorized.

3.3.2 Calculate town's share of Capewide vacant land.

3.3.3 Project town's total dwelling units by distributing added dwelling units according to its share of vacant land.

3.3.4 Project town's winter population as a function of the percentage winter occupied units, household size, and total dwelling units (percent winter occupancy based on 1970 to 1980 trend; household size estimated to be 0.94 of 1980 level in 1990 and 0.92 of 1980 level in 2000).

3.4 Project by shift share of population.

3.4.1 Calculate percent share of winter population at ten year intervals between 1960-80.

3.4.2 Project town's share of winter population to 1990 and 2000.

3.4.3 Calculate town's winter population by multiplying projected share of winter population with the project Capewide population.

3.5 Project by shift share of dwelling units.

3.5.1 Calculate percent town's share of Capewide dwelling units for 1960 to 1983.

3.5.2 Project town's share of dwelling units for 1990 and 2000.

3.5.3 Calculate town's total number of dwelling units by multiplying the town's projected share of dwelling units with the Capewide total.

3.5.4 Project the town's percent share of winter occupied dwelling units based on 1970 to 1980 data.

3.5.5 Calculate town's winter population by multiplying the town's winter occupied units by the town's household size.

3.6 Judgmentally make estimates based on above results.

4. TOWN PEAK POPULATION

4.1 Project peak populations for each alternative way of projecting winter population using the following general method of calculating non-winter population.

4.1.1 Calculate the number of second homes by town as the difference between total projected units, winter occupied units and units vacant for other reasons.

4.1.2 Calculate percentage of second homes by town.

4.1.3 Project second home population based on a declining second home occupancy rate (for 4.0 in 1980 to 3.8 in 2000).

4.1.4 Project the extra population in year round homes using the assumed constant 0.43 extra persons per year round home.

4.1.5 Project the non-dwelling population as a function of the 1983 town's population share in commercial accommodations as modified by the town's share of Capewide winter population growth.

[Non-dwelling unit population = town's existing non-dwelling unit population ± (Percentage town's share of Capewide commercial accommodation in 1983 + Percent town's share of winter population growth) x (1/2 x Capewide non-dwelling unit population growth)]

4.1.6 Calculate town's non-winter population by summing second home population + extra year round population + non-dwelling population.

4.1.7 Calculate town's peak population by adding non-winter and winter population for each alternative way.

5. CAPEWIDE COVERED EMPLOYMENT

5.1 Calculate covered employment by town by job sector, summing to get Capewide totals. (Government jobs are estimated for 1970-78 based on recent years' breakdown of government jobs into federal, state and other).

5.2 Calculate earned income (in 1980 dollars) per covered job and earned income per total income for 1970-1982.

5.3 Project total jobs to year 2000 based on a constant earned income/total income rate of 0.42 and an income per job of $13,000.

5.4 Distribute total projected jobs among job sectors by shift share and by linear extrapolation.

5.5 Judgmentally distribute total projected jobs among job sectors based on above results.

6. HOUSING STOCK

6.1 Calculate town's housing stock by summing the number of second homes, year round homes and dwelling units vacant for other reasons (assumed to remain constant to year 2000).

6.2 Calculate homebuilding rate by calculating the annual change in the housing stock by town.

Data in the following tables in general should have 2-figure accuracy, although for convenience figures are often displayed as if having five or more significant digits. For that reason, and the use of many data sources which are not all in perfect agreement, figures for the same item may vary slightly among tables. This study, unlike the 1976 one, accepted the most recent U. S. Census figures as being accurate. More recent field information in Provincetown indicates that may not always be the case.

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H-5	Town Land Development, 1975
H-6	Town Land Development, 1983
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Table.idx/APCC

Table A-1
CAPE COD POPULATION, 1970 - 2000 November 30,1983

	1970	1975	1980	1985	1990	1995	2000
WINTER POPULATION (from income analyses in constant 1980 dollars):							
Leisure supported income*	192	247	247	271	285	302	309
Retirement supp. income*	203	296	331	399	462	493	516
Military supported income*	75	38	36	36	36	36	36
Commuter supported income*	32	125	157	190	220	250	280
Other outside supp. income*	91	128	145	167	189	211	233
Total outside supp. income*	594	834	916	1063	1192	1292	1374
Respending income*	411	540	597	708	795	861	893
Total income*	1005	1374	1513	1753	1967	2132	2267
Total income/capita	10359	10731	10230	10500	10500	10500	10500
Winter population	97000	128000	147900	167000	187400	203100	215900
NON-WINTER POPULATION:							
Second home population	114120	129790	145400	158800	164500	172600	174900
"Extra" summer population	13850	19570	25000	29700	33800	37200	39800
Non-dwelling population+	47350	50780	54500	58400	61400	65000	66500
Non-winter population+	175310	200140	225000	246900	259700	274800	281200
PEAK POPULATION+	272310	328140	372900	413900	447000	477900	497100

* in millions of dollars
\+ National Guardsmen from Otis not included in total. In 1980, there were 1200.

CPCensus/APCC-1

Table A-2
CAPE COD POPULATION, 1970 - 2000 (Details) August 15, 1984

	1970	1975	1980	1985	1990	1995	2000
MA pop 35-54#	1296800	1248000	1211800	1340000	1479700	1630000	1770200
Capture rate	.022	.026	.03	.03	.0285	.0275	.026
No. second homes#	28530	32448	36354	40200	42171	44825	46025
Persons/second home	4	4	4	3.95	3.9	3.85	3.8
Second home population	114118	129792	145416	158790	164469	172576	174896
Year-round homes	32200	45500	58200	69000	78500	86500	92500
"Extra" summer pop/home	.43	.43	.43	.43	.43	.43	.43
"Extra" summer population	13846	19565	25026	29670	33755	37195	39775
Non-D.U. Factor	.37	.34	.32	.31	.31	.31	.31
Non-dwelling population+	47347	50781	54541	58423	61449	65029	66548
Non-winter population+	175311	200138	224983	246883	259673	274800	281219
Adj Bas. Inc./Nonwinter Pop	1094	1233	1098	1098	1098	1098	1098
Leisure supported income*	192	247	247	271	285	302	309
Cape population 65+#	16348	24266	30721	37000	42900	45800	47900
Adj Bas. Inc./Cape Pop. 65+	12434	12202	10774	10774	10774	10774	10774
Retirement supp. income*	203	296	331	399	462	493	516
Military supported income*	75	38	36	36	36	36	36
Commuter supported income*	32	125	157	190	220	250	280
Other outside supp. income*	91	128	145	167	189	211	233
Total outside supp. income*	594	834	916	1063	1192	1292	1374
Respending rate	0.69	0.65	0.65	0.65	0.65	0.65	0.65
Respending income*	411	540	597	691	775	840	893
Total income*	1005	1374	1513	1753	1967	2132	2267
Total income/capita	10359	10731	10230	10500	10500	10500	10500
Winter population	97000	128000	147900	166995	187362	203054	215888
Peak population+	272311	328138	372883	413877	447035	477854	497107

Income analyses in constant 1980 dollars
from Census data
* in millions of dollars
+ National Guardsmen from Otis not included in total. In 1980, there were 1200.
Year round units only include occupied units.

CPcensus/APCC-1

Table A-3
1980 CAPE COD INCOME ANALYSIS ($ million) July 27,1984

Sector	Total	Adjusted	Basic	Military	Property	Transfer	Commuting	Visitsale	Offsale
Work Earnings									
Construction	42	41	20	0	0	0	0	20	0
Manufacturing	45	44	20	0	0	0	0	0	20
Farm	3	3	3	0	0	0	0	0	3
Military	13	13	13	13	0	0	0	0	0
Federal civil.	23	22	22	22	0	0	0	0	0
Other gov't.	101	98	13	0	0	0	0	0	13
Trade, service	459	447	224	0	0	0	0	217	7
Subtotal	686	668	315	35	0	0	0	237	42
Property Income	407	397	222	0	222	0	0	0	0
Transfer Income	301	293	220	0	0	220	0	0	0
Commuting Income	161	157	157	0	0	0	157	0	0
Social Insurance	-39	0							
TOTAL INCOME	1516	1515	913	35	222	220	157	237	42
Percent of Basic			100	4	24	24	17	26	5
Population Support			147900	5679	35955	35612	25398	38431	6825

Visitsale is sales to visitors. Offsale is sales to outside Cape Cod but not including sales to visitors.
Income is in millions of dollars.

INCOME3/APCC-1

Table A-4
1980 NET INCOME TO WINTER CAPE COD RESIDENTS ($ million) July 23,1984

Sector	SOURCE: Military	Retirees	Leisure	Commuters	Others	Total
Military	35	0	0	0	0	35
Property	0	155	9	0	58	222
Transfer	0	176	0	0	44	220
Commuting	0	0	0	157	0	157
Sales to Visitors	0	0	237	0	0	237
Sales off-Cape	0	0	0	0	42	42
TOTAL BASIC INCOME	35	331	246	157	144	913
Percent of Basic	4	36	27	17	16	100
Population Support	5679	53658	39869	25398	23296	147900

Income is in millions of dollars.

INCOME3/APCC_4
Table A-5
ADJUSTED BASIC INCOME TO WINTER CAPE COD RESIDENTS ($ million) August 3,1984

Sector	Military				Retirees				Leisure				Commuters				Others				Total			
	'69	'73	'77	'80	'69	'73	'77	'80	'69	'73	'77	'80	'69	'73	'77	'80	'69	'73	'77	'80	'69	'73	'77	'80
ConManFarmNMGovt	9	11	17	23	0	0	0	0	11	18	16	21	0	0	0	0	8	15	23	36	28	44	56	80
Trade & Services	0	0	0	0	0	0	0	0	58	103	150	217	0	0	0	0	2	3	5	7	60	106	155	224
Military	29	8	10	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	8	10	13
Property Income	0	0	0	0	44	67	104	155	2	4	6	9	0	0	0	0	16	25	38	58	62	96	148	222
Transfer Income	0	0	0	0	30	66	122	176	0	0	0	0	0	0	0	0	8	16	30	44	38	82	152	220
Commuting Income	0	0	0	0	0	0	0	0	0	0	0	0	1	53	100	157	0	0	0	0	1	53	100	157
Totl Adj Basic	38	19	27	36	74	133	226	331	71	125	172	247	1	53	100	157	34	59	96	145	218	389	621	916
Percent of Total	17	5	4	4	34	34	36	36	33	32	28	27	0	14	16	17	16	15	15	16	100	100	100	100
Pop. Supp. (000)	16	5	6	6	31	38	50	53	30	36	38	40	0	15	22	25	14	17	21	23	91	111	137	148

Income is in millions of dollars.

BEA3/APCC_4

Table F-1
CAPE COD COHORT SURVIVAL HISTORY July 27,1984

Years	Cape Births	Rate
1955-59	8551	0.32
1960-64	8039	0.30
1965-69	6503	0.19
1970-74	7046	0.21
1975-79	7624	0.13

Age Groups	1960 MA Deaths	Death Rate	1970 MA Deaths	Death Rate	1980 MA Deaths	Death Rate
age 0-4	2414	.0044014	1794	.0038165	875	.0025948
5-14	394	4.226E-4	340	3.097E-4	170	2.033E-4
15-24	482	7.347E-4	860	8.785E-4	940	8.537E-4
25-34	651	.0010297	727	.0010902	925	9.887E-4
35-44	1845	.0026441	1702	.0027116	1191	.0018986
45-54	4397	.0072185	4449	.0066526	3050	.0052151
55-64	8797	.0175622	8702	.0160283	7455	.0126704
65+	37138	.0649710	38365	.0603048	40325	.0555035

Age Groups	Cape Pop 1960	Cape Pop 1970	Survival Rate	Migrated	1960-70 Rate	Cape Pop 1980	Survival Rate	Migrated	1970-80 Rate
age 0-4	8423	7122	.9810627	742	0.12	8007	.9870932	481	0.06
5-14	12312	18093	.9766923	2015	0.12	19398	.9800817	5512	0.39
15-24	9065	13618	.9935137	1386	0.11	21152	.9941983	3164	0.17
25-34	9066	10118	.9909130	1135	0.13	21587	.9907032	8096	0.59
35-44	8623	10196	.9814505	1298	0.14	14570	.9851560	4602	0.45
45-54	7180	10410	.9544765	2180	0.25	13564	.9610659	3765	0.37
55-64	6657	10751	.8896610	4363	0.61	18926	.9074789	9479	0.91
65+	8960	16348	.5870183	7181	0.46	30721	.6078742	14248	0.53
TOTAL	70286	96656				147925			

Source: MA Dept. of Health Annual Reports of Vital Statistics

AL7COHO/APCC-1

Table B-2

CAPE COD COHORT SURVIVAL PROJECTIONS July 27, 1984

****

Estim. Birth Rates

1980-84	.13
1985-89	.13
1990-94	.13
95-1999	.13

Estimated Migration Multipliers

1980-1990:	0-54 years	0.80
	55+ years	0.50
1990-2000:	0-54 years	0.40
	55+ years	0.33

Age Groups	1980-1990 Rates Survive	Migrate	Pop. 1990	1990-2000 Rates Survive	Migrate	Pop. 2000
age 0-4	.9870932	0.05	7730	.9870932	0.02	10806
5-14	.9800817	0.31	19960	.9800817	0.15	19520
15-24	.9941983	0.14	21999	.9941983	0.07	21223
25-34	.9907032	0.48	31015	.9907032	0.23	26961
35-44	.9851560	0.36	29122	.9851560	0.18	36127
45-54	.9610659	0.30	18307	.9610659	0.15	32235
55-64	.9074789	0.45	18423	.9074789	0.30	22032
65+	.6078742	0.26	43102	.6078742	0.17	47915
TOTAL			189658			216818

AL7COHO/APCC-1

Table B-3
PROJECTED EFFECT OF GREATLY REDUCED NET INMIGRATION
ON CAPE COD POPULATION July 23,1984

****

Estim. Birth Rates

1980-84	.13
1985-89	.13
1990-94	.13
95-1999	.13

Estimated Migration Multipliers

1980-1990:	0-54 years	0.45
	55+ years	0.30
1990-2000:	0-54 years	0.35
	55+ years	0.20

Age	1980-1990 Rates		Pop.	1990-2000 Rates		Pop.	Percentage	
Groups	Survive	Migrate	1990	Survive	Migrate	2000	1980	2000
age 0-4	.9870932	0.03	7566	.9870932	0.02	9592	5	5
5-14	.9800817	0.18	17855	.9800817	0.14	17918	13	10
15-24	.9941983	0.08	20812	.9941983	0.06	18845	14	11
25-34	.9907032	0.27	26614	.9907032	0.21	24949	15	14
35-44	.9851560	0.20	25685	.9851560	0.16	30456	10	17
45-54	.9610659	0.17	16424	.9610659	0.13	28005	9	16
55-64	.9074789	0.27	16014	.9074789	0.18	17895	13	10
65+	.6078742	0.00	30179	.6078742	0.00	28080	21	16
TOTAL			161149			175739	100	100

* For ages 65+, assume no net inmigration.

COHOnom/APCC-1

Table C-1
CAPE COD EMPLOYMENT HISTORY June 13, 1984

Year	Government	Agriculture Forest/Fish & Mining	Construct.	Manufacture	Transport. Communicat. Utilities	Wholesale & Retail Trade	Finance Insurance Real Estate	Services	Total Jobs
1970	8500	526	2681	1527	1739	9451	1298	5242	30964
%	27.45	1.70	8.66	4.93	5.62	30.52	4.19	16.93	100.00
1974	7100	532	2835	1957	2579	12749	1899	8861	38512
%	18.44	1.38	7.36	5.08	6.70	33.10	4.93	23.01	100.00
1978	8100	631	2613	2790	2846	16245	2117	10732	46074
%	17.58	1.37	5.67	6.06	6.18	35.26	4.59	23.29	100.00
1980	9786	777	2331	3268	3130	18105	2374	12746	52517
%	18.63	1.48	4.44	6.22	5.96	34.47	4.52	24.27	100.00
1981	9413	774	2487	3575	3167	19343	2622	13644	55025
%	17.11	1.41	4.52	6.50	5.76	35.15	4.77	24.80	100.00
1982	9319	824	2414	3527	3014	19524	2787	14167	55576
%	16.77	1.48	4.34	6.35	5.42	35.13	5.01	25.49	100.00

Year	Earned Income	Income/ Total jobs	Earn.Inc./ Total Inc.
1970	564	18219	.561363636
1974	653	16947	.491228070
1978	722	15668	.473594549
1980	685	13043	.451846966
1981	686	12467	.440483036
1982	689	12397	.424572317

Note: Employment is average annual covered employment from MA Div. of Employment Security, Employment and Wages: Cities and Towns. Government jobs include military jobs. Between 1970 and 1978, government jobs are estimated by PBH.
Earned income data is from Bureau of Economic Analysis.

CovEmp2/APCC-1

Table C-2

CAPE COD EMPLOYMENT PROJECTIONS

June 20, 1984

Year	Total Income	Earned/ Total Inc.	Earned Income	Income/ Job	Total Jobs
1990	2000	.42	840	13000	64615
2000	2300	.42	966	13000	74308

		Government	Agriculture Forest/Fish & Mining	Construct.	Manufacture	Transport. Communicat. Utilities	Wholesale & Retail Trade	Finance Insurance Real Estate	Services	Total Jobs
1990:	Shift Share									
	%Total Jobs	15.60	1.40	4.25	6.20	4.45	36.00	4.90	27.20	100.00
	Jobs	10080	905	2746	4006	2875	23262	3166	17575	64615
	Linear Extrapolation									
	Jobs	11072	1028	1981	5009	4521	26759	3450	20250	74070
	Best Judgement									
	Jobs	10100	950	2500	4000	3150	23200	3200	17600	64700
2000:	Shift Share									
	%Total Jobs	13.81	1.24	4.10	6.19	3.90	37.14	5.05	28.57	100.00
	Jobs	10262	920	3043	4600	2902	27600	3751	21231	74308
	Linear Extrapolation									
	Jobs	12358	1279	1631	6750	5912	35413	4526	27754	95623
	Best Judgement									
	Jobs	10300	950	2600	4600	3200	27600	3800	21300	74350

Note: Employment is average annual covered employment.

CovEmp2/APCC-1

Table D-1
1990 TOWN WINTER POPULATION: SUMMARY 24-Sep-84

	1960 Pop.	1970 Pop.	1980 Pop.	1990 Winter Population: 208 1976 Analysis	Linear Extrapol.	Land Share	Shift Share By Population	Shift Share By Dwelling	Best Judgement
BOURNE	7430	8770	11830	14000	14030	14300	13100	13700	14100
FALMOUTH	13040	15820	23635	28800	28935	29000	29000	28500	29000
MASHPEE	870	1290	3700	5200	5100	6300	6200	5600	6200
SANDWICH	2080	3630	8730	10300	12030	12400	13300	11300	12600
OTIS	6590	5600	2045	2000	2000	2000	2000	2000	2000
BARNSTABLE	13470	19840	30900	36100	39600	38700	39300	38800	39000
DENNIS	3730	6450	12360	14000	16660	14500	16900	16100	15500
YARMOUTH	5500	12030	18450	22700	24950	20200	23400	21700	22000
BREWSTER	1240	1800	5230	7000	7230	7800	8400	7200	8000
CHATHAM	3270	4550	6010	8200	7410	7300	6700	7800	7500
EASTHAM	1200	2040	3470	5000	4570	4700	4700	4800	4700
HARWICH	3750	5900	8970	11100	11570	11400	11200	10800	11200
ORLEANS	2340	3060	5300	6200	6800	6900	6700	6700	6900
PROVINCETOWN	3390	3700	3540	4200	3610	5700	2400	5700	4200
TRURO	1000	1230	1490	2000	1740	2000	1400	1700	1800
WELLFLEET	1400	1740	2200	2700	2600	2800	2400	2800	2700
TOTAL	70000	97000	147860	179500	188835	186000	187100	185200	187400

2TWNPOP/APCC-3

Table D-2

1990 TOWN PEAK POPULATION: SUMMARY

24-Sep-84

	1960 Pop.	1970 Pop.	1980 Pop.	1990 Peak Population: 208 1976 Analysis	Linear Extrapol.	Land Share	Shift Share By Population	Shift Share by Dwelling	Best Judgement
BOURNE	17380	21480	26300	39000	30700	30600	28610	29400	30000
FALMOUTH	25750	37510	51090	74000	63700	60800	62590	59700	61000
MASHPEE	5260	7950	12840	21000	16600	19800	17430	17600	17600
SANDWICH	10020	11640	18570	26000	22800	25000	22350	23000	23000
OTIS	6590	5600	2050	3200	2000	2000	2010	2000	2000
BARNSTABLE	26920	37290	54450	80000	68200	68300	68400	68400	68400
DENNIS	24490	29510	46530	57000	57600	48700	56770	53700	54000
YARMOUTH	17630	30690	43000	61000	55800	47500	54540	50700	52000
BREWSTER	7060	9280	15830	28000	20200	21600	20560	20200	20500
CHATHAM	10840	14040	17410	25000	20600	19400	19670	20700	20000
EASTHAM	8360	10110	13990	23000	16800	16700	16320	17000	16500
HARWICH	12020	16290	21930	33000	26900	26700	26380	25200	26500
ORLEANS	5360	7990	11800	16000	15000	14800	15200	14400	15000
PROVINCETOWN	13370	13480	13370	19000	13400	16000	11620	16100	14000
TRURO	7980	9090	10560	17000	11800	12700	10280	11600	11500
WELLFLEET	9390	10800	13310	18000	15300	15100	14310	15100	15000
TOTAL	208420	272750	373030	540200	457400	445700	447040	444800	447000

Summer/APCC-3

Table D-3

2000 TOWN WINTER POPULATION: SUMMARY 16-Jan-85

	1970 Pop.	1980 Pop.	1990 Pop.	2000 Winter Population: Linear Extrapolation	Land Share	Shift Share By Population	Shift Share By Dwelling	Best Judgement
BOURNE	8770	11830	14100	16200	16900	13000	15200	16200
FALMOUTH	15820	23635	29000	34200	33400	32800	31800	33000
MASHPEE	1290	3700	6200	6500	8500	8400	7600	8400
SANDWICH	3630	8730	12600	15400	15200	17300	13500	15500
OTIS	5600	2045	2000	2000	2000	2100	2000	2000
BARNSTABLE	19840	30900	39000	48300	43800	45600	44500	45000
DENNIS	6450	12360	15500	21000	15700	20500	19200	17000
YARMOUTH	12030	18450	22000	31400	21900	27100	24800	24300
BREWSTER	1800	5230	8000	9200	10000	11000	8900	10000
CHATHAM	4550	6010	7500	8800	7900	6700	9100	8200
EASTHAM	2040	3470	4700	5700	5800	5600	5800	5700
HARWICH	5900	8970	11200	14200	13600	13000	12000	13000
ORLEANS	3060	5300	6900	8300	8100	7300	7900	8000
PROVINCETOWN	3700	3540	4200	3700	6000	1900	6100	4400
TRURO	1230	1490	1800	2000	2500	1300	1900	2000
WELLFLEET	1740	2200	2700	3000	3300	2400	3300	3200
TOTAL	97000	147860	187400	229900	214600	216000	213600	215900

Note: 1990 population is the best judgement projection

2TWNPOP/APCC-3

Table D-4
2000 TOWN PEAK POPULATION: SUMMARY 29-Aug-84

	1970 Pop.	1980 Pop.	1990 Pop.	--2000 Peak Population-- Linear Extrapolation	Land Share	Shift Share By Population	Shift Share By Dwelling	Best Judgement
BOURNE	21480	26300	30000	35200	34600	28830	31300	32500
FALMOUTH	37510	51090	61000	76400	68300	71580	64900	67500
MASHPEE	7950	12840	17600	20400	24200	21380	21500	22000
SANDWICH	11640	18570	23000	27100	29600	25350	26600	27000
OTIS	5600	2050	2000	2000	2000	1990	2000	2000
BARNSTABLE	37290	54450	68400	82000	77200	79540	78200	78200
DENNIS	29510	46530	54000	68600	49900	64130	60000	57000
YARMOUTH	30690	43000	52000	68400	50200	63630	56400	56400
BREWSTER	9280	15830	20500	24600	26300	24850	23800	25000
CHATHAM	14040	17410	20000	23900	20000	20380	22900	21000
EASTHAM	10110	13990	16500	19600	18300	17900	18300	18500
HARWICH	16290	21930	26500	31800	31000	29330	27300	29000
ORLEANS	7990	11800	15000	18300	16900	17400	16500	17000
PROVINCETOWN	13480	13370	14000	13400	16500	8450	16700	15000
TRURO	9090	10560	11500	13200	14400	8950	12100	13000
WELLFLEET	10800	13310	15000	17200	16100	13420	15900	16000
TOTAL	272750	373030	447000	542100	495500	497110	494400	497100

Note: 1990 population is the best judgement projection

Summer/APCC-3

Table E-1

TOWN WINTER POPULATION (By Linear Extrapolation Method) April 4, 1984

	1960 Population	1980 Population	Population Added, '60-'80	Proj. 1990 Population*	Proj. 2000 Population	% Share
BOURNE	7430	11830	4400	14030	16200	7
FALMOUTH	13040	23635	10595	28935	34200	15
MASHPEE	870	3700	2830	5100	6500	3
SANDWICH	2080	8730	6650	12030	15400	7
OTIS	6590	2045	-4545	2000	2000	1
BARNSTABLE	13470	30900	17430	39600	48300	21
DENNIS	3730	12360	8630	16660	21000	9
YARMOUTH	5500	18450	12950	24950	31400	14
BREWSTER	1240	5230	3990	7230	9200	4
CHATHAM	3270	6010	2740	7410	8800	4
EASTHAM	1200	3470	2270	4570	5700	2
HARWICH	3750	8970	5220	11570	14200	6
ORLEANS	2340	5300	2960	6800	8300	4
PROVINCETOWN	3390	3540	150	3610	3700	2
TRURO	1000	1490	490	1740	2000	1
WELLFLEET	1400	2200	800	2600	3000	1
TOTAL	70000	147860	77560	188835	229900	100

* 1990 population is interpolated between 1980 and projected 2000 populations.
Note: Population at Otis is assumed to remain at the 1980 level.

twnpopEA/APCC-1

Table E-2
AVERAGE TOWN HOUSEHOLD SIZE, 1950-2000 July 27,1984

	1950	1960	1970	1980	1990	2000
BOURNE	3.40	3.51	3.36	2.78	2.61	2.56
FALMOUTH	3.20	3.22	3.02	2.62	2.46	2.41
MASHPEE	3.50	3.50	2.88	2.51	2.36	2.31
SANDWICH	2.90	2.90	2.98	2.79	2.62	2.57
OTIS						
BARNSTABLE	3.30	3.04	2.90	2.53	2.38	2.33
DENNIS	2.70	2.70	2.60	2.32	2.18	2.13
YARMOUTH	3.10	3.00	2.76	2.37	2.23	2.18
BREWSTER	2.80	2.84	2.60	2.52	2.37	2.32
CHATHAM	2.90	2.81	2.67	2.25	2.12	2.07
EASTHAM	2.80	2.76	2.76	2.50	2.35	2.30
HARWICH	2.90	2.91	2.64	2.40	2.26	2.21
ORLEANS	2.80	2.77	2.63	2.20	2.07	2.02
PROVINCETOWN	3.00	2.80	2.41	2.98	2.80	2.74
TRURO	3.00	2.95	2.92	2.44	2.29	2.24
WELLFLEET	2.80	2.78	2.69	2.28	2.14	2.10
CAPE AVERAGE	3.09	3.06	2.86	2.48	2.36	2.31

Note: Household sizes for 1990 and 2000 are projected to be 0.94 and 0.92 of 1980's.

TwnpopSS/APCC-2

Table E-3

1990 TOWN WINTER POPULATION (By Land Share Method) July 23,1984

	% Share of Vacant Land June 1983	Total D. U.'s June 1983	Added D.U.'s 6/83 to 1990	Total D.U.'s 1990	% of D.U.'s Winter Occupied '90	D.U.'s Winter Occupied '90	Proj. 1990 Winter Population
BOURNE	7.59	7000	1240	8240	66.36	5470	14300
FALMOUTH	14.80	15600	2430	18030	65.40	11790	29000
MASHPEE	8.35	4500	1370	5870	45.20	2650	6300
SANDWICH	8.98	5000	1470	6470	73.10	4730	12400
OTIS		600		600		600	2000
BARNSTABLE	17.71	18800	2900	21700	75.03	16280	38700
DENNIS	3.86	12900	630	13530	49.06	6640	14500
YARMOUTH	5.95	13100	980	14080	64.44	9070	20200
BREWSTER	8.60	4000	1410	5410	60.60	3280	7800
CHATHAM	2.11	5500	350	5850	58.67	3430	7300
EASTHAM	3.33	4000	550	4550	44.24	2010	4700
HARWICH	8.16	7000	1340	8340	60.60	5050	11400
ORLEANS	4.68	4100	770	4870	68.30	3330	6900
PROVINCETOWN	0.83	3100	140	3240	62.52	2030	5700
TRURO	3.04	1700	500	2200	39.44	870	2000
WELLFLEET	2.02	2800	330	3130	41.36	1290	2800
TOTAL	100.00	109700	16410	126110		78520	186000

D.U.= dwelling or housing unit

Note: See Table G-1 for estimates of vacant land area. Dwelling units added by 1990 are distributed according to the availability of vacant land. The share of dwelling units that is winter occupied is projected from 1950 to 1980 U.S. Census data. Winter population is calculated by multiplying the winter occupied units with the household size (estimated to be 0.94 of 1980 levels).

TwnPop3/APCC-1

Table E-4

2000 TOWN WINTER POPULATION (By Land Share Method) July 23,1984

	% Share of Vacant Land 1990	D.U.'s Added 1990 - 2000	Total D.U.'s 2000	% of D.U.'s Wint. Occ. 2000	D.U.'s Winter Occupied	Proj. 2000 Winter Population
BOURNE	7.37	1320	9560	68.92	6590	16900
FALMOUTH	14.85	2660	20690	67.00	13860	33400
MASHPEE	8.52	1520	7390	49.77	3680	8500
SANDWICH	8.02	1440	7910	74.66	5910	15200
OTIS			600		600	2000
BARNSTABLE	17.84	3190	24890	75.61	18820	43800
DENNIS	4.07	730	14260	51.69	7370	15700
YARMOUTH	6.31	1130	15210	66.05	10050	21900
BREWSTER	8.63	1540	6950	62.21	4320	10000
CHATHAM	2.17	390	6240	61.26	3820	7900
EASTHAM	3.22	580	5130	48.82	2500	5800
HARWICH	8.75	1570	9910	62.21	6170	13600
ORLEANS	4.60	820	5690	69.88	3980	8100
PROVINCETOWN	0.91	160	3400	64.13	2180	6000
TRURO	2.68	480	2680	41.16	1100	2500
WELLFLEET	2.06	370	3500	44.99	1570	3300
TOTAL	100.00	17900	144010		92520	214600

D.U.= dwelling or housing unit

Note: Amount of vacant land available in 1990 is calculated by subtracting the land developed between 1983 to 1990 from the vacant land in 1983. Dwelling units added between 1990 and 2000 are distributed according to the availability of vacant land. The share of dwelling units that is winter occupied is projected from 1950 to 1980 U.S. Census data. Winter population is calculated by multiplying the winter occupied units with the household size (estimated to be 0.92 of 1980 levels).

TwnPop3/APCC-1

Table E-5

TOWN WINTER POPULATION (By Shift Share of Population Method) April 4, 1984

	Percent Share Of Winter Population					Number Of Residents	
	1960	1970	1980	1990	2000	1990	2000
BOURNE	10.57	9.00	8.00	7.00	6.00	13100	13000
FALMOUTH	18.55	16.23	15.98	15.50	15.20	29000	32800
MASHPEE	1.24	1.32	2.50	3.30	3.90	6200	8400
SANDWICH	2.96	3.72	5.90	7.10	8.00	13300	17300
OTIS	9.37	5.75	1.38	1.05	0.95	2000	2100
BARNSTABLE	19.16	20.36	20.90	21.00	21.10	39300	45600
DENNIS	5.31	6.62	8.36	9.00	9.50	16900	20500
YARMOUTH	7.82	12.34	12.48	12.50	12.55	23400	27100
BREWSTER	1.76	1.85	3.54	4.50	5.10	8400	11000
CHATHAM	4.65	4.67	4.06	3.60	3.10	6700	6700
EASTHAM	1.71	2.09	2.35	2.50	2.60	4700	5600
HARWICH	5.33	6.05	6.07	6.00	6.00	11200	13000
ORLEANS	3.33	3.14	3.58	3.60	3.40	6700	7300
PROVINCETOWN	4.82	3.80	2.39	1.30	0.90	2400	1900
TRURO	1.42	1.26	1.01	0.75	0.60	1400	1300
WELLFLEET	1.99	1.79	1.49	1.30	1.10	2400	2400
TOTAL	100.00	100.00	100.00	100.00	100.00	187100	216000

Note: The number of residents is calculated by multiplying the projected share of winter population with the projected capewide population (see Table A-2).

TWNWIN/APCC-2

Table E-6

DISTRIBUTION OF DWELLING UNITS (By Shift Share of Dwelling Unit Method) July 23,1984

	Percent Share Of Total Dwelling Units						Added Dwelling Units	
	1960	1970	1980	1983	1990	2000	1990	2000
BOURNE	9.45	7.76	6.64	6.42	6.30	6.00	907	698
FALMOUTH	14.51	14.79	14.49	14.30	14.10	13.70	2096	1950
MASHPEE	2.64	3.07	3.62	4.12	4.20	4.60	771	1325
SANDWICH	3.74	3.39	4.43	4.58	4.70	4.90	899	1128
OTIS								
BARNSTABLE	15.82	15.88	16.50	17.23	17.30	17.60	2912	3527
DENNIS	11.65	11.31	12.27	11.82	12.00	12.10	2160	2291
YARMOUTH	8.13	11.69	12.37	12.01	12.00	12.00	1960	2148
BREWSTER	2.00	2.32	3.52	3.67	4.00	4.30	1020	1146
CHATHAM	6.15	6.08	5.03	5.04	5.00	5.00	775	895
EASTHAM	4.40	4.15	3.62	3.67	3.70	3.60	644	519
HARWICH	7.03	7.00	6.54	6.42	6.30	6.10	907	841
ORLEANS	3.30	3.44	3.72	3.76	3.80	3.90	669	824
PROVINCETOWN	5.93	4.32	3.02	2.84	2.60	2.40	163	179
TRURO	2.04	1.75	1.61	1.56	1.50	1.40	183	125
WELLFLEET	3.52	2.98	2.62	2.57	2.50	2.40	338	304
TOTAL	100.31	99.94	100.00	100.00	100.00	100.00	16400	17900

Note: The added dwelling (or housing) units are calculated by multiplying the projected share of total dwelling units with the projected capewide total (see Table A-2).

twnpopSS/APCC-2

Table E-7

TOWN WINTER POPULATION (By Shift Share of Dwelling Unit Method) August 22,1984

	Total Dwelling Units		Percent Share of Winter Occupied Dwelling Units					Winter Population	
	1990	2000	1970	1975	1980	1990	2000	1990	2000
BOURNE	7907	8604	54.51	54.10	62.12	66.46	69.06	13700	15200
FALMOUTH	17696	19646	54.24	59.66	61.81	65.49	67.14	28500	31800
MASHPEE	5271	6596	22.60	31.03	38.89	45.27	49.87	5600	7600
SANDWICH	5899	7027	56.44	68.75	70.45	73.20	74.81	11300	13500
OTIS	600	600						2000	2000
BARNSTABLE	21712	25238	65.10	68.61	73.17	75.13	75.77	38800	44500
DENNIS	15060	17351	33.84	36.63	43.44	49.13	51.80	16100	19200
YARMOUTH	15060	17208	57.43	63.73	63.41	64.53	66.18	21700	24800
BREWSTER	5020	6166	45.24	55.56	57.14	60.68	62.34	7200	8900
CHATHAM	6275	7170	43.37	50.00	54.00	58.75	61.38	7800	9100
EASTHAM	4644	5162	27.54	36.36	38.89	44.30	48.92	4800	5800
HARWICH	7907	8747	48.95	53.45	56.92	60.68	62.34	10800	12000
ORLEANS	4769	5593	52.04	58.62	64.86	68.39	70.02	6700	7900
PROVINCETOWN	3263	3442	53.57	55.17	60.00	62.60	64.26	5700	6100
TRURO	1883	2008	33.57	35.38	37.50	39.49	41.25	1700	1900
WELLFLEET	3138	3442	33.63	33.04	38.46	41.42	45.08	2800	3300
TOTAL	126100	144000	49.69	54.56	58.55	62.26	64.24	185200	213600

Note: Winter population is projected by first multiplying the projected share of winter occupied units with the total dwelling units to get the number of winter occupied units and then multiplying that by the household size (estimated to be 0.94 of 1980 levels in 1990 and 0.92 of 1980 levels in 2000).

twnpopSS/APCC-2

Table F-1
TOWN PEAK POPULATION HISTORY

August 15,1984

	1960	1970	1980
Persons/second home	4.10	4.00	4.00
Extra population/ year round home	0.43	0.43	0.43

	No. Of Second Homes			Year Round D.U.'s			Non-Winter Pop.			Peak Population		
	1960	1970	1980	1960	1970	1980	1960	1970	1980	1960	1970	1980
BOURNE	1500	2000	2200	2340	2740	4100	9954	12705	14477	17384	21475	26307
FALMOUTH	2000	3900	4800	3970	5200	8900	12707	21690	27448	25747	37510	51088
MASHPEE	960	1500	2000	250	450	1400	4393	6659	9139	5263	7949	12839
SANDWICH	1000	860	1000	530	1240	3100	7944	8009	9841	10024	11639	18571
OTIS										6590	5600	2050
BARNSTABLE	2200	2800	3500	4360	6700	12000	13450	17452	23554	26920	37292	54454
DENNIS	3700	4100	6400	1370	2480	5300	20755	23062	34165	24485	29512	46525
YARMOUTH	1600	2800	3600	1820	4350	7800	12128	18655	24550	17628	30685	43000
BREWSTER	430	750	1300	420	680	2000	5824	7483	10600	7064	9283	15830
CHATHAM	1500	1900	2200	1150	1710	2700	7566	9489	11337	10836	14039	17407
EASTHAM	1500	1700	2200	430	740	1400	7157	8073	10515	8357	10113	13985
HARWICH	1700	2100	2500	1280	2220	3700	8273	10394	12959	12023	16294	21929
ORLEANS	550	970	1200	850	1160	2400	3022	4929	6500	5362	7989	11800
PROVINCETOWN	1300	1200	1100	1190	1500	1800	9982	9784	9829	13372	13484	13369
TRURO	570	710	900	320	380	600	6978	7864	9072	7978	9094	10562
WELLFLEET	1000	1200	1600	490	650	1000	7990	9056	11107	9390	10796	13307
TOTAL	21510	28490	36500	20770	32200	58200	138122	175303	225093	208422	272753	373023

D.U.= dwelling or housing unit. Year round D.U.'s are occupied units.

Note: Peak population is the sum of non-winter and winter populations. The non-dwelling population is calculated by distributing the Cape total according to the summer 1983 survey of commercial accomodations and winter population growth.

PkPopIE/APCC-2

Table F-2
TOWN PEAK POPULATION PROJECTION (By Linear Extrapolation) August 15,1984

	1960	1970	1980	1990	2000
Persons/second home	4.10	4.00	4.00	3.90	3.80
Extra population/ year round home	0.43	0.43	0.43	0.43	0.43

	Non-Winter Population			Winter Population			Peak Population		
	1980	1990	2000	1980	1990	2000	1980	1990	2000
BOURNE	14477	16700	19000	11830	14000	16200	26307	30700	35200
FALMOUTH	27448	34800	42200	23640	28900	34200	51088	63700	76400
MASHPEE	9139	11500	13900	3700	5100	6500	12839	16600	20400
SANDWICH	9841	10800	11700	8730	12000	15400	18571	22800	27100
OTIS				2050	2000	2000	2050	2000	2000
BARNSTABLE	23554	28600	33700	30900	39600	48300	54454	68200	82000
DENNIS	34165	40900	47600	12360	16700	21000	46525	57600	68600
YARMOUTH	24550	30800	37000	18450	25000	31400	43000	55800	68400
BREWSTER	10600	13000	15400	5230	7200	9200	15830	20200	24600
CHATHAM	11337	13200	15100	6070	7400	8800	17407	20600	23900
EASTHAM	10515	12200	13900	3470	4600	5700	13985	16800	19600
HARWICH	12959	15300	17600	8970	11600	14200	21929	26900	31800
ORLEANS	6500	8200	10000	5300	6800	8300	11800	15000	18300
PROVINCETOWN	9829	9800	9700	3540	3600	3700	13369	13400	13400
TRURO	9072	10100	11200	1490	1700	2000	10562	11800	13200
WELLFLEET	11107	12700	14200	2200	2600	3000	13307	15300	17200
TOTAL	225093	268600	312200	147930	188800	229900	373023	457400	542100

Note: Peak population is the sum of non-winter and winter populations. Winter population for 1990 and 2000 was previously projected by linear the extrapolation method. The non-dwelling population component of the non-winter population is calculated by distributing a projected Cape total according to a summer 1983 survey of commercial accomodations and winter population growth.

PkPopIE/APCC-2

Table F-3
1990 TOWN PEAK POPULATION (By Land Share Method) August 15,1984

	1990	2000
Persons/Second Home	3.90	3.80
Extra Pop/Year Round Home	0.43	0.43

	Second Homes 1980	Total D.U.'s 1990	% Second Homes	1990 Second Homes	Second Home Pop'90	YearRd Homes 1990	Extra YearRd Pop'90	Non-DU Pop. 1990	Non-Winter Pop'90	Winter Pop. 1990	Peak Pop. 1990
BOURNE	2300	8240	29.77	2453	9566	5470	2352	4417	16300	14300	30600
FALMOUTH	4900	18030	30.51	5501	21455	11790	5070	5267	31800	29000	60800
MASHPEE	2000	5870	50.24	2949	11502	2650	1140	828	13500	6300	19800
SANDWICH	1000	6470	21.33	1380	5383	4730	2034	5150	12600	12400	25000
OTIS		600				600				2000	2000
BARNSTABLE	3500	21700	20.23	4389	17117	16280	7000	5475	29600	38700	68300
DENNIS	6400	13530	46.16	6246	24359	6640	2855	6939	34200	14500	48700
YARMOUTH	3700	14080	28.99	4081	15917	9070	3900	7445	27300	20200	47500
BREWSTER	1300	5410	34.51	1867	7281	3280	1410	5076	13800	7800	21600
CHATHAM	2200	5850	39.38	2304	8985	3430	1475	1600	12100	7300	19400
EASTHAM	2200	4550	55.43	2522	9837	2010	864	1315	12000	4700	16700
HARWICH	2500	8340	35.01	2919	11386	5050	2172	1711	15300	11400	26700
ORLEANS	1200	4870	29.36	1430	5577	3330	1432	878	7900	6900	14800
PROVINCETOWN	1100	3240	34.02	1102	4299	2030	873	5152	10300	5700	16000
TRURO	900	2200	55.52	1221	4763	870	374	5588	10700	2000	12700
WELLFLEET	1600	3130	58.37	1827	7126	1290	555	4608	12300	2800	15100
TOTAL	36800	126110		42193	164551	78520	33506	61449	259700	186000	445700

Note: The share of total dwelling (or housing) units in each community was previously derived. The percent share of second homes is the difference between total units, winter occupied, and units vacant for other reasons (for rent or for sale, for ex.). Yearround units are winter occupied. Non-D.U. population is a function of the 1983 population share in commercial accomodations and winter population growth.

SumProj/APCC-1

Table F-4

2000 TOWN PEAK POPULATION (By Land Share Method) August 15,1984

	1990	2000
Persons/Second Home	3.90	3.80
Extra Pop/Year Round Home	0.43	0.43

	Second Homes 1990	Total D.U.'s 2000	% Second Homes	2000 Second Homes	Second Home Pop.	YearRd Homes 2000	Extra YearRd Pop.	Non-DU Pop. 2000	Non-Winter Pop.	Winter Pop. 2000	Peak Pop. 2000
BOURNE	2453	9560	27.71	2649	10065	6590	2834	4832	17700	16900	34600
FALMOUTH	5501	20690	29.39	6081	23108	13860	5960	5874	34900	33400	68300
MASHPEE	2949	7390	46.45	3432	13043	3680	1582	1053	15700	8500	24200
SANDWICH	1380	7910	20.69	1637	6220	5910	2541	5612	14400	15200	29600
OTIS		600				600				2000	2000
BARNSTABLE	4389	24890	20.21	5029	19112	18820	8093	6149	33400	43800	77200
DENNIS	6246	14260	43.76	6240	23711	7370	3169	7342	34200	15700	49900
YARMOUTH	4081	15210	27.78	4226	16058	10050	4322	7916	28300	21900	50200
BREWSTER	1867	6950	33.97	2361	8972	4320	1858	5484	16300	10000	26300
CHATHAM	2304	6240	36.88	2301	8745	3820	1643	1720	12100	7900	20000
EASTHAM	2522	5130	50.86	2609	9914	2500	1075	1466	12500	5800	18300
HARWICH	2919	9910	33.93	3363	12779	6170	2653	1975	17400	13600	31000
ORLEANS	1430	5690	28.07	1597	6069	3980	1711	1019	8800	8100	16900
PROVINCETOWN	1102	3400	32.68	1111	4222	2180	937	5390	10500	6000	16500
TRURO	1221	2680	54.78	1468	5579	1100	473	5869	11900	2500	14400
WELLFLEET	1827	3500	54.70	1915	7275	1570	675	4848	12800	3300	16100
TOTAL	42193	144010		46019	174872	92520	39526	66548	280900	214600	495500

Note: The non-dwelling population is calculated by distributing Cape total according to the summer 1983 survey of commercial accomodations and winter population growth.

SumProj/APCC-1

Table F-5

TOWN PEAK POPULATION (By Shift Share of Population Method) August 15,1984

	% Share Of Peak Population 1960	1970	1980	Projected % Share Of Peak Population 1990	2000	Number Of Residents 1990	2000
BOURNE	8.34	7.87	7.05	6.40	5.80	28610	28832
FALMOUTH	12.35	13.75	13.70	14.00	14.40	62585	71583
MASHPEE	2.53	2.91	3.44	3.90	4.30	17434	21376
SANDWICH	4.81	4.27	4.98	5.00	5.10	22352	25352
OTIS	3.16	2.05	0.55	0.45	0.40	2012	1988
BARNSTABLE	12.92	13.67	14.60	15.30	16.00	68396	79537
DENNIS	11.75	10.82	12.47	12.70	12.90	56773	64127
YARMOUTH	8.46	11.25	11.53	12.20	12.80	54538	63630
BREWSTER	3.39	3.40	4.24	4.60	5.00	20564	24855
CHATHAM	5.20	5.15	4.67	4.40	4.10	19670	20381
EASTHAM	4.01	3.71	3.75	3.65	3.60	16317	17896
HARWICH	5.77	5.97	5.88	5.90	5.90	26375	29329
ORLEANS	2.57	2.93	3.16	3.40	3.50	15199	17399
PROVINCETOWN	6.42	4.94	3.58	2.60	1.70	11623	8451
TRURO	3.83	3.33	2.83	2.30	1.80	10282	8948
WELLFLEET	4.51	3.96	3.57	3.20	2.70	14305	13422
TOTAL	100.00	100.00	100.00	100.00	100.00	447035	497107

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Table F-6
1990 TOWN PEAK POPULATION (By Shift Share of Dwelling Unit Method) August 15,1984

	1990	2000
Persons/Second Home	3.90	3.80
Extra Pop/Year Round Home	0.43	0.43

	Second Homes 1980	Total D.U.'s 1990	% Second Homes	1990 Second Homes	Second Home Pop.	YearRd Homes 1990	Extra YearRd Pop.	Non-DU Pop. 1990	Non-Winter Pop.	Winter Pop. 1990	Peak Pop. 1990
BOURNE	2300	7907	29.55	2337	9112	5254	2259	4366	15700	13700	29400
FALMOUTH	4900	17696	30.34	5369	20940	11589	4983	5231	31200	28500	59700
MASHPEE	2000	5271	49.64	2617	10205	2386	1026	769	12000	5600	17600
SANDWICH	1000	5899	20.72	1222	4767	4318	1857	5055	11700	11300	23000
OTIS		600				600				2000	2000
BARNSTABLE	3500	21712	20.12	4369	17040	16312	7014	5500	29600	38800	68400
DENNIS	6400	15060	46.56	7012	27345	7399	3182	7091	37600	16100	53700
YARMOUTH	3700	15060	29.29	4411	17203	9718	4179	7587	29000	21700	50700
BREWSTER	1300	5020	34.10	1712	6677	3046	1310	5026	13000	7200	20200
CHATHAM	2200	6275	39.37	2471	9635	3687	1585	1649	12900	7800	20700
EASTHAM	2200	4644	55.32	2569	10019	2057	885	1326	12200	4800	17000
HARWICH	2500	7907	34.65	2740	10685	4798	2063	1660	14400	10800	25200
ORLEANS	1200	4769	29.30	1397	5449	3262	1403	862	7700	6700	14400
PROVINCETOWN	1100	3263	34.08	1112	4337	2043	878	5156	10400	5700	16100
TRURO	900	1883	54.84	1033	4028	743	319	5561	9900	1700	11600
WELLFLEET	1600	3138	58.19	1826	7122	1299	559	4610	12300	2800	15100
TOTAL	36800	126104		42196	164563	78511	33502	61449	259600	185200	444800

Note: The share of total dwelling (or housing) units in each community was previously derived. See winter population projections by shift share of dwelling unit method. The non-dwelling population is calculated by distributing Cape total according to the summer 1983 survey of commercial accomodations and winter growth.

SumPSS/APCC-2

Table F-7

2000 TOWN PEAK POPULATION (By Shift Share of Dwelling Unit Method) August 15,1984

****

	1990	2000
Persons/Second Home	3.90	3.80
Extra Pop/Year Round Home	0.43	0.43

	Second Homes 1990	Total D.U.'s 2000	% Second Homes	2000 Second Homes	Second Home Pop.	YearRd Homes 2000	Extra YearRd Pop.	Non-DU Pop. 2000	Non-Winter Pop.	Winter Pop. 2000	Peak Pop. 2000
BOURNE	2337	8604	27.24	2343	8905	5942	2555	4684	16100	15200	31300
FALMOUTH	5369	19646	29.07	5711	21701	13190	5672	5742	33100	31800	64900
MASHPEE	2617	6596	45.97	3032	11521	3290	1415	977	13900	7600	21500
SANDWICH	1222	7027	20.05	1409	5354	5257	2261	5465	13100	13500	26600
OTIS		600				600				2000	2000
BARNSTABLE	4369	25238	20.11	5075	19284	19123	8223	6230	33700	44500	78200
DENNIS	7012	17351	44.39	7702	29267	8988	3865	7665	40800	19200	60000
YARMOUTH	4411	17208	28.36	4880	18545	11389	4897	8185	31600	24800	56400
BREWSTER	1712	6166	33.34	2056	7812	3844	1653	5390	14900	8900	23800
CHATHAM	2471	7170	36.93	2648	10062	4401	1892	1831	13800	9100	22900
EASTHAM	2569	5162	50.68	2616	9942	2525	1086	1469	12500	5800	18300
HARWICH	2740	8747	33.39	2921	11099	5453	2345	1836	15300	12000	27300
ORLEANS	1397	5593	27.97	1565	5945	3916	1684	1004	8600	7900	16500
PROVINCETOWN	1112	3442	32.57	1121	4260	2212	951	5403	10600	6100	16700
TRURO	1033	2008	53.36	1072	4072	828	356	5816	10200	1900	12100
WELLFLEET	1826	3442	54.48	1875	7125	1552	667	4849	12600	3300	15900
TOTAL	42196	144000		46025	174895	92510	39521	66548	280800	213600	494400

SumPSS/APCC-2

Table G-1
1982 SEASONAL DISTRIBUTION OF CAPE COD POPULATION August 15, 1984

Capacity(Unit or Occupancy)	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
YearRound Unit-YR Occup.	54326	54484	54642	54800	54958	55116	55274	55432	55590	55748	55906	56064
YearRound Unit-Extra Summer	54326	54484	54642	54800	54958	55116	55274	55432	55590	55748	55906	56064
YearRound Unit-SprSum Occup	7734	7756	7778	7800	7822	7844	7866	7888	7910	7932	7954	7976
Second Home-Sum Only	37708	37772	37836	37900	37964	38028	38092	38156	38220	38284	38348	38412
Comm. Accomodations(Occ.)	57279	57344	57409	57474	57539	57604	57669	57734	57799	57864	57929	57994

Occupancy Density or Rate	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Pop./YR Unit-YR Occup.	2.44	2.44	2.44	2.43	2.43	2.43	2.43	2.43	2.42	2.42	2.42	2.42
Pop./YR Unit-SprSum Occup.	0.00	0.00	1.02	2.08	2.30	2.43	2.56	2.56	2.30	2.08	1.02	0.00
Extra Pop./YrRound Unit	0.00	0.00	0.00	0.00	0.00	0.22	0.43	0.43	0.22	0.00	0.00	0.00
Pop./Second Home-Sum Only	0.00	0.00	0.00	0.00	0.00	1.98	3.95	3.95	1.98	0.00	0.00	0.00
Comm. Accom. Occupancy Rate	0.00	0.00	0.00	0.00	0.25	0.50	1.00	1.00	0.50	0.25	0.00	0.00

Population	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Total Housing Pop.(Survey)	132700	132900	141100	149200	149500	238300	327500	328100	239700	151000	143300	135600
YearRound Population	132555	132832	141073	149617	151680	153008	154342	154671	152961	151505	143418	135563
Extra Pop.in YrRound Units	0	0	0	0	0	11850	23768	23836	11952	0	0	0
Second Home Population	0	0	0	0	0	75105	150463	150716	75485	0	0	0
Total Housing Population	132555	132832	141073	149617	151680	239964	328573	329223	240397	151505	143418	135563
Population in Comm. Accom.	0	0	0	0	14385	28802	57669	57734	28900	14466	0	0
TOTAL POPULATION	132555	132832	141073	149617	166064	268766	386242	386957	269296	165971	143418	135563

Note: Population in each housing unit and total housing population were based on results of the APCC survey.
Year round population includes the population living in both year round and spring-summer occupied year round housing units.
Commercial accomodations were derived from summer 1983 data.

Seas/APCC-3

Table C-2

1982 CAPE COD HOUSING UNITS: SURVEY RESULTS 7-23-1984

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	Unit Occupancy			
	Summer only	Spring & Summer	Year-round	Total
Estimated % distribution 1980 & 1982 du				
Seasonal area	50	30	5	
Mixed area	40	20	30	
Year-rd. area	10	50	65	
Total	100	100	100	
Estimated 1982 dwelling units, April				
Total	37900	7800	54800	100500
Seasonal area	18950	2340	2740	24030
Mixed area	15160	1560	16440	33160
Year-rd. area	3790	3900	35620	43310
Calc. % of all du,1982				
Seasonal area	19	2	3	24
Mixed area	15	2	16	33
Year-rd. area	4	4	35	43
Total	38	8	55	100
Estimated 1980 du, April				
Total	37000	7000	53600	95600
Seasonal area	18500	2100	2680	23280
Mixed area	14800	1400	16080	32280
Year-rd. area	3700	3500	34840	42040

APCC4/APCC-1

Table C-3 July 23, 1984

CAPE COD POPULATION IN HOUSING UNITS: SURVEY RESULTS

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	Unit Occupancy			
	Summer only	Spring & Summer	Year-round	Total
Total Persons, February, 1982				
Seasonal area	0	0	6562	6562
Mixed area	0	0	42252	42252
Year-rd. area	0	0	84666	84666
Total	0	0	133479	133479
Total Persons, April, 1982				
Seasonal area	0	5021	6491	11512
Mixed area	0	3970	42170	46140
Year-rd. area	0	7231	84313	91544
Total	0	16222	132974	149196
Total Persons, August, 1982				
Seasonal area	77137	6829	9102	93068
Mixed area	61463	5104	53812	120378
Year-rd. area	10930	8034	93133	112097
Total	149530	19967	156046	325543
Persons/dwelling unit, February, 1982				
Seasonal area	0.00	0.00	2.39	0.27
Mixed area	0.00	0.00	2.57	1.27
Year-rd. area	0.00	0.00	2.38	1.95
Total	0.00	0.00	2.44	1.33
Persons/dwelling unit, April, 1982				
Seasonal area	0.00	2.15	2.37	0.48
Mixed area	0.00	2.54	2.57	1.39
Year-rd. area	0.00	1.85	2.37	2.11
Total	0.00	2.08	2.43	1.48
Persons/dwelling unit, August				
Seasonal area	4.07	2.92	3.32	3.87
Mixed area	4.05	3.27	3.27	3.63
Year-rd. area	2.88	2.06	2.61	2.59
Total	3.95	2.56	2.85	3.24

APCC4/APCC-1

Table C-4
CAPE COD SEASONAL POPULATION IN DWELLINGS, SUMMER 1983 August 8, 1984

	Second Homes*		Year Round Dwellings		All Dwellings	
	units	persons	units	extra pop.	units	seas.pop.
BOURNE	2342	9366	4568	1964	6910	11330
FALMOUTH	5132	20527	10140	4360	15271	24887
MASHPEE	2415	9661	2004	862	4420	10523
SANDWICH	1115	4460	3815	1640	4930	6100
BARNSTABLE	3948	15792	14382	6184	18330	21976
DENNIS	6563	26253	6175	2655	12738	28909
YARMOUTH	3827	15310	8993	3867	12820	19177
BREWSTER	1476	5905	2448	1053	3924	6958
CHATHAM	2323	9292	3041	1308	5364	10600
EASTHAM	2342	9366	1616	695	3957	10061
HARWICH	2586	10345	4256	1830	6843	12176
ORLEANS	1291	5163	2745	1180	4036	6343
PROVINCETOWN	1062	4246	1997	859	3059	5105
TRURO	994	3974	715	308	1709	4282
WELLFLEET	1802	7208	1155	497	2957	7705
TOTAL	39218	156870	68049	29261	107266	186131

* Includes cottage colony units.
Population is calculated by multiplying the number of units with the following occupancy factors: 4.0 persons per second home and 0.43 extra persons per year-round dwelling unit.

SeasF1/APCC-1

Table G-5

OTHER ACCOMODATIONS ON CAPE COD, SUMMER 1983 August 8, 1984

	Campgrounds		Motels		Guesthouses		All Accommodations	
	units	persons	units	persons	units	persons	units	persons
BOURNE	804	3216	415	955	--	0	1219	4171
FALMOUTH	226	904	1564	3597	170	391	1960	4892
MASHPEE	140	560	40	92	--	0	180	652
SANDWICH	1098	4392	186	428	9	21	1293	4841
BARNSTABLE	--	0	2060	4738	106	244	2166	4982
DENNIS	738	2952	1627	3742	20	46	2385	6740
YARMOUTH	295	1180	2544	5851	109	251	2948	7282
BREWSTER	1143	4572	42	97	63	145	1248	4814
CHATHAM	0	0	604	1389	46	106	650	1495
EASTHAM	55	220	416	957	16	37	487	1214
HARWICH	0	0	452	1040	220	506	672	1546
ORLEANS	0	0	290	667	50	115	340	782
PROVINCETOWN	218	872	1033	2376	679	1562	1930	4810
TRURO	726	2904	1045	2404	37	85	1808	5393
WELLFLEET	490	1960	578	1329	500	1150	1568	4439
TOTAL	5933	23732	12896	29661	2025	4658	20854	58050

Note: Population is calculated by multiplying the number of units with the following occupancy factors: 4.0 persons per unit at campgrounds and 2.3 persons per unit in motels and guesthouses.

SeasT3.DIF/APCC-1

Table C-6

CAPE COD SEASONAL POPULATION, SUMMER 1983 August 8, 1984

Community	Campground Population	Motel Population	Guesthouse Population	Total NonDU Population	Second Home Population	Year Round Extra Pop.	Non-Winter Population
BOURNE	3216	955	0	4171	9366	1964	15501
FALMOUTH	904	3597	391	4892	20527	4360	29779
MASHPEE	560	92	0	652	9661	862	11175
SANDWICH	4392	428	21	4841	4460	1640	10941
BARNSTABLE	0	4738	244	4982	15792	6184	26958
DENNIS	2952	3742	46	6740	26253	2655	35649
YARMOUTH	1180	5851	251	7282	15310	3867	26459
BREWSTER	4572	97	145	4814	5905	1053	11771
CHATHAM	0	1389	106	1495	9292	1308	12095
EASTHAM	220	957	37	1214	9366	695	11275
HARWICH	0	1040	506	1546	10345	1830	13721
ORLEANS	0	667	115	782	5163	1180	7125
PROVINCETOWN	872	2376	1562	4810	4246	859	9915
TRURO	2904	2404	85	5393	3974	308	9674
WELLFLEET	1960	1329	1150	4439	7208	497	12144
TOTAL	23732	29661	4658	58050	156870	29261	244181

Note: Second home population includes cottage colony population.
Updates to 6/83 are estimated from building permits authorized data.

SeasPl/APCC-1

Table H-1
TOWN LAND USE CHANGES, 1975 AND 1983** July 11,1984

	Total, Except Water	Nonreserved Wet, Sand		Reserved Open		Developed		Vacant Buildable		
		1975	1983*	1975	1983	1975	1983	1975	1983	%Change
BOURNE	26300	4100	3900	9900	11100	4600	5300	7700	6000	-22
FALMOUTH	28300	4200	3900	3600	3700	7400	9000	13100	11700	-11
MASHPEE	14600	2500	2400	1200	2700	2200	2900	8700	6600	-24
SANDWICH	27700	2900	2900	9900	11100	5100	6600	9800	7100	-28
BARNSTABLE	38500	8000	6600	1800	5300	10100	12600	18600	14000	-25
DENNIS	13200	2800	2600	1100	2500	4500	5100	4800	3000	-38
YARMOUTH	15400	2400	2100	700	2600	5200	6000	7100	4700	-34
BREWSTER	14400	2400	2200	2300	2500	2300	2900	7400	6800	-8
CHATHAM	10200	600	600	4300	4500	2900	3400	2400	1700	-29
EASTHAM	9200	700	700	3100	3400	2100	2500	3300	2600	-21
HARWICH	13400	2000	2000	800	1400	3300	3600	7300	6400	-12
ORLEANS	9000	500	500	1500	1900	2400	2900	4600	3700	-20
PROVINCETOWN	6400	600	600	4515	4515	570	630	715	655	-8
TRURO	13600	500	400	9000	9000	1400	1700	2700	2500	-7
WELLFLEET	13300	900	900	8000	8900	1700	1900	2700	1600	-41
CAPE TOTAL	253500	35100	32300	61715	75115	55770	67030	100915	79055	-22

* Estimated from open space data where available. Otherwise, assumed no change since CCPEDC 1976 report.

** In acres

Note: Estimates of reserved open land based on community open space plans where available. Estimates of developed land based on MacConnell's 1971 and 1980 land use data and local building permit information.

LandUse/APCC-2

Table H-2
1975 TOWN RESERVED OPEN SPACE

	Federally Owned	State Owned	Town and Other Owned	Total Reserved Open
BOURNE	8700	500	700	9900
FALMOUTH	200	1600	1800	3600
MASHPEE	400	0	800	1200
SANDWICH	8100	800	1000	9900
BARNSTABLE	0	100	1700	1800
DENNIS	0	0	1100	1100
YARMOUTH	0	0	700	700
BREWSTER	0	1800	500	2300
CHATHAM	3700	0	600	4300
EASTHAM	3000	0	100	3100
HARWICH	0	100	700	800
ORLEANS	1000	0	500	1500
PROVINCETOWN	4500	0	15	4515
TRURO	8900	0	100	9000
WELLFLEET	7900	0	100	8000
TOTAL	46400	4900	10415	61715

Table H-3
1983 TOWN RESERVED OPEN SPACE July 11,1984

	Federally Owned	State Owned	Town and Other Owned	Total Reserved Open
BOURNE	9200	500	1400	11100
FALMOUTH	200	1700	1800	3700
MASHPEE	900	500	1300	2700
SANDWICH	8100	900	2100	11100
BARNSTABLE	0	300	5000	5300
DENNIS	0	0	2500	2500
YARMOUTH	0	0	2600	2600
BREWSTER	0	1800	700	2500
CHATHAM	3700	0	800	4500
EASTHAM	3000	0	400	3400
HARWICH	0	200	1200	1400
ORLEANS	1000	0	900	1900
PROVINCETOWN	4500	0	15	4515
TRURO	8900	0	100	9000
WELLFLEET	8600	0	300	8900
TOTAL	48100	5900	21115	75115

Note: Federally owned land includes open land at Otis and the National Seashore.
State owned land is estimated from 1971 SCORP data.
Town owned land is estimated from community open space plans where available and does not include school land, town buildings land, and other town land not normally associated with open space. Other reserved open space includes public and semi-public open space likely to be perpetually preserved and private land under permanent conservation restrictions.

Space75/APCC-3

Table H-9
OTHER CAPE COD 2020 DEVELOPMENT SCENARIOS July 27, 1984

****

LARGE-LOT SCENARIO

Lot size factor: 2
Open space factor: 1

	1971	1975	1980	1983	1990	2000	2010	2020
Total Land (Except Water)	253500	253500	253500	253500	253500	253500	253500	253500
Developed Land	48650	55760	61480	66870	82290	99570	114420	124320
Reserved Open Land		61715	70090	75115	82921	91750	97968	102079
Unbuildable land		35100	35100	32300	29698	27049	25184	23951
Vacant Buildable Land		100925	86830	79215	58591	35131	15928	3150

FOCUSSED SCENARIO

Lot size factor: 1
Open space factor: 3

	1971	1975	1980	1983	1990	2000	2010	2020
Total Land (Except Water)	253500	253500	253500	253500	253500	253500	253500	253500
Developed Land	48650	55760	61480	66870	74580	83220	90650	95600
Reserved Open Land		61715	70090	75115	98533	122649	136938	144712
Unbuildable land		35100	35100	32300	24494	17259	12972	10640
Vacant Buildable Land		100925	86830	79215	55893	30372	12939	2548

UNFETTERED SCENARIO

Lot size factor: 1
Open space factor: 1

	1971	1975	1980	1983	1990	2000	2010	2020
Total Land (Except Water)	253500	253500	253500	253500	253500	253500	253500	253500
Developed Land	48650	55760	61480	66870	74070	82140	89070	93690
Reserved Open Land		61715	70090	75115	79018	84039	88405	92206
Unbuildable land		35100	35100	32300	30999	29493	28183	27043
Vacant Buildable Land		100925	86830	79215	69413	57829	47842	40561

Table H-10
HOUSING STOCK (Housing Units) 22-Aug-84

	1960	1970	1980	1990	2000
BOURNE	4300	5027	6600	7973	9042
FALMOUTH	6600	9587	14400	17654	20102
MASHPEE	1200	1991	3600	5700	7190
SANDWICH	1700	2197	4400	6445	7957
OTIS	1200	1200	600	600	600
BARNSTABLE	7200	10292	16400	21435	25153
DENNIS	5300	7329	12200	14208	15159
YARMOUTH	3700	7574	12300	15027	16601
BREWSTER	910	1503	3500	5465	6820
CHATHAM	2800	3943	5000	5927	6362
EASTHAM	2000	2687	3600	4433	4994
HARWICH	3200	4535	6500	8034	9310
ORLEANS	1500	2229	3700	4791	5565
PROVINCETOWN	2700	2800	3000	3539	3705
TRURO	930	1132	1600	1952	2130
WELLFLEET	1600	1933	2600	2987	3336
TOTAL	46840	65959	100000	126171	144025

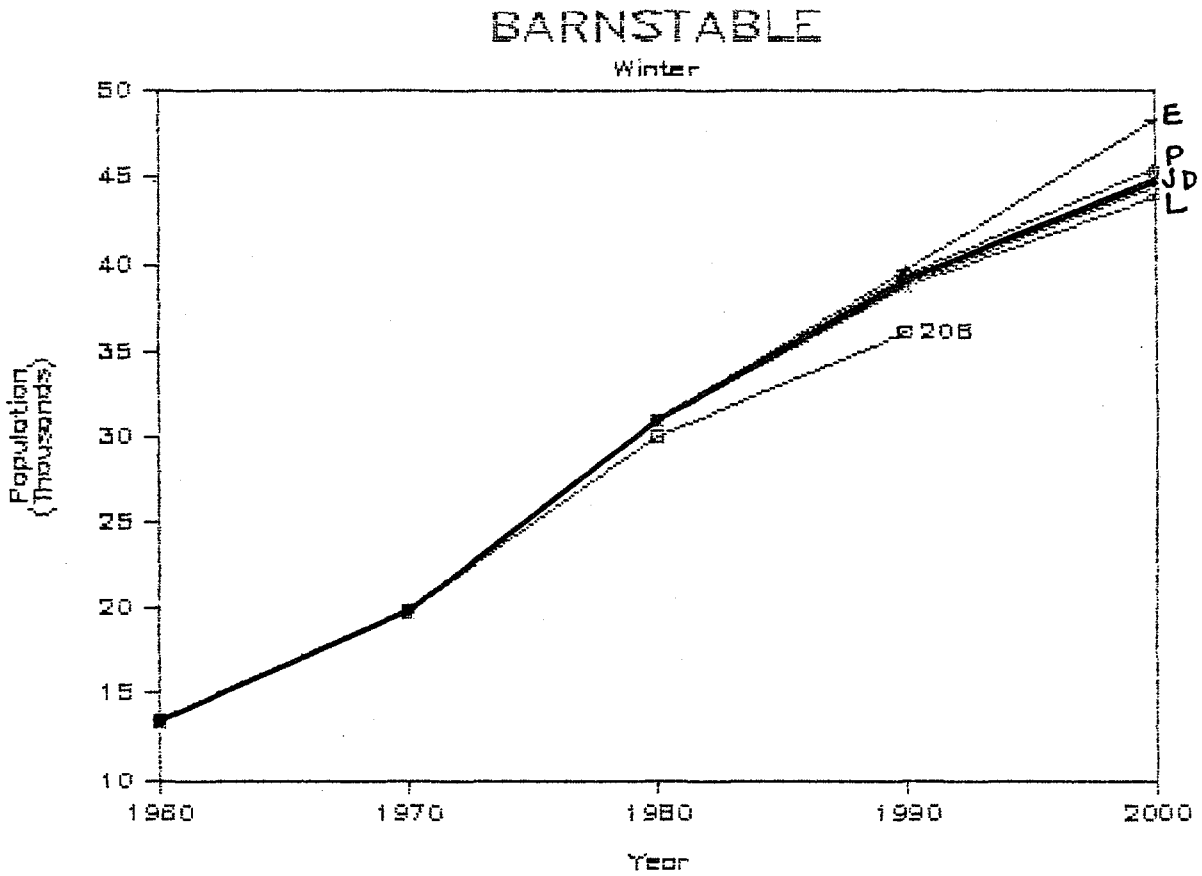
HmeBld2/APCC-3

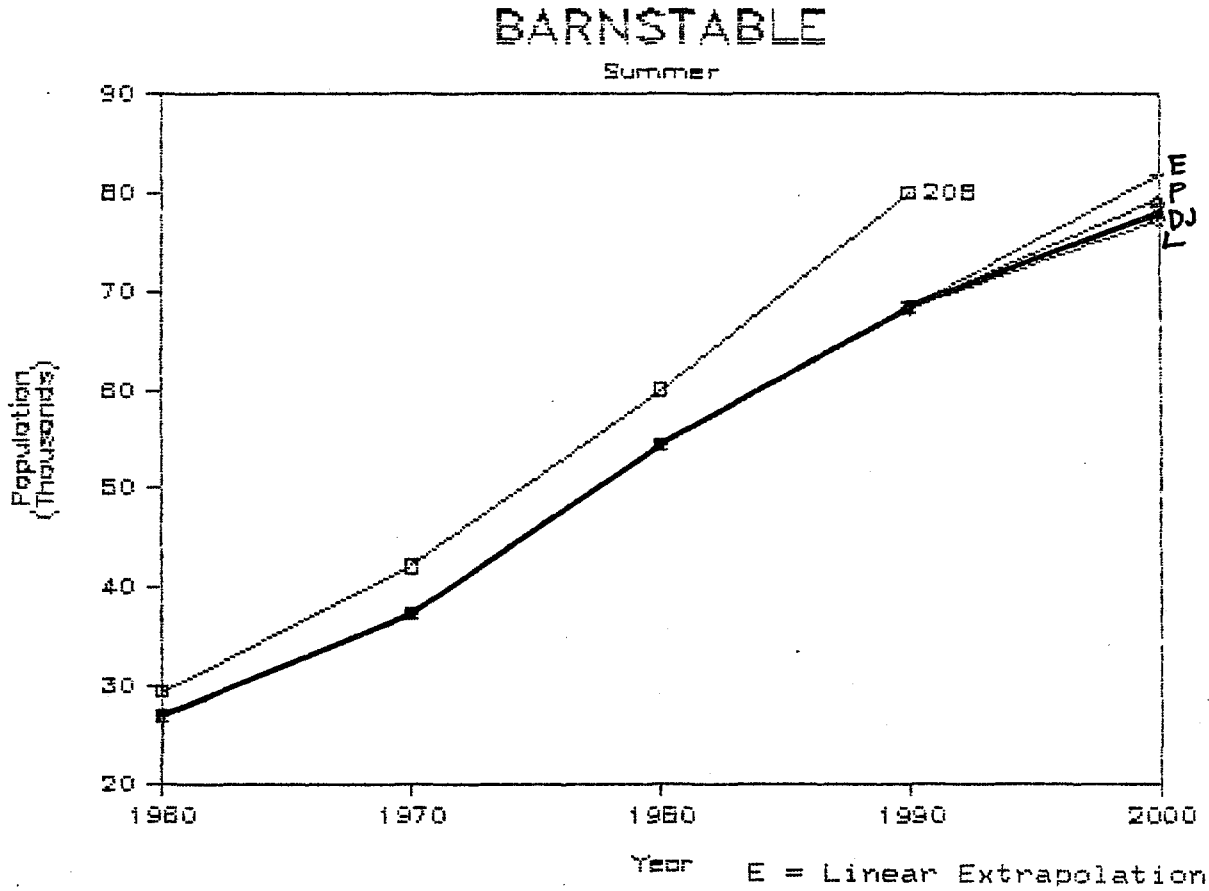
Table H-11
HOMEBUILDING RATE (Units/Year) 22-Aug-84

	1960-69	1970-79	1980-89	1990-2000
BOURNE	73	157	137	107
FALMOUTH	299	481	325	245
MASHPEE	79	161	210	149
SANDWICH	50	220	204	151
OTIS	0	0	0	0
BARNSTABLE	309	611	503	372
DENNIS	203	487	201	95
YARMOUTH	387	473	273	157
BREWSTER	59	200	197	135
CHATHAM	114	106	93	43
EASTHAM	69	91	83	56
HARWICH	134	197	153	128
ORLEANS	73	147	109	77
PROVINCETOWN	10	20	54	17
TRURO	20	47	35	18
WELLFLEET	33	67	39	35
TOTAL	1912	3404	2617	1785

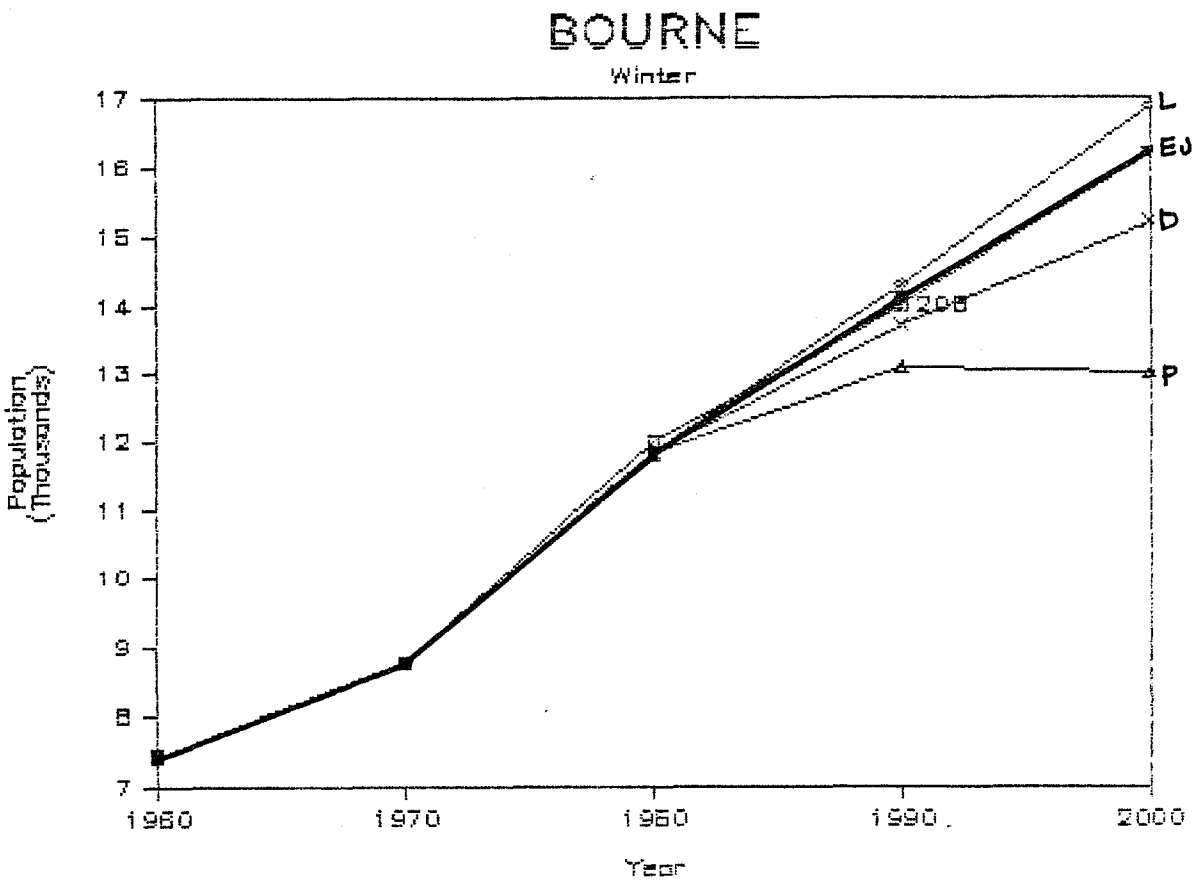
Note: The loss of 600 units at Otis is not included.

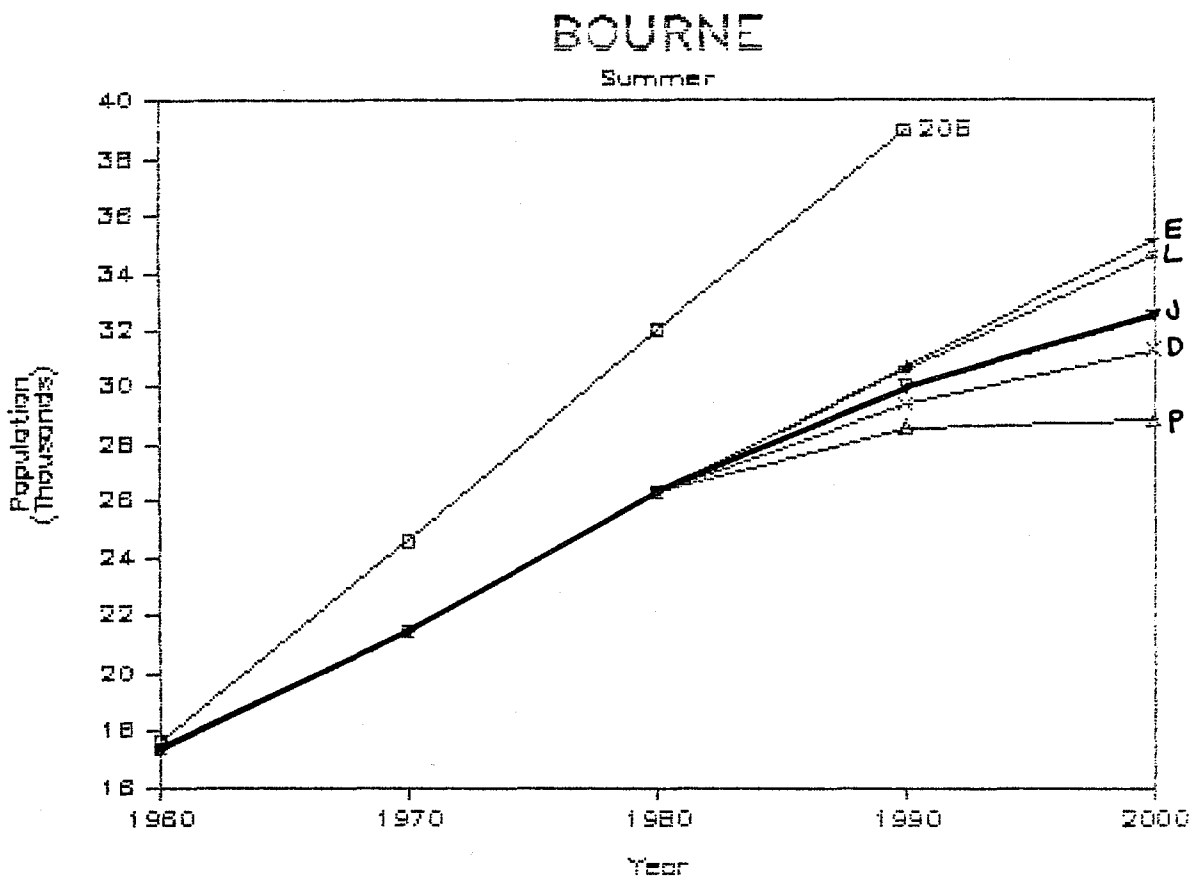
HmeBld2/APCC-3





E = Linear Extrapolation
L = Land Share
P = Shift Share of Population
D = Shift Share of Dwelling
J = Best Judgement


BOURNE
Winter
Population (Thousands)
17
16
15
14
13
12
11
10
9
8
7
1960
1970
1980
1990
2000
Year
L
EJ
D
P
208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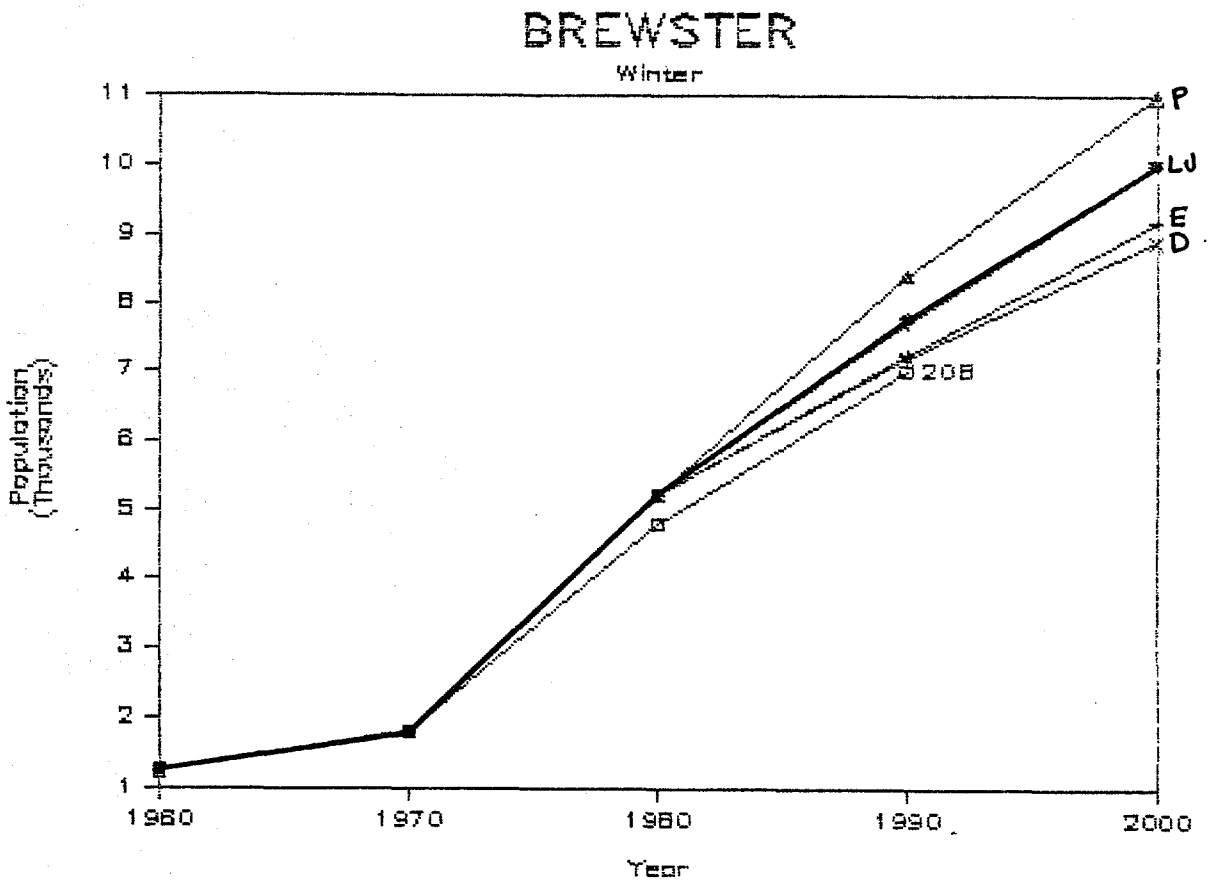
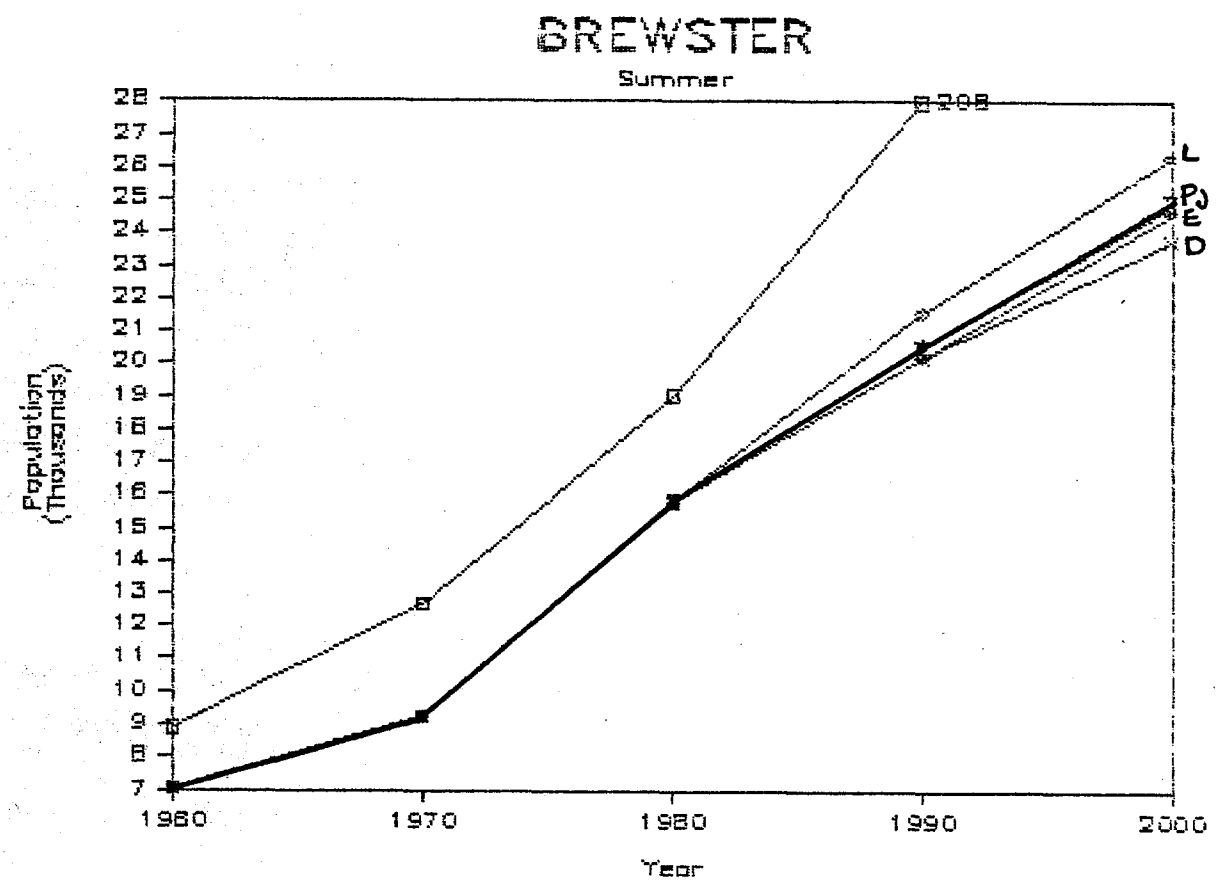
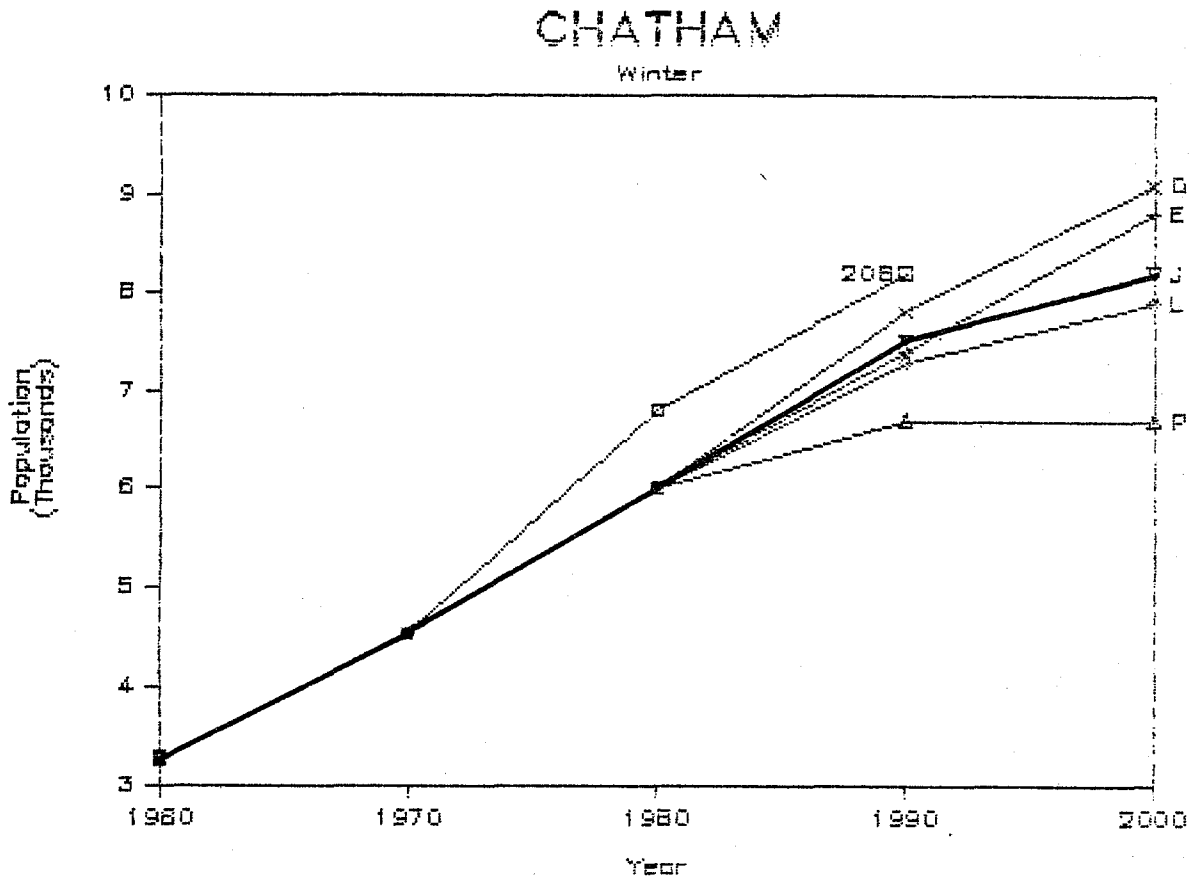
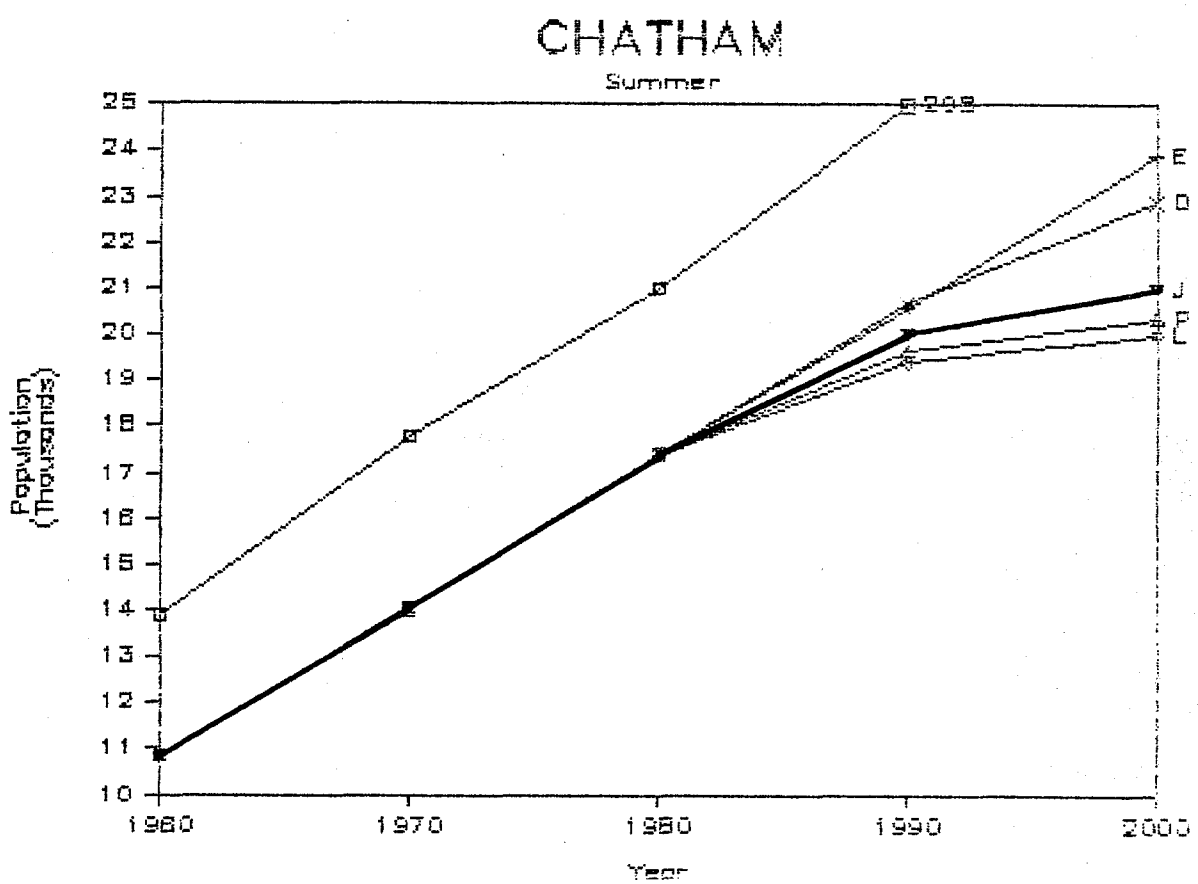
Summer
Population (Thousands)
40
38
36
34
32
30
28
26
24
22
20
18
16
1960
1970
1980
1990
2000
Year
208
E
L
J
D
P


BREWSTER
Winter
Population (Thousands)
Year
1960
1970
1980
1990
2000
P
LJ
E
D
208


BREWSTER
Summer
Population (Thousands)
Year
1960
1970
1980
1990
2000
208
L
PJ
E
D


CHATHAM
Winter
Population (Thousands)
10
9
8
7
6
5
4
3
1960
1970
1980
1990
2000
Year
2080
D
E
J
L
P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Summer
Population (Thousands)
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24
23
22
21
20
19
18
17
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13
12
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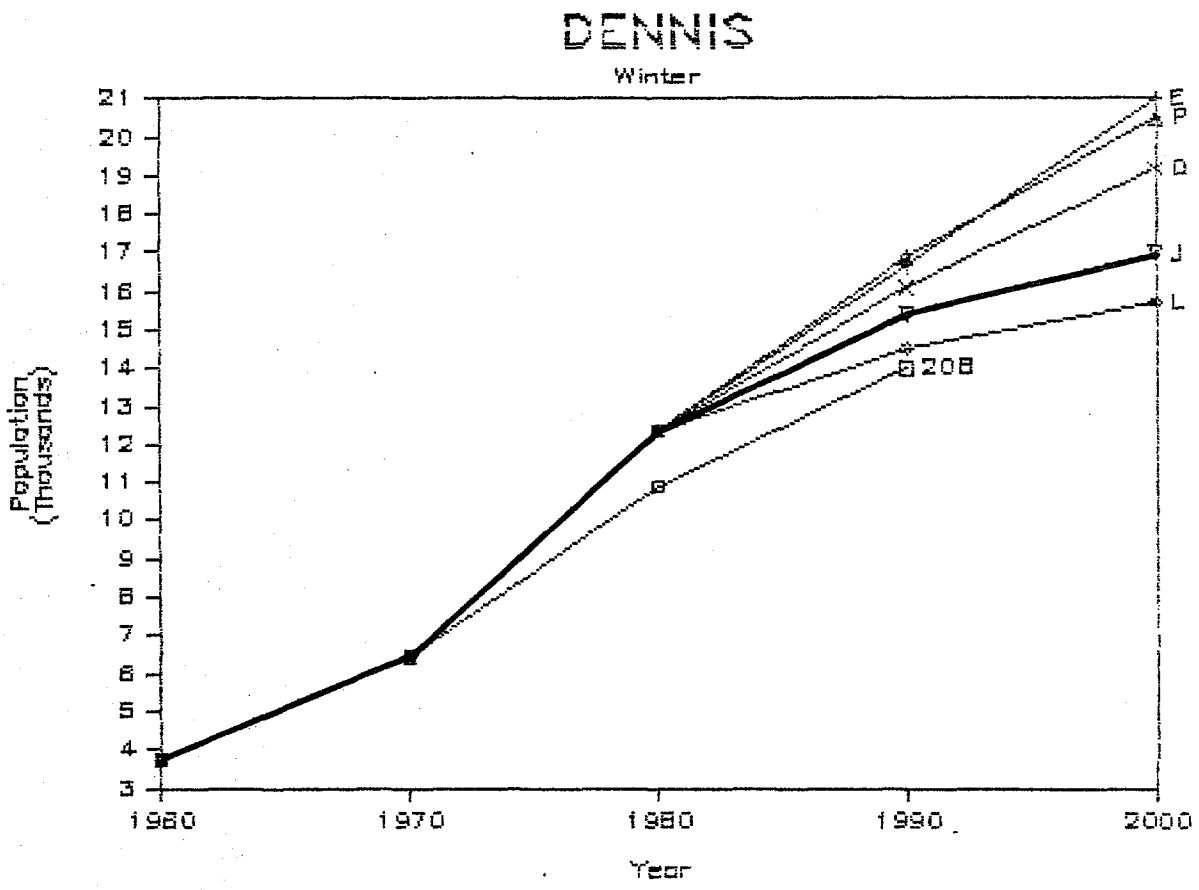
Year
2080
E
D
J
P
L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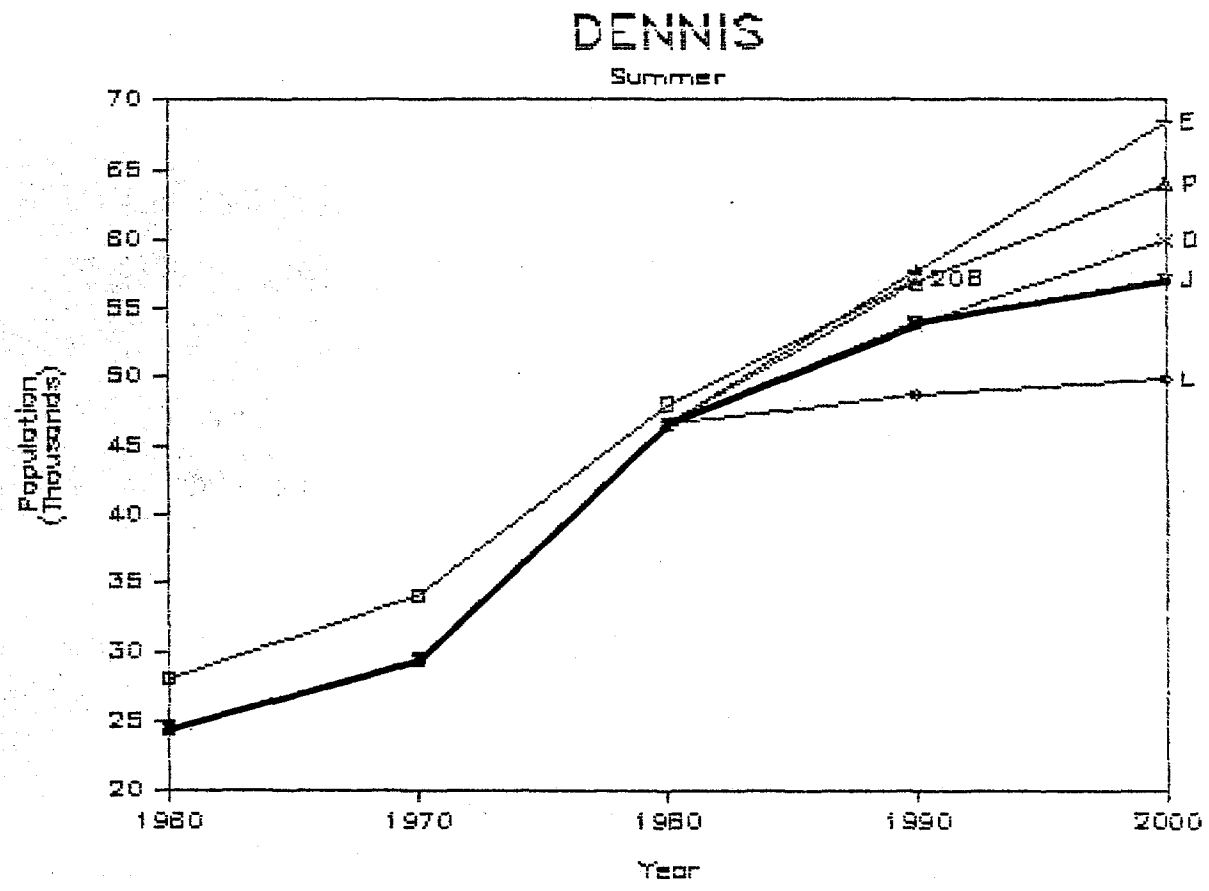
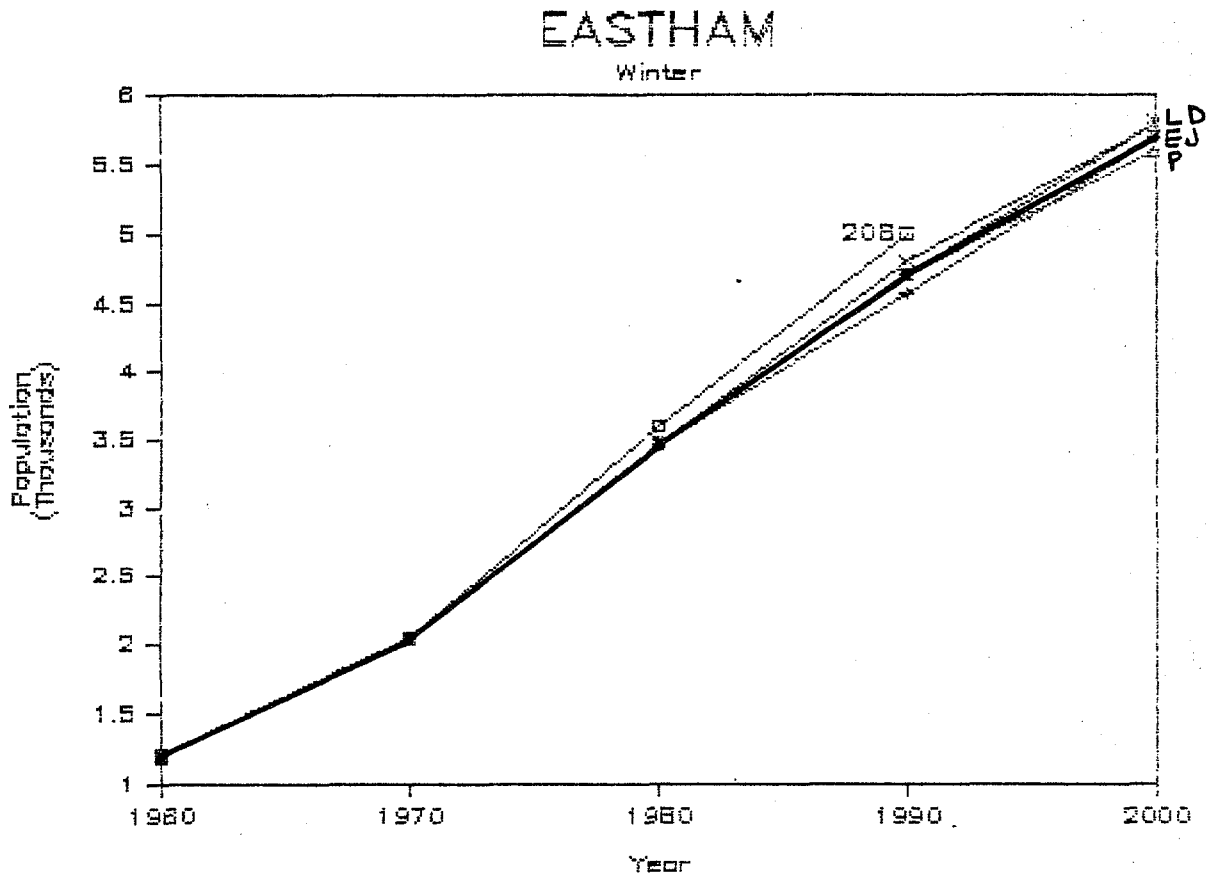
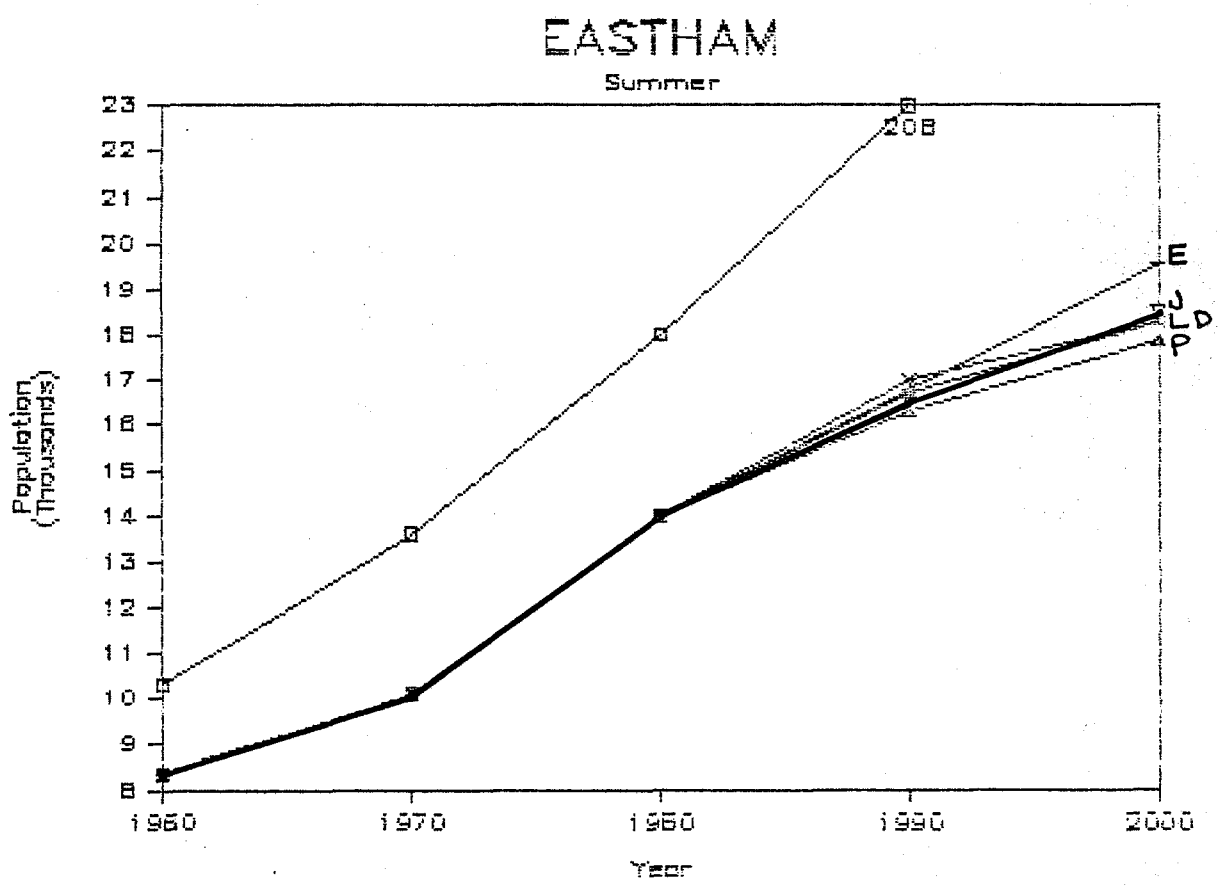
Winter
Population (Thousands)
Year
1960
1970
1980
1990
2000
E
P
D
J
L
208


DENNIS
Summer
Population (Thousands)
Year
1960
1970
1980
1990
2000
E
P
D
J
L
208


EASTHAM
Winter
Population (Thousands)
Year
208
L
D
E
J
P
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
1960
1970
1980
1990
2000


EASTHAM
Summer
Population (Thousands)
Year
208
E
J
L
D
P
23
22
21
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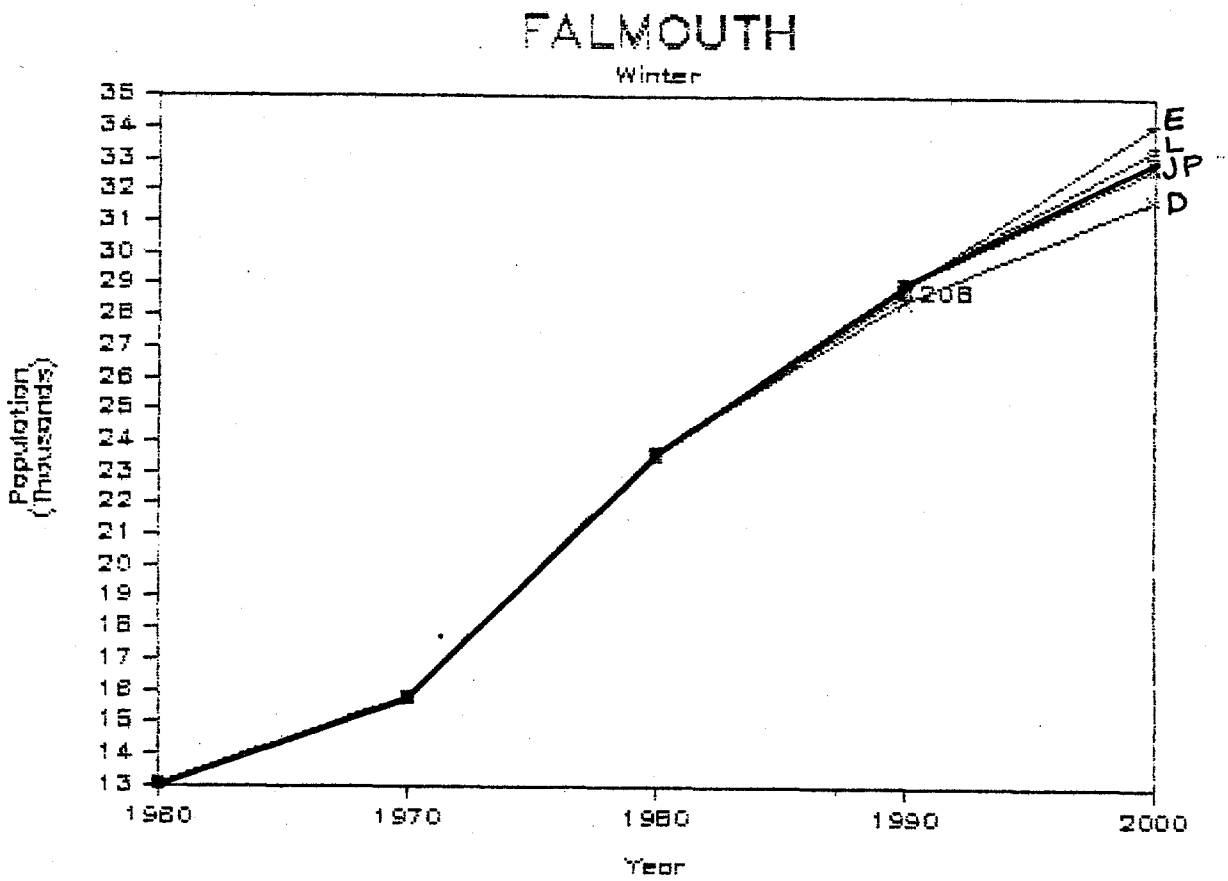
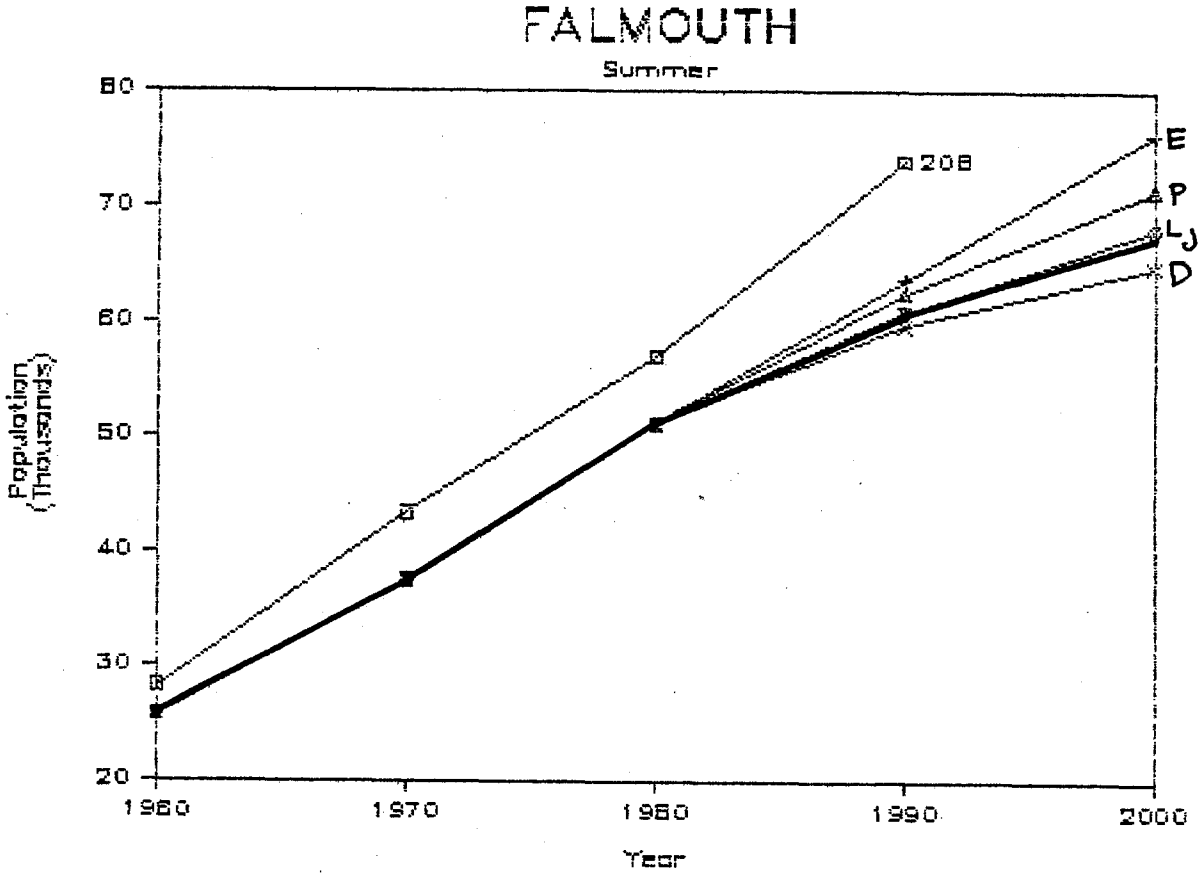
14
13
12
11
10
9
8
1960
1970
1980
1990
2000


FALMOUTH
Winter
Population (Thousands)
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
1960
1970
1980
1990
2000
Year
E
L
JP
D
208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Summer
Population (Thousands)
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60
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40
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20
1960
1970
1980
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Year
E
P
L
J
D
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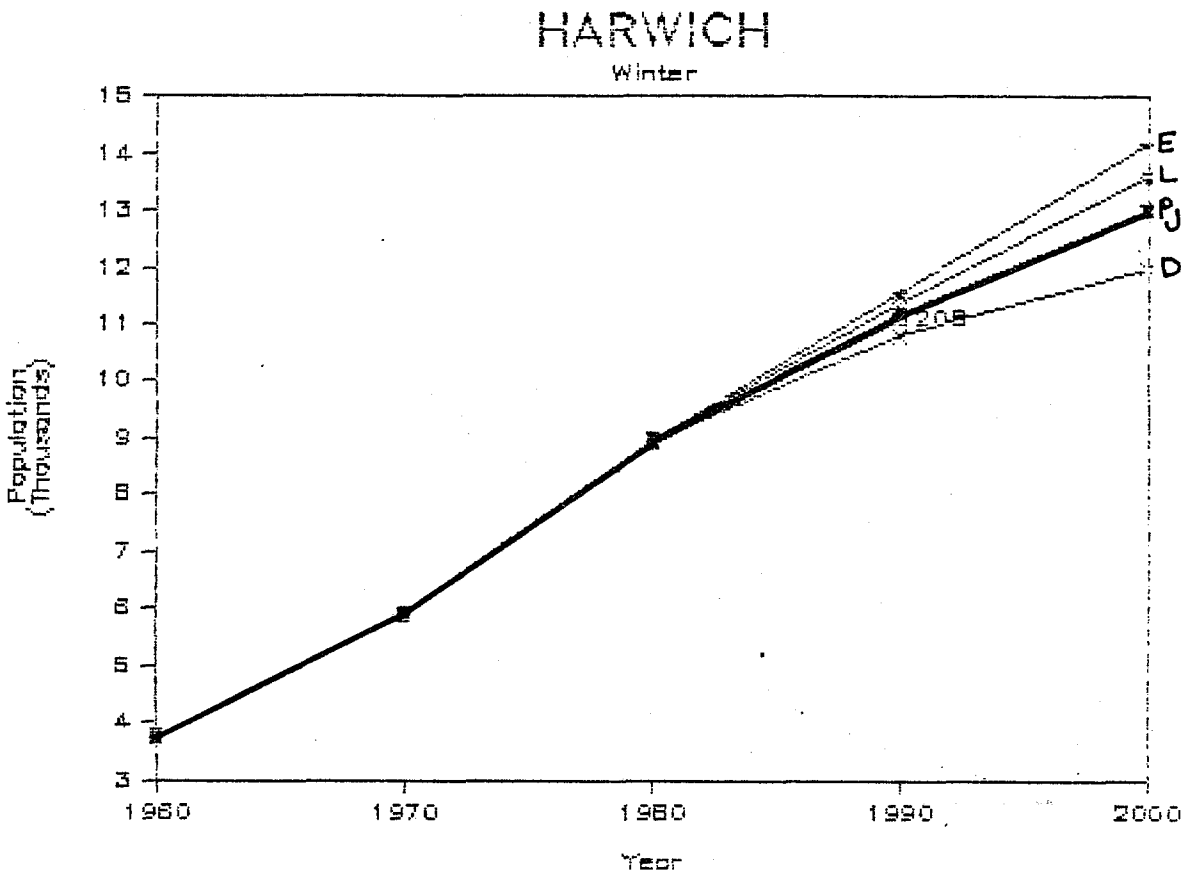
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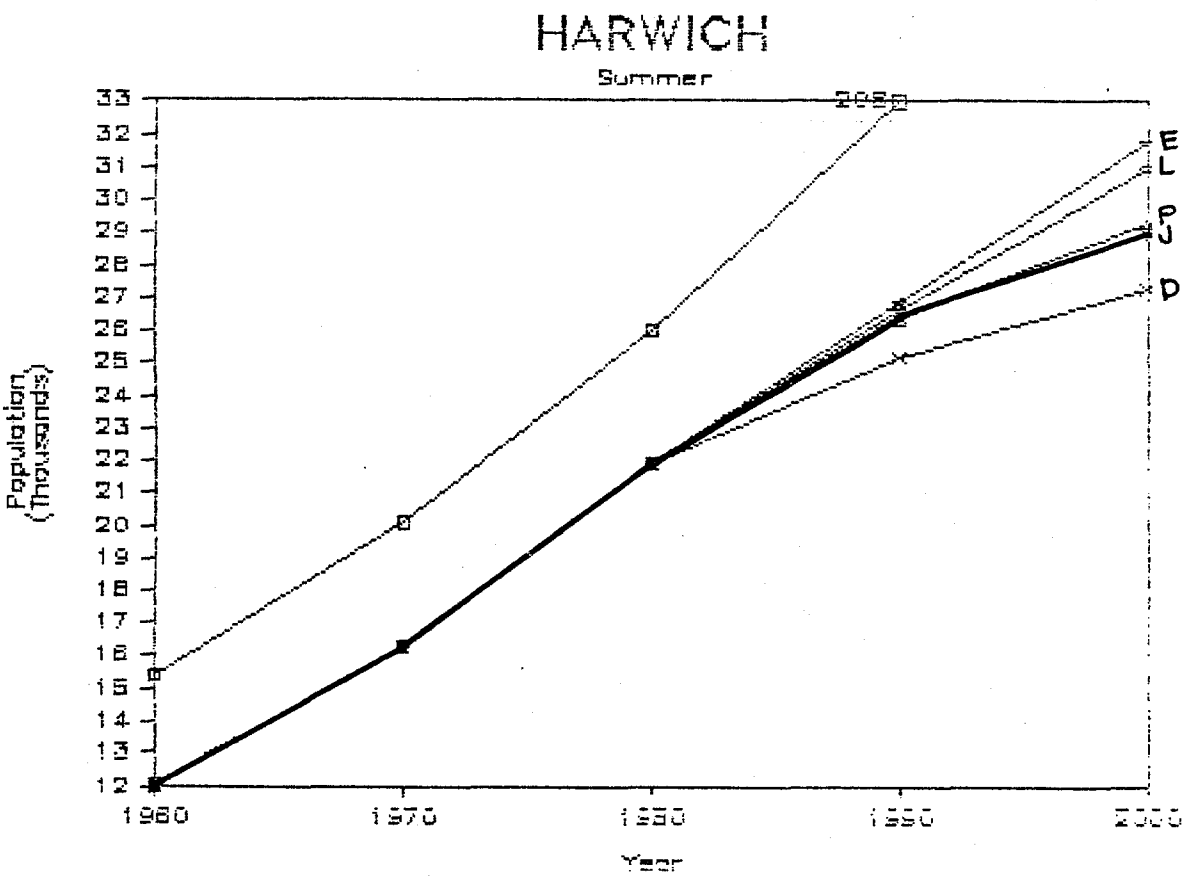
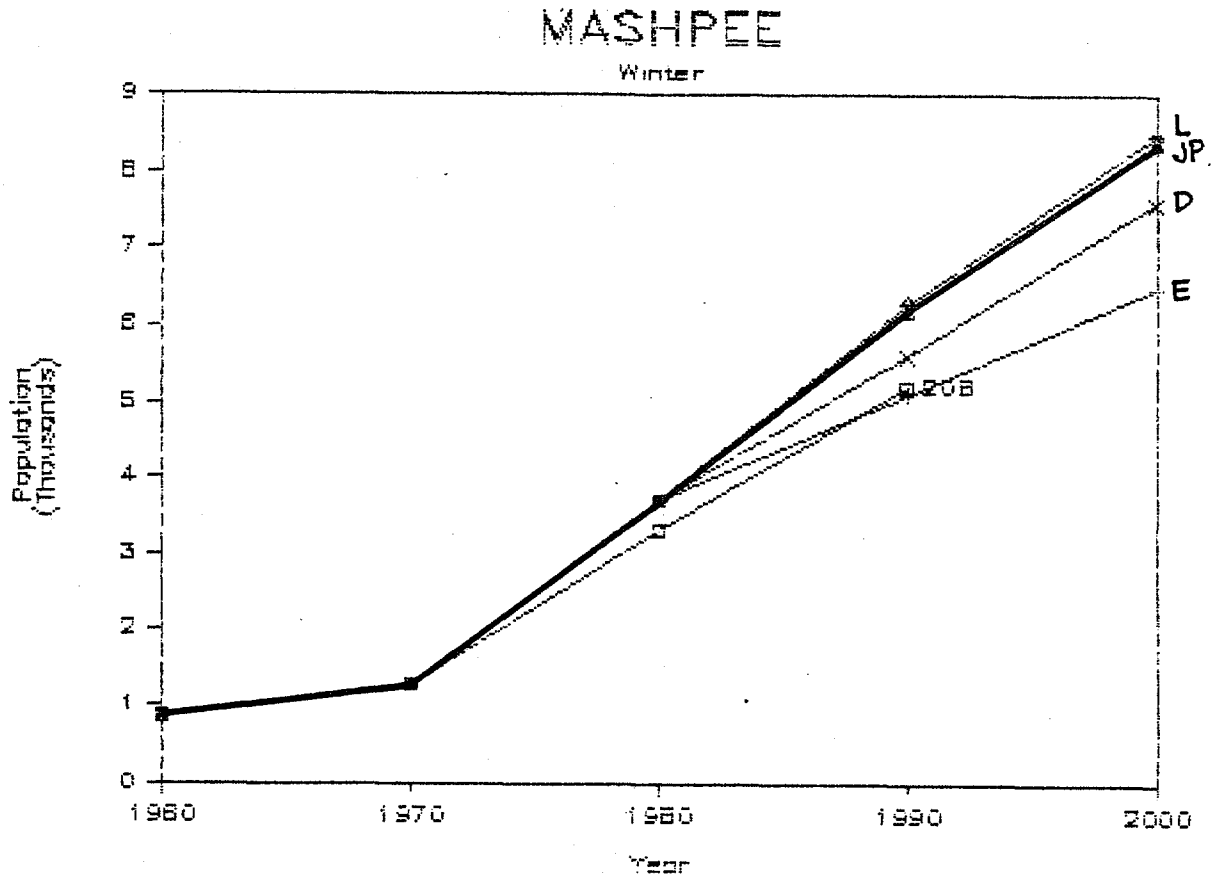
Winter
Population (Thousands)
Year
E
L
PJ
D
2000


HARWICH
Summer
Population (Thousands)
Year
E
L
PJ
D


MASHPEE
Winter
Population (Thousands)
Year
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1
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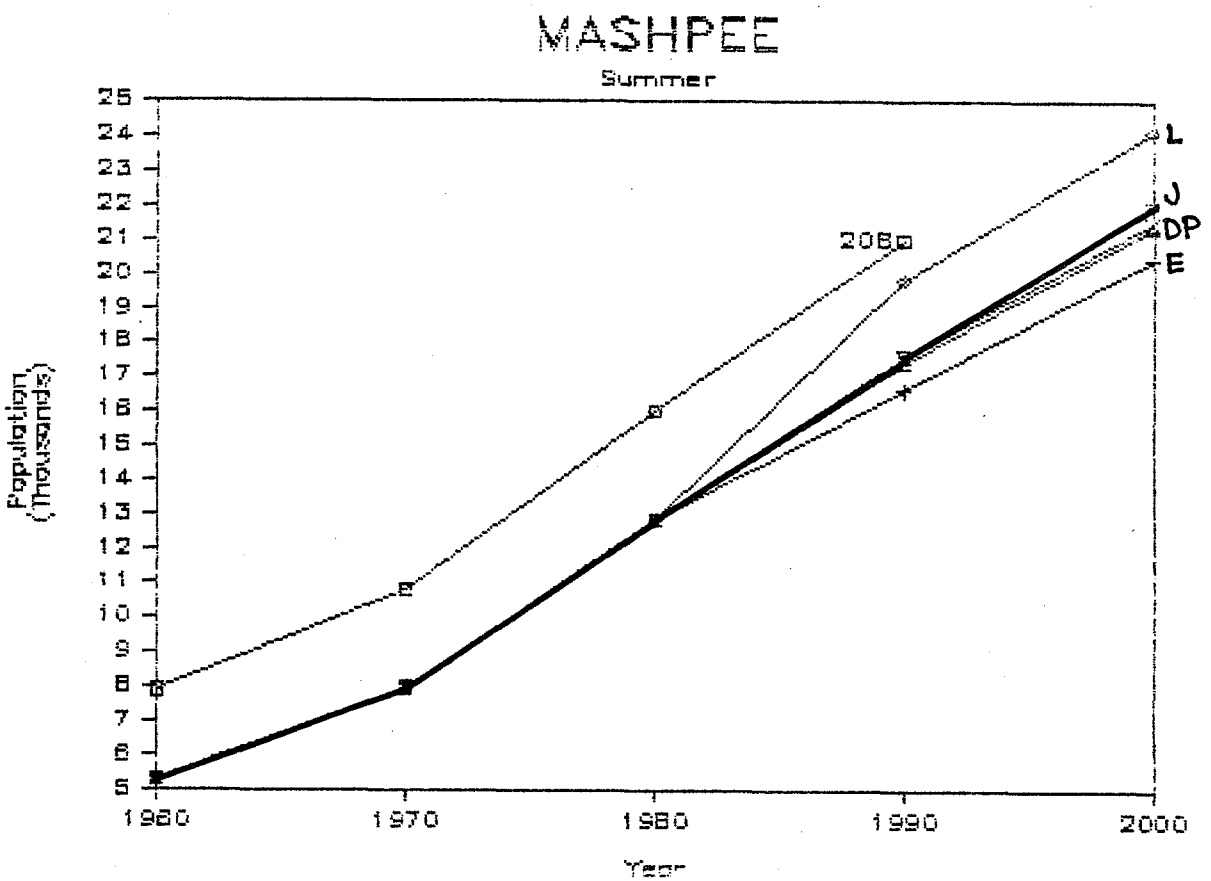
3
4
5
6
7
8
9
1960
1970
1980
1990
2000
L
JP
D
E
208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Summer
Population (Thousands)
Year
5
6
7
8
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10
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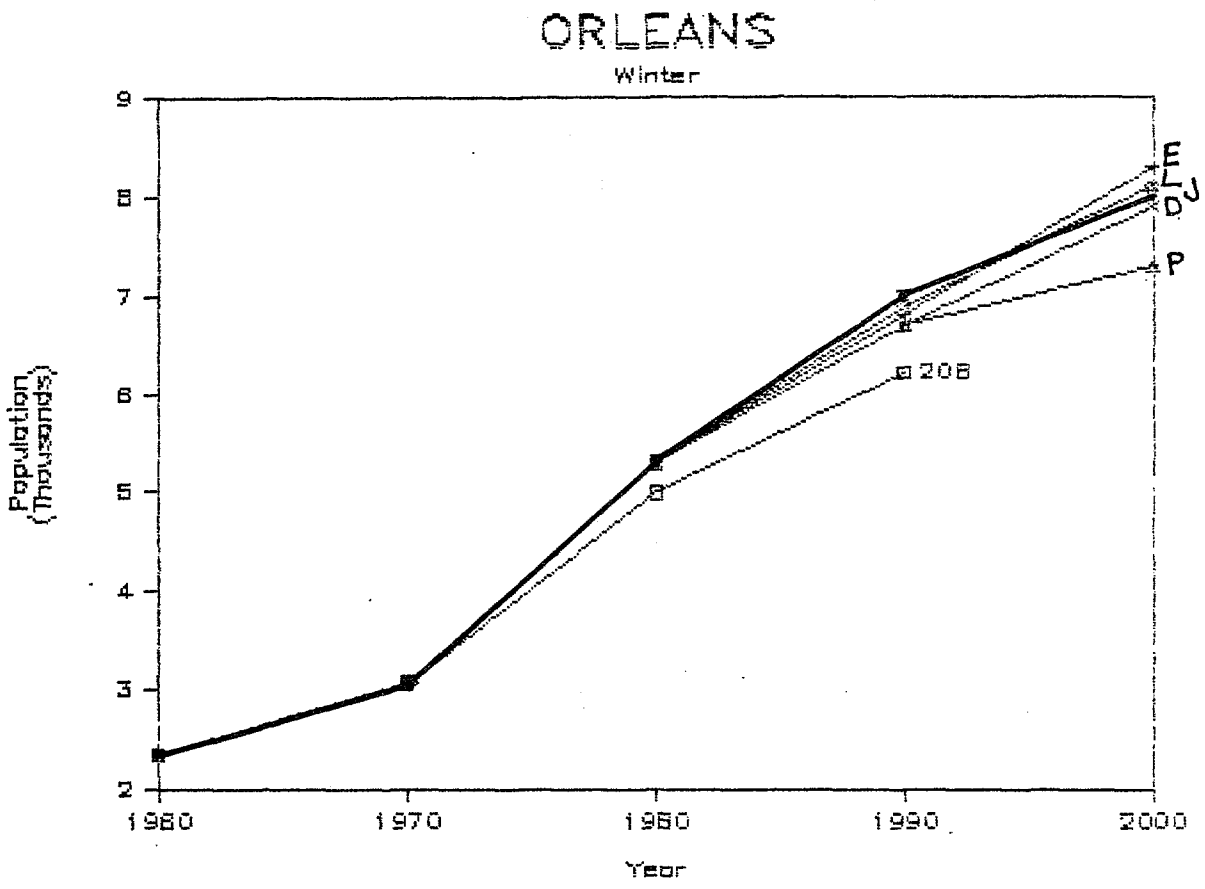
ORLEANS
Winter
Population (Thousands)
Year
1980
1970
1960
1990
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L
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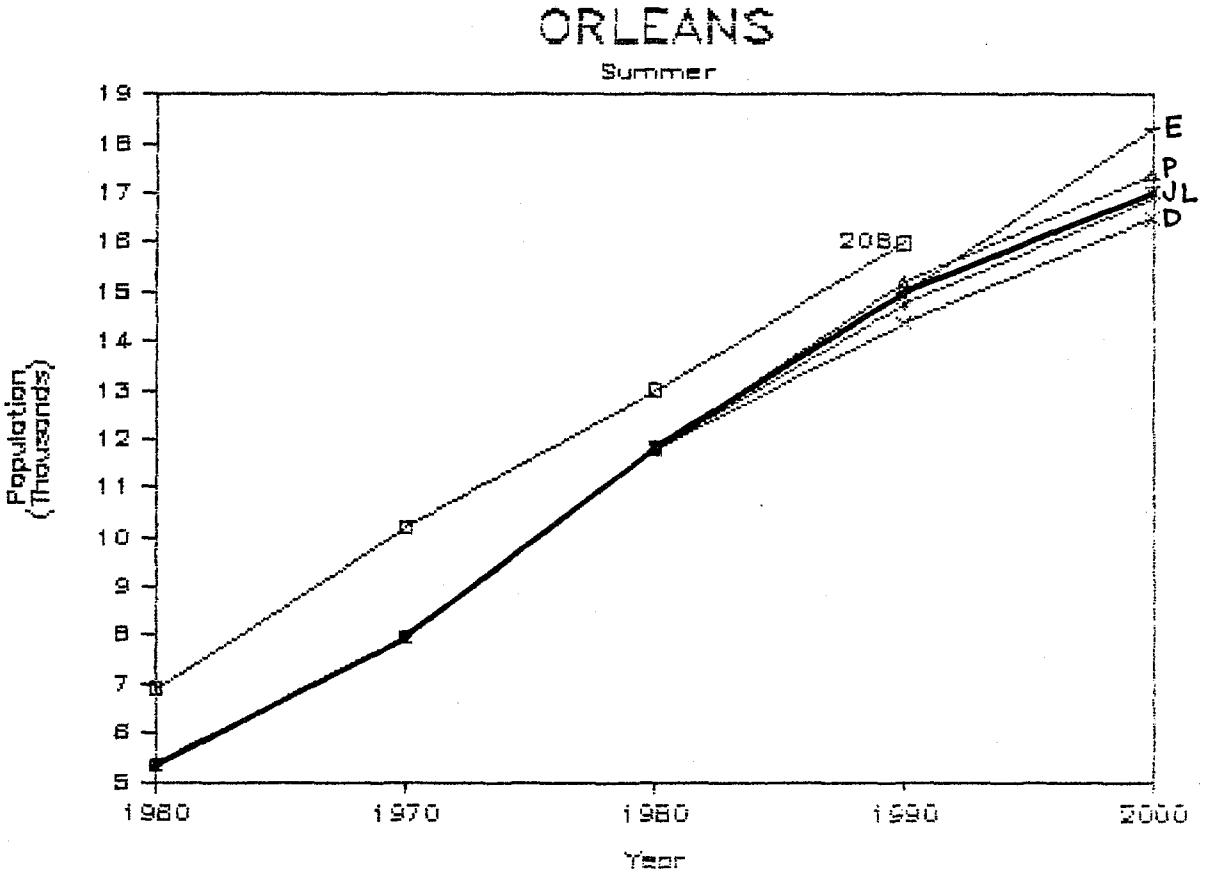
P
208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Summer
Population (Thousands)
Year
1980
1970
1960
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5
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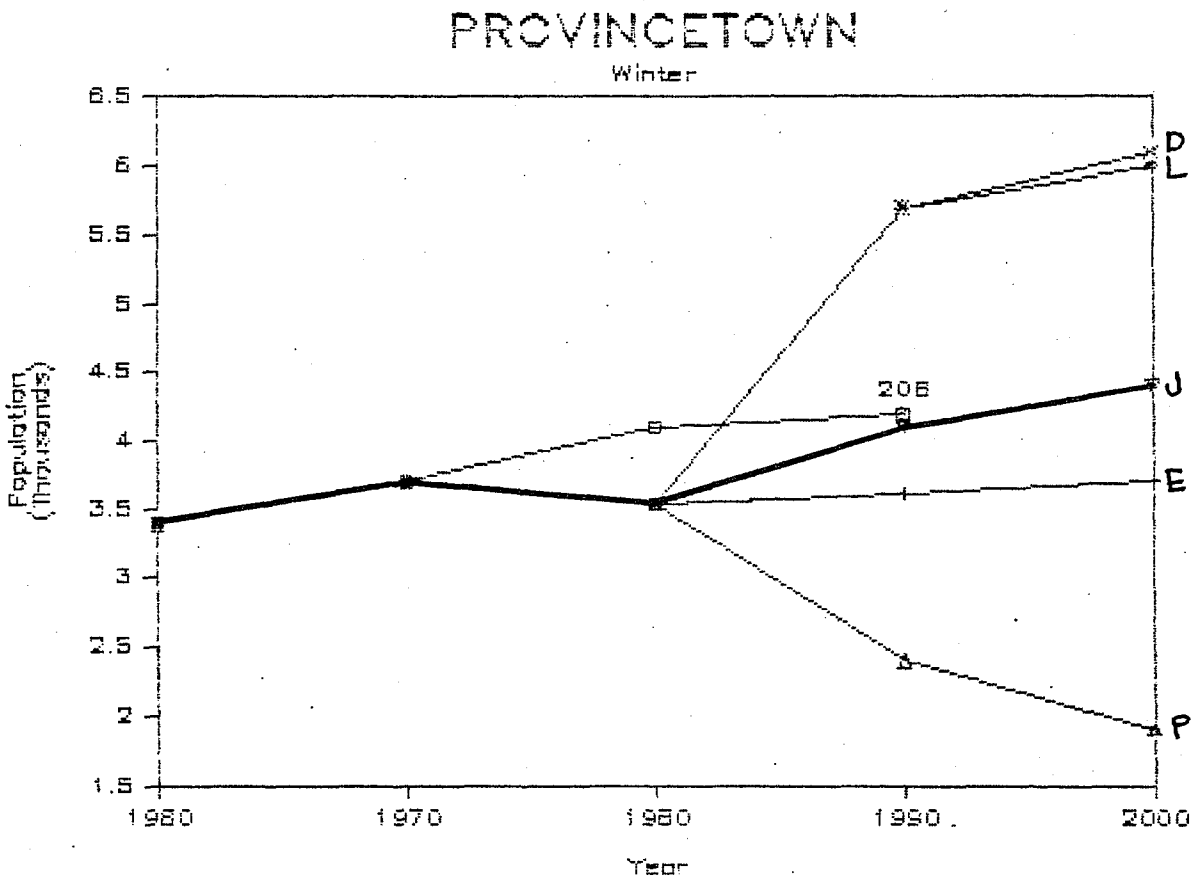
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Winter
Population (Thousands)
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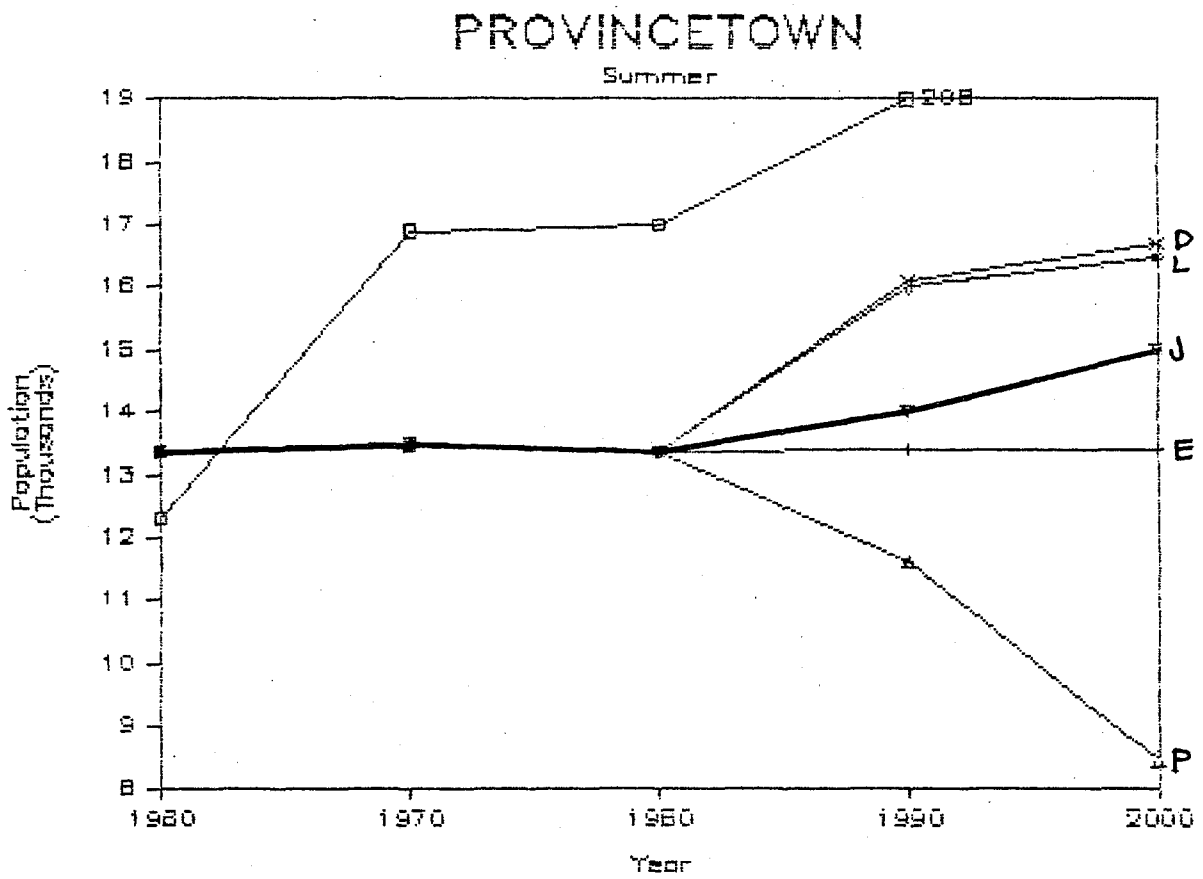
1970
1980
1990
2000
Year
206
D
L
J
E
P


PROVINCETOWN
Summer
Population (Thousands)
19
18
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13
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10
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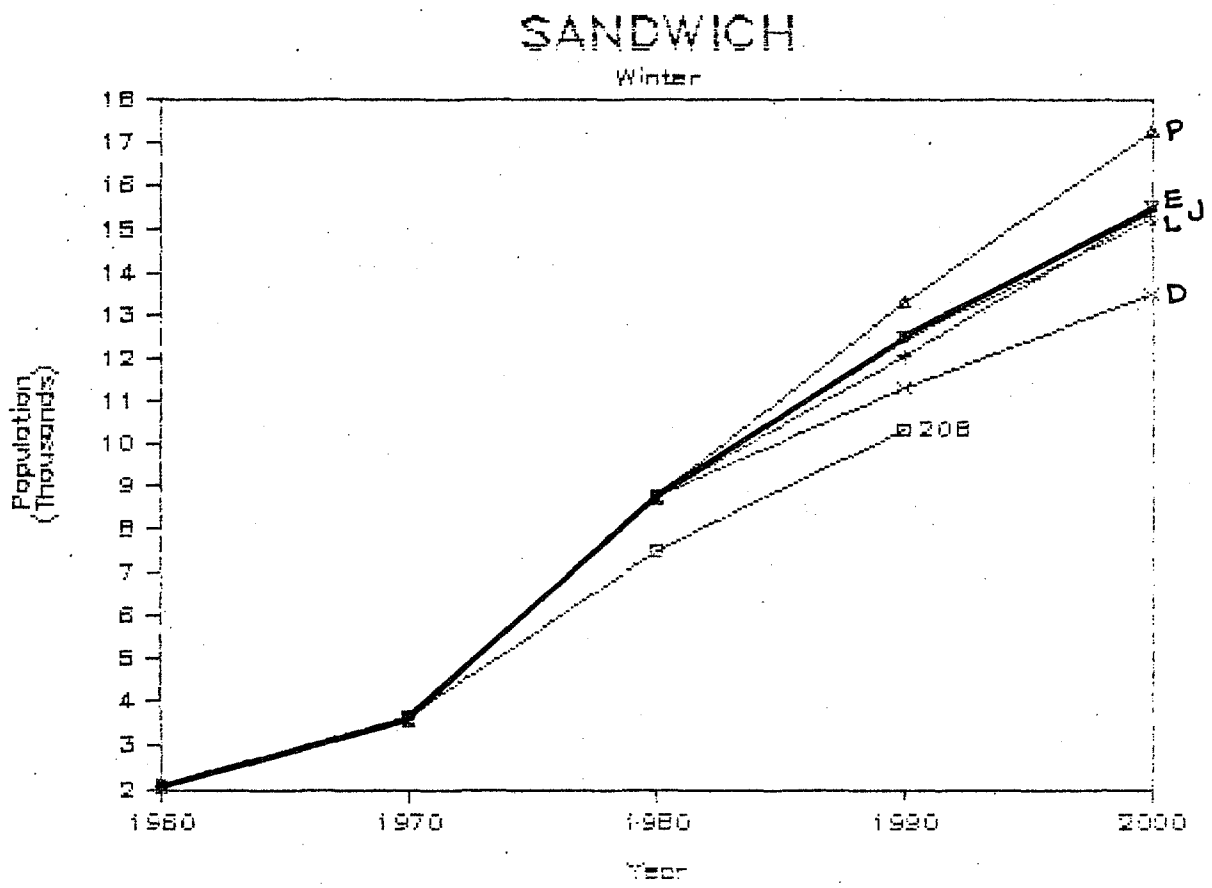
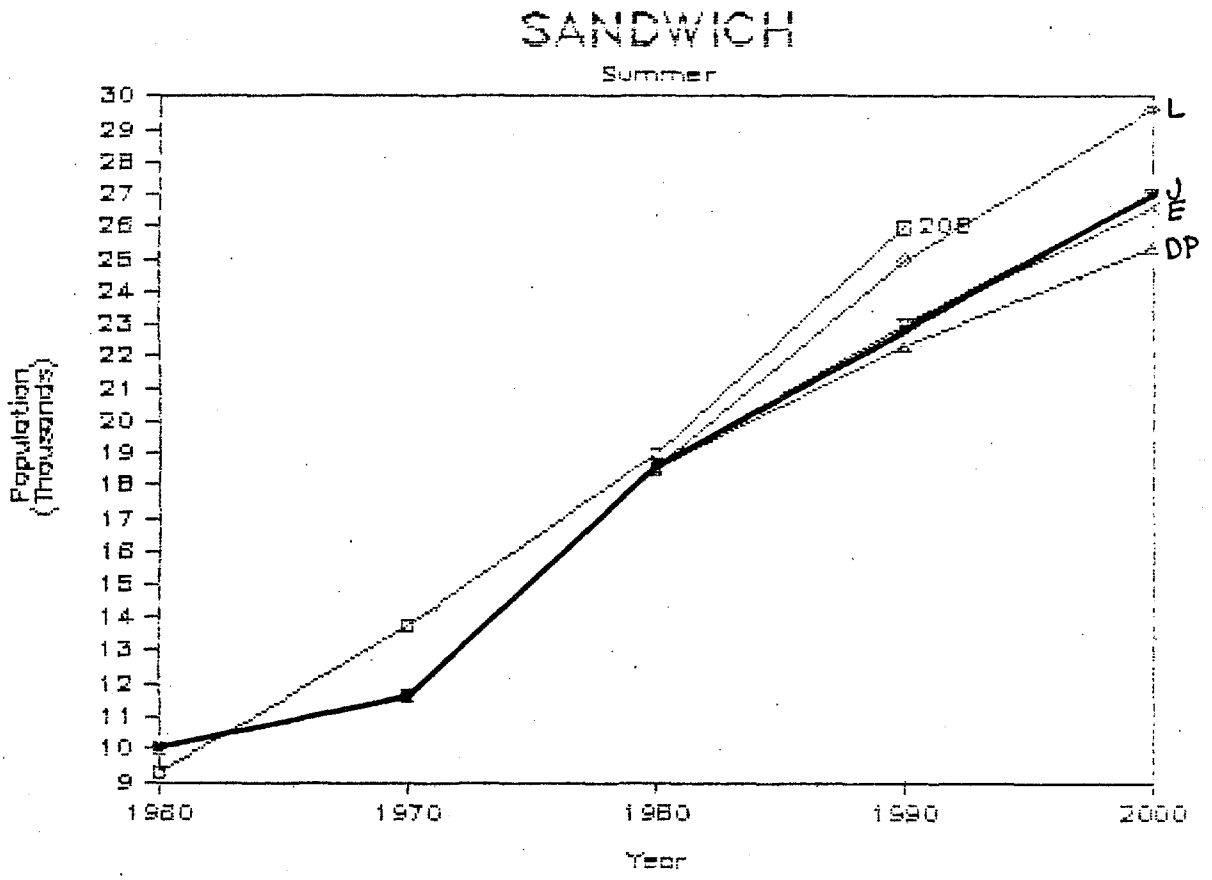
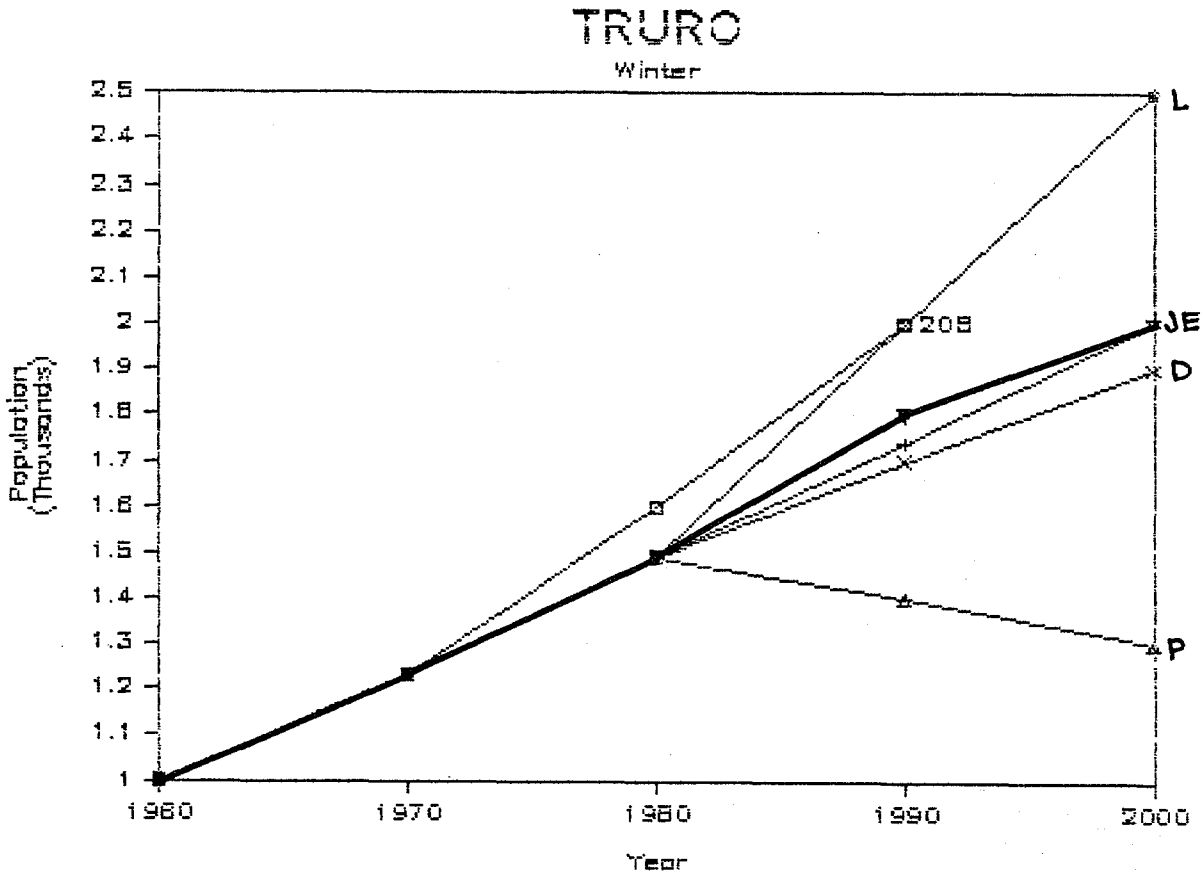
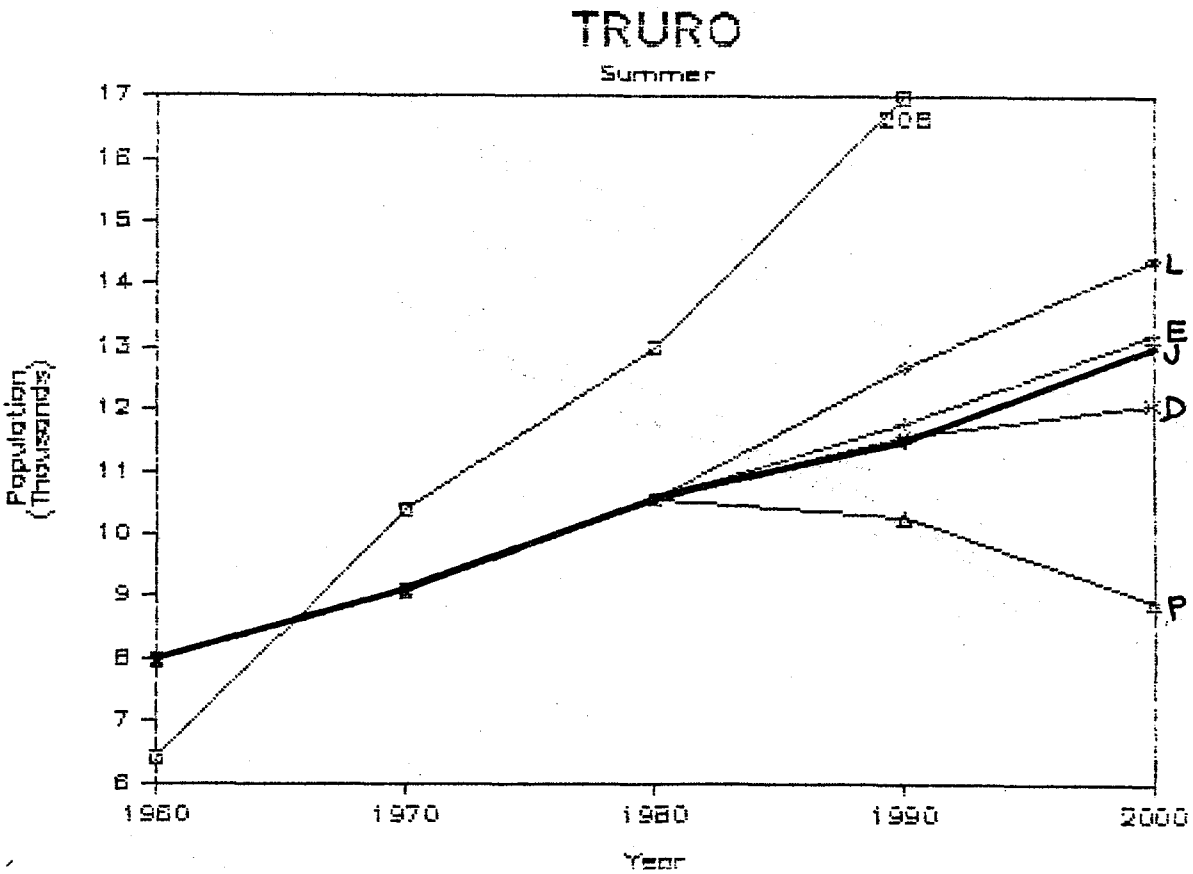
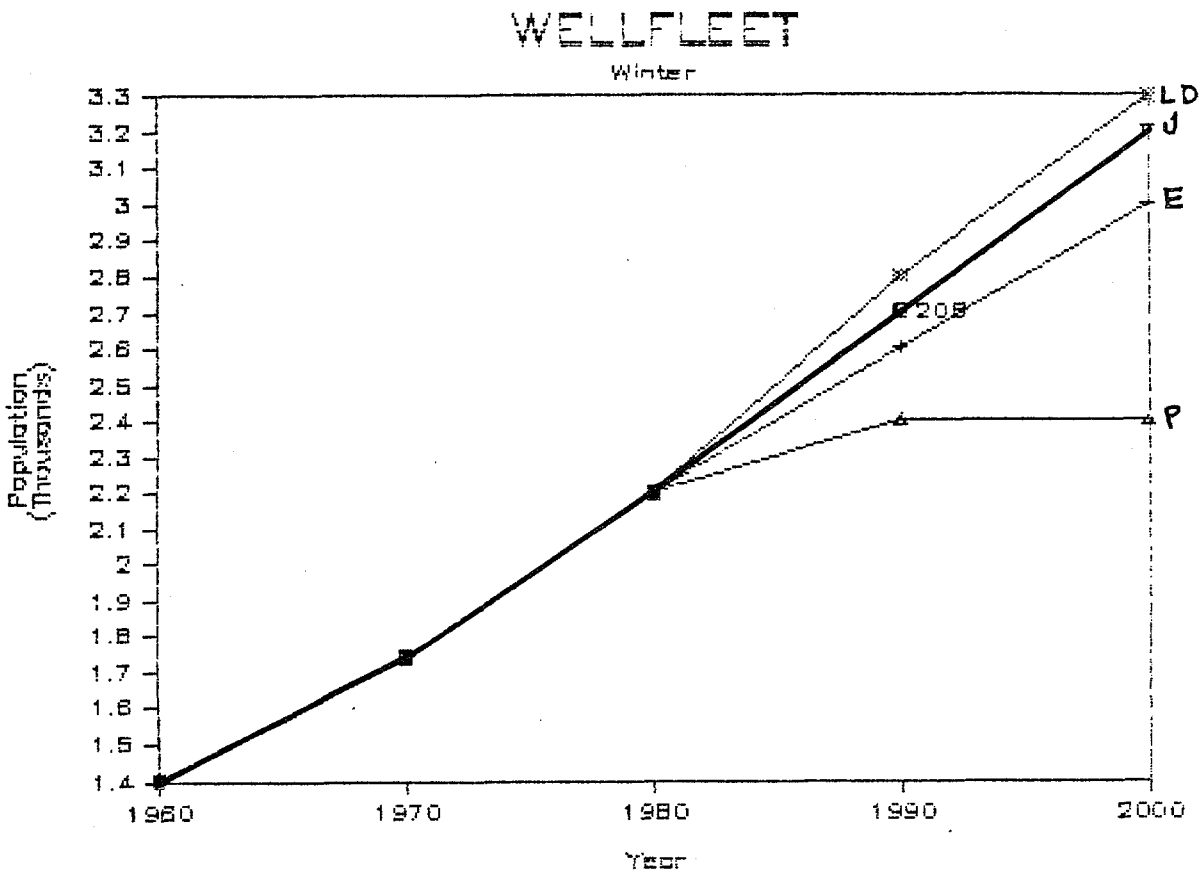
8
1980
1970
1980
1990
2000
Year
208
D
L
J
E
P

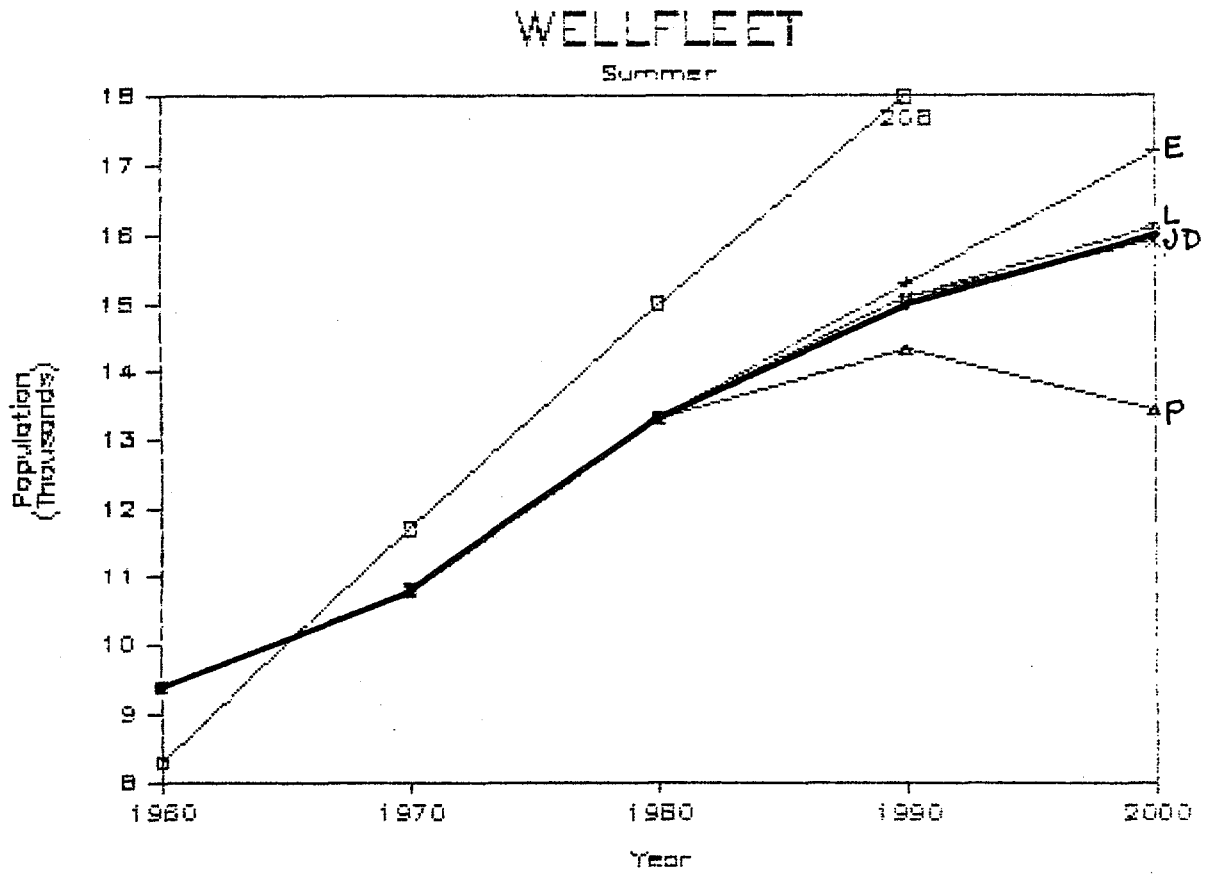

SANDWICH
Winter
Population (Thousands)
Year
1960
1970
1980
1990
2000
P
E
L
J
D
208

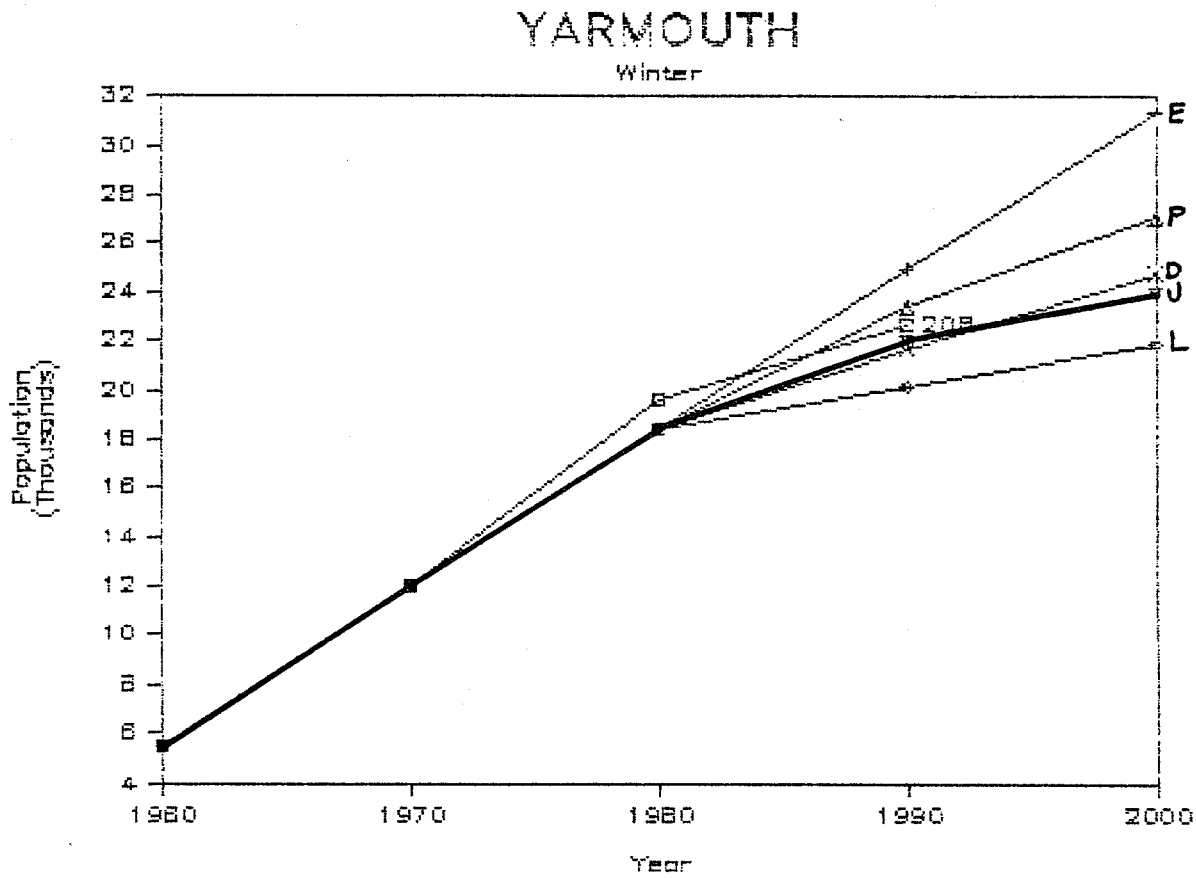

SANDWICH
Summer
Population (Thousands)
Year
1960
1970
1980
1990
2000
L
J
E
DP
208

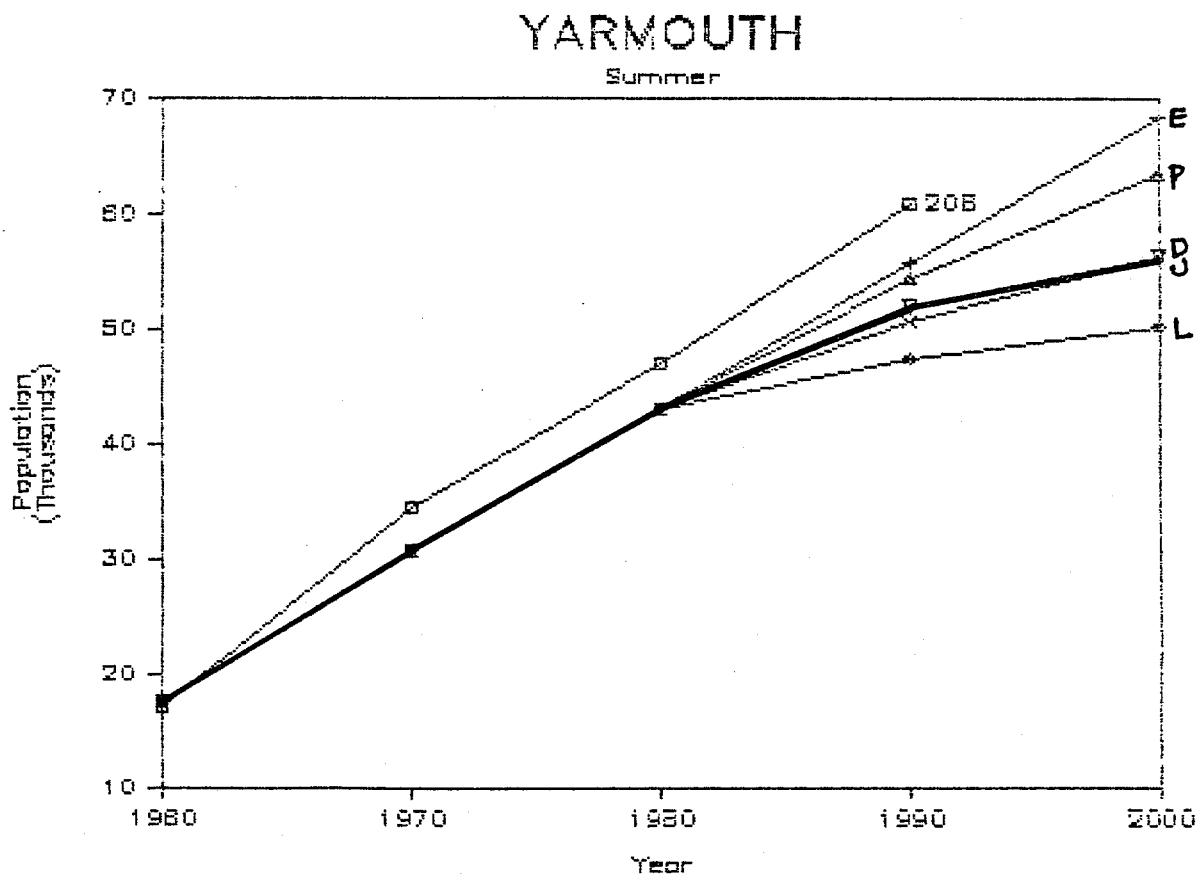

TRURO
Winter
Population (Thousands)
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
1960
1970
1980
1990
2000
Year
L
208
JE
D
P


TRURO
Summer
Population (Thousands)
17
16
15
14
13
12
11
10
9
8
7
6
1960
1970
1980
1990
2000
Year
208
L
E
J
D
P


WELLFLEET
Winter
Population (Thousands)
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1960
1970
1980
1990
2000
Year
LD
J
E
208
P


WELLFLEET
Summer
Population (Thousands)
18
17
16
15
14
13
12
11
10
9
8
1960
1970
1980
1990
2000
Year
208
E
L
JD
P


YARMOUTH
Winter
Population (Thousands)
Year
E
P
D
J
L
20B
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
1960
1970
1980
1990
2000


YARMOUTH
Summer
Population (Thousands)
Year
E
P
D
J
L
20B
70
60
50
40
30
20
10
1960
1970
1980
1990
2000

INDEX TO TABLES

	HISTORIC		PROJECTED	
	Capewide	By Town	Capewide	By Town
POPULATION				
Winter				
Total	A-1,A-2,H-8	D-1,D-3,E-1 F-2	A-1,A-2,H-8	D-1,D-3,E-1 E-3,E-4,E-5 E-7,F-2,F-3, F-4,F-6,F-7
Over 65	A-2,B-1		A-2,B-2,B-3	
Projected by others				D-1
By age	B-1		B-2,B-3	
Persons/household		E-2		E-2
Non-winter				
Total	A-1,F-1,G-4	F-1,G-4,G-5 G-6	A-1	F-2
Components	A-1,G-1	G-4,G-5,G-6	A-1	F-3,F-4,F-6, F-7
Persons/household	F-2,G-3		F-2,F-4,F-6 F-7	
Peak	A-1,A-2,D-2	D-2,D-4,F-1	A-1,A-2,D-2 D-4,F-2,F-3 F-4,F-5,F-6 F-7	D-2,D-4,F-2 F-3,F-4,F-5 F-6,F-7
By month	G-1,G-3			
By source of support	A-1,A-2,A-3 A-4,A-5		A-1,A-2	
ECONOMY				
Employment by industry	C-1		C-2	
Income	A-1,A-2,A-3 A-4,A-5		A-1,A-2	

INDEX TO TABLES (continued)

	HISTORIC		PROJECTED	
	Capewide	By Town	Capewide	By Town
LAND USE				
% share vacant land		E-3		E-4
By component	H-1,H-2,H-3, H-8,H-9	H-1,H-2,H-3, H-5	H-8,H-9	H-7
Developed	H-1,H-5,H-6 H-7,H-8,H-9	H-1,H-5,H-6 H-7	H-7,H-8,H-9	H-7
Total	H-1,H-8,H-9	H-1,H-5,H-6	H-8,H-9	
Increment		H-5,H-6		H-7
HOUSING UNITS				
Year-round occupied	A-2,G-1,G-2 G-4	F-1,G-4	A-2,E-3,F-7	E-3,E-4,F-3 F-4,F-7
Second homes	A-2,G-2,G-4	F-1,F-3,F-6 G-4	A-2,F-7	F-3,F-4,F-6, F-7
Total	E-3,G-2,G-4 H-10	E-3,G-4,H-10	E-3,E-4,F-7 H-10	E-3,E-4,E-7 F-4,F-6,F-7 H-10
Authorized or added				
By year	H-4	H-4		
By year group	H-5,H-6,H-8 H-11	H-5,H-6,H-11	E-3,E-4,H-8 H-11	E-3,E-4,E-6 H-7,H-11

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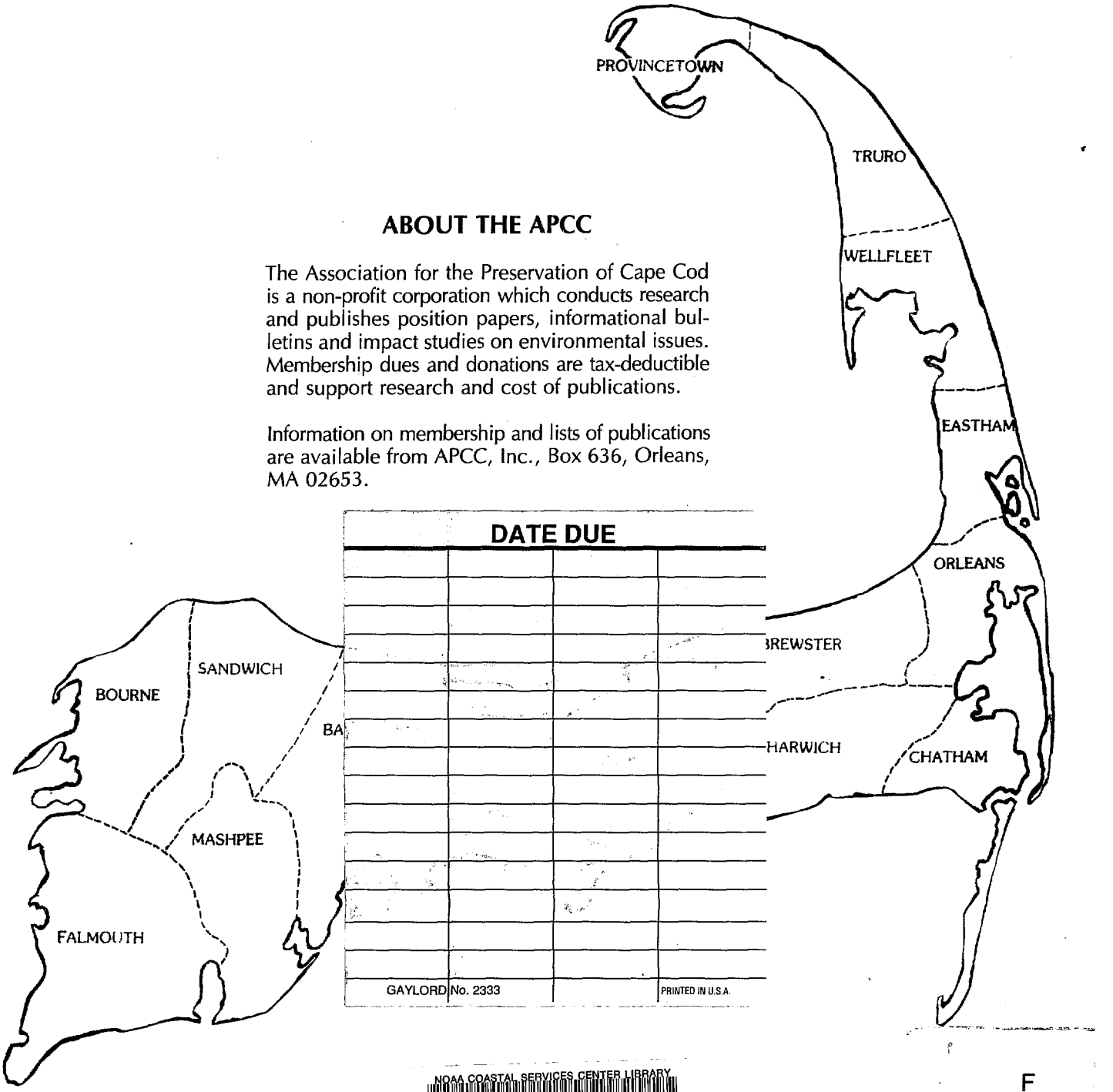

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